

Chapter 4

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Roseate tern

Management Direction

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Introduction

This CCP is a 15-year management plan that provides long-term guidance for management decisions on the refuge and sets forth goals, objectives, and strategies needed to accomplish refuge purposes. We propose to undertake activities in the next 15 years that will enhance management of habitat and species, wilderness resources, and public uses on Monomoy NWR over the long-term. This chapter begins with a description of our process for developing our management direction, and includes brief descriptions of the two management alternatives that were not selected for the final plan. The final management direction is then presented in detail, organized by goals, objectives, and strategies. The chapter concludes with a description of other actions or activities incorporated into the plan that are either cross-programmatic, relate to multiple goals, and/or represent general administrative or compliance activities.

Developing Management Direction

Relationship Between Goals, Objectives, and Strategies

As described in chapter 2, the first step in the planning process is to map out the refuge's resources of concern and prioritize focal management species. These identified resources and species were used to develop a set of refuge goals, objectives to achieve those goals, and a series of strategies to implement them.

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 evaluated 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 fixed-Time.

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

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.

Where possible, we incorporated the principles of 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).

Developing Alternatives, including those not selected

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 developed three alternatives that characterized different ways of managing the refuge over the next 15 years. As required by NEPA, we believe they represented a reasonable range of alternative proposals for achieving the refuge purpose, vision, and goals, and addressing the issues described in chapter 2. The alternatives are described fully in the final CCP/EIS. A brief description follows.

Alternative A satisfied the NEPA requirement of a “no action” alternative, which we defined as continuing the status quo, or current management. It described our existing management priorities, activities, and available resources, and served as a baseline for comparing and contrasting alternatives B and C. Alternative A represented the management conducted on lands that we actively managed in 2012 but, if it had been adopted, would also have included that portion of Nauset/South Beach lying west of the management boundary identified in the June 2015 MOU between the Service and the Town (appendix L).



Bill Thompson/USFWS

American black duck duckling

Alternative B, the Service-preferred alternative in both the draft and final CCP/EIS, proposed enhanced management of habitat and public uses which more formally emphasized adaptive management to reduce biological uncertainty, with particular attention to landscape context and scientific integrity. Priority resources of concern were re-evaluated in light of new Federal trust resources (red knot listing as threatened species), recent landscape-level plans and priorities (including but not limited to BCR 30, NALCC Regional Prioritization, the U.S. Shorebird Conservation Plan), and additional biological information gathered on Monomoy NWR and surrounding lands, including Nauset/South Beach where we would work in collaboration with the Town. In addition, this alternative enhanced our present visitor services with opportunities to

reach more offsite visitors. Increased emphasis on wilderness stewardship would also occur under this alternative.

Alternative C proposed less intensive management, with a theme of allowing natural succession of habitats to progress, to the extent that the refuge purposes and goals were 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 was similar to alternative B, except that motorized boat access would not be allowed.

Appendix N documents the decision and rationale for adopting alternative B for implementation.

Overview of Management Direction by Program

Habitat and Population Management

We will take a more active role in habitat and species management both on and off the refuge through partnerships, including those facilitated by the NALCC (see chapter 3). Our highest priority will 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 will 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 or migrating birds and other wildlife. In recent years, public access closures have generally occurred between April 1 and September 30 (see maps 3.7 and 3.8).

We will use a more proactive approach to monitoring and minimizing disturbance to foraging and resting migratory shorebirds and terns, especially in intertidal and adjacent upland habitats. Not all intertidal habitat provides the environmental characteristics that staging and migrating birds rely upon. The location of the most important habitat varies depending on a number of natural factors, such as weather, landforms, distribution and abundance of prey and predators, as well as human disturbance at other sites. Refuge staff will evaluate these pressures to determine the necessity to further restrict access through the implementation of additional seasonal and area closures.

We will 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 will consider increasing the acreage of grassland by removing some shrublands. Refuge staff will work with partners to protect alternative, offsite areas in order to maintain habitat otherwise lost to sea level rise.

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

Inventory and Monitoring

We will increase our inventory and monitoring efforts to provide key information on the trust resources to the extent staffing and funding resources allow. Special emphasis will be placed on obtaining baseline data of wildlife populations and habitat conditions, or filling in information gaps as needed, in order to develop detailed, science-based step-down plans under this CCP. Wildlife population and habitat monitoring surveys and inventories will be 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. A priority will be to inventory and monitor piping plover, nesting or staging common and roseate terns, and migrating red knots. Monitoring of seals on the refuge will be included as well. We will target any alterations or additions to these ongoing surveys to help us better understand the implications of our management actions. We will continue to work closely with our conservation partners to conduct these inventories and surveys.

Visitor Services

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

Recreational fishing and hand harvest of subterranean clams will be allowed under Town, State, and refuge regulations, as deemed compatible (see appendix D.) Horseshoe crab harvesting will continue to be prohibited and additionally, mussel harvesting will be prohibited. Salting for razor clam and sea clam harvest above MLW will not be allowed. No mechanized equipment other than boats can be used for harvest or transport of any fisheries above MLW. All other fisheries regulated by the NMFS, the MA DMF, and/or the Town can occur with no special regulation or oversight from the Service at this time.

Refuge staff will initiate additional NEPA analysis, planning and public outreach through a *Federal Register* announcement to establish a waterfowl hunt program on the refuge.

The refuge will be closed to personal watercraft operation and kiteboarding. We will enhance local community outreach and partnerships, continue to work with and support our Friends group, and strive to improve our relationships with our neighbors in the Cape Cod and Islands region in order to strengthen support for Service resource management and management priorities.

We will 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. We will pursue the use of virtual technology, such as critter-cams and podcasts, to offer opportunities to learn about the refuge remotely. In addition, we will explore the feasibility of and, if warranted, institute a wilderness access pass for all visitors to North Monomoy Island and South Monomoy Island, including the intertidal flats and beaches.

Wilderness Management

We will manage the existing Monomoy Wilderness to simultaneously secure an enduring resource of wilderness and accomplish refuge purposes in a way that preserves wilderness character. We will continue managing the existing wilderness to maintain its 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). Chapter 3 provides a description of the history of Monomoy wilderness designation, the dynamic nature of the area, and the results of our wilderness review during this planning cycle. We will also manage the two exclusion areas, Inward Point and Powder Hole (currently non-wilderness), so as not to diminish their eligibility as a wilderness area. In 15 years, these exclusions may once again be reviewed by the Service for suitability as additions to the NWPS.

In addition, we will manage that portion of Nauset/South Beach lying west of the management boundary identified in the June 2015 MOU between the Service and the Town (appendix L) consistent with other refuge wilderness lands.

Cultural Resources

We will continue to protect cultural resources on the refuge.

Project-specific cultural resource surveys will continue to be required, as warranted. We will also complete a refuge-wide cultural resource overview.

Refuge Administration

Over time, if budgets allow, we will seek to increase our staffing. 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 will remain the primary contact station for visitors, we could 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.

Management Goals, Objectives and Strategies

This section describes in detail the goals, objectives, and strategies that we will implement in this CCP. The objectives and strategies will be used to develop step-down management plans. Our successes will be based on how well we achieve our objectives.

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 1.1 (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

We address common and roseate tern protection and management as one combined objective in this document. 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 need for active management for common and roseate terns (including habitat and predator management) is detailed in chapter 3.

We will manage 75 acres of habitat for common terns and 10 acres of habitat for roseate terns in a manner consistent with preserving wilderness character. More resources will 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 2005b, and USFWS 2010a). Management actions will be the minimum necessary and will be evaluated annually through a minimum requirements analysis.

The Northeastern population of roseate terns 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 1979). 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 Northeast 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 (Nisbet et al. 2014, 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 avian diversity project was initiated in 1996, 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 (refer to appendix J for more details). This marked the beginning of nesting tern population increases that have been largely sustained for the last 20 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 (Blodget and Henze 1992) and in Maine (Kress 1983, USFWS 2005a).

The increase of nesting common terns in the first few years following the start of the avian diversity project was concomitant with a decline in the number of nesting common terns at Plymouth Beach (USFWS 2000, Blodget 1999, see chapter 3) which led to a dramatic increase in the number of common terns nesting at the refuge and for several years Monomoy NWR also saw an increase in the 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).

Since the recent peak nesting years following implementation of the avian diversity project (2003 to 2006), numbers have fluctuated in response to habitat changes, predator pressures, and nesting habitat quality at other nearby sites. Despite this fluctuation, Monomoy NWR has remained 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.

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. This then informs adaptations of strategies for subsequent years.

In recent years, several species of specialist predators became problematic for nesting terns at Monomoy NWR. The most prevalent mammalian predator on the refuge during the last 15 years has been the eastern coyote. With the State's increasing coyote population, and the establishment of the land bridge to South Monomoy Island in 2006, coyote presence in the tern colony 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 NWR, 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 2005a, 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 2005a, USFWS 2005b, Kress and Hall 2004).

During the last 10 years, we have experimented with various types of habitat management on a small scale (see chapter 2 for details), but have only recently applied management at a scale that exceeds the current nesting area (a prescribed burn of 30+ acres). Careful monitoring of different techniques has provided 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 NWR, 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, personal communication 2013; Spendelow, personal communication 2013; Burger and Gochfeld 1991a, Burger et al. 1995a, Cooper et al. 1970, Nisbet 1981). A larger habitat base will also allow terns to move around between microhabitats within the larger area, as we apply a rotational-based habitat management scheme. We will continue working mostly on the north end of South Monomoy Island 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 will be given to habitat free from human disturbance, with ease of access for monitoring, and low presence of predators).

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 suitable the available habitat is available. 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 2005b). 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. Spendelow, USGS Patuxent Wildlife Research Center, Laurel, MD) covered with a 2.4 m by 0.6 m by 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, Massachusetts, Great Gull Island in New York) often have very high reproductive success (USFWS 2010a).

Members of the 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.
- Minimize impacts on terns through the closure of the Monomoy Islands to dogs and pets.
- 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 resource and predator management and 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, and thus increase 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, Wisconsin, 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 surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Within 1 year of CCP implementation:

- Minimize impacts to terns by expanding the prohibition of dogs and pets on the refuge to include Morris Island from May 1 to September 15.

- 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.
- Meet annually with the Town and NPS to discuss any proposed changes in refuge, Cape Cod National Seashore or Town coastal management and regulations.

Within 5 years of CCP implementation:

- Control non-native 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 provide wildlife habitat.

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 by 60 meter 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 by 60 meter 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 Island 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 refuge-wide every 5 to 10 years.

Objective 1.2 (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

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 state 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 (personal communication 1991) 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 Commonwealth 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, which makes the Town extremely important to the species.

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 2009a). Plovers forage along the waterline, on the mudflats, and among the wrack line (USFWS 1996a). 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.

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. On Monomoy NWR, nesting habitat is currently not considered a limiting factor. A thorough assessment of refuge beaches conducted by Service and MA DFW biologists in 1995 and 1997 found all prime piping plover habitat to be located on South Monomoy Island. 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). These habitat assessments indicated the refuge could have supported approximately 94 pairs at that time (approximately 50 percent of the State's population). 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) which are not limiting factors for the refuge population. Monomoy Island is a rare example of an actively

accreting coastal landform (appendix I). Habitat has been increasing in recent years due to an annual influx of sand from Nauset/South Beach and the outer Cape Cod. 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 NWR, relative to the percentage of the State population we support, could increase if sea level rise adversely affects habitat on artificially stabilized sites.

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 20th century trends (CCSP 2008b, appendix I). Sea level rise alone could 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 2009a). This would also likely impact other beach nesting species, such as American oystercatcher and least tern.

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 experience OSV users, and higher volumes of beach visitors that potentially 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 2009a, Hecht and Melvin 2009). Protecting crucial habitat from development and restricting recreational use in plover nesting areas is essential to maintaining healthy piping plover populations in the long term (USFWS 2009a).

Much of the refuge upland is federally designated wilderness that is mainly accessible by boat and where OSVs are not allowed. Dog walking is also prohibited on these offshore portions of the refuge year-round. The refuge provides a safe place for plovers to nest, and is relatively unaffected by human disturbance issues more 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 but unused habitat. 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.

Due to the fact that public use is well-managed, 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 recovery

plan strongly recommends 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, densely 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. The benefits of exclosures have been questioned as reproductive output has declined at many sites using exclosures, concurrent with increased observations of nest abandonments at exclosed nests. Recent evidence that most nest abandonments are caused by mortalities of incubating adults (Roche et al. 2010) makes evaluation of hatching benefits versus potential risk of elevated nest abandonment rates a critical decision. Research is currently being done to study the impacts of exclosures, and management on the refuge will be adjusted based on the outcome of this research. In addition to exclosures, active predator management has been employed on the refuge to selectively remove unwanted predators (see appendix J).

We will 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 (as described above) will 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 will be mapped on the annual closed area map and will be posted in public locations (map 3.7). Closures used will be appropriate for preserving wilderness character. Closed areas will be created using fiber rod posts (1/2-inch diameter) and string. Signs currently used on the refuge for closing areas will 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 will be visually less obtrusive and more in line with wilderness management, but will still adequately identify closures to visitors. Closed areas will 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 in use, we will experiment with the use of temporary electric and non-electric predator fencing to protect piping plovers. Refer to the rationale for objective 1.3, for a full explanation of when the use of electric fencing is deemed appropriate on the refuge.

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 plan. 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.

*Service employees at
the refuge*



USFWS

- 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, collecting unhatched eggs for DNA analysis, or evaluating habitat availability as a limiting factor.
- 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 surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can 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 will be removed as staff time allows once these criteria are met).

- Minimize impacts to plovers by expanding the prohibition of dogs and pets on the refuge to include Morris Island from May 1 to September 15.
- 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.
- Meet annually with the Town and NPS to discuss any proposed changes in refuge, Cape Cod National Seashore or Town coastal management and regulations.

Within 5 years of CCP implementation:

- Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to provide wildlife habitat.

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 (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 being conducted by Virginia Tech and other organizations and universities.
- 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 1.3 (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

American oystercatchers are a species of high conservation concern that 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). We will 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, personal communication 2011). 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.

Historically, American oystercatchers were widespread on the Atlantic coast though in the early 1900s they were not found nesting north of Virginia (American Oystercatcher Working Group (AMOY WG) 2012). In the 1800s, market hunting and eggging reduced the population and extirpated the species from the Northeast. Concurrent 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 (AMOY WG 2012).

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 AMOY WG was formed and, since the initial meeting in 2001, the group has met every year at various locations within the birds' Atlantic coast range (AMOY WG 2011).

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 AMOY WG of which Monomoy NWR 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 $10,971 \pm 298$ 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 et al. 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 NWR, 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 NWR 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, personal communication 2011). Population growth and health for this species are shared objectives of the AMOY WG (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. Hatch success in American oystercatchers is very low at many sites, including the refuge, due to overwash and predator pressures (see appendix J). 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. 2010).

Funding provided by the NFWF 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 NFWF 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.

A new technique involving artificial incubation of eggs is another innovative non-lethal method to enhance productivity of nesting oystercatchers that has shown promise at sites in South Carolina and Georgia. We will investigate the feasibility

and appropriateness of artificially incubating eggs from nests on Monomoy NWR 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. Management actions will be the minimum necessary and will be evaluated annually through a minimum requirements analysis.

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. 2010). Storm and tidal overwash is a major factor influencing the success of American oystercatchers on the refuge. In 2008, 8 of 34 total nests and in 2009, 3 of 25 total nests lost, were lost to overwash or storm-related weather (USFWS 2008a, 2012). We will 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 investigation into elevating nests and creating stable nest platforms to prevent overwash will continue.

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 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 surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Within 1 year of CCP implementation:

- Minimize impacts to American oystercatchers by expanding the prohibition of dogs and pets on the refuge to include Morris Island from May 1 to September 15.
- Use temporary symbolic fencing to seasonally close all suitable American oystercatcher habitat regardless of the presence of pairs (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 AMOY WG 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.
- Meet annually with the Town and NPS to discuss any proposed changes in refuge, Cape Cod National Seashore or Town coastal management and regulations.

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 two 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 when appropriate.
- Resight and report banded adults during migration and staging periods to contribute to metapopulation studies coordinated through the AMOY WG and better understand Monomoy NWR's importance during migration and staging.

Objective 1.4 (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

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 least terns are not federally listed, they are 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 occupy similar habitat as nesting

*Shoreline at
Monomoy*

Gary M. Stoitz/USFWS

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.

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 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). In Massachusetts, least tern numbers have been generally increasing since 1985 with the exception of a few outlier years (Mostello 2014). In 2013, 38 percent of the State's least tern population could be found in three large colony sites during the a-period (Mostello 2014), which increases the vulnerability of the State population.

The numbers of nesting least terns on the refuge has fluctuated between zero and 200 pairs over the last 10 years (see chapter 2 for more details) and in recent years has been even larger. Though there is an abundance of least tern habitat on the refuge, especially on South Monomoy Island, numbers have likely fluctuated presumably due to the prevalence of coyote on refuge beaches throughout the nesting season (USFWS annual Monomoy field season activities reports 1998 to present), the species' low tolerance threshold for disturbance of this kind, and lack of nesting site fidelity (Kress and Hall 2004). Least terns are highly disposed to abandonment due to predator pressures. Even sites that have

suitable nesting habitat often do not have consistent nesting populations year to year. Least terns are notoriously inconsistent and may leave a site altogether if predator presence is too high (Thompson et al. 1997). In addition to predation, abandonment or localized shifts in colony sites have occurred in response to flooding, changes in colony size, increased vegetative cover, or human activities (Kotliar and Burger 1986, Atwood and Massey 1988).

Predation on least tern colonies at the refuge is not quantitatively monitored though coyotes have been documented preying on least tern eggs and chicks, and in some years, coyote tracks are frequently seen through least tern nesting areas (USFWS 2012). Both herring and great black backed gulls have been documented preying on least tern eggs or chicks at Monomoy NWR and other sites (Rimmer and Deblinger 1992, USFWS 2009e, USFWS 2012).

We will actively seek to increase the number of nesting pairs of least terns 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 non-electric fencing (refer to objective 1.3, for an explanation of when electric fencing is appropriate). If the refuge population reaches or exceeds 10 percent of the State population, further measures will be taken to manage avian predators such as large gulls (including lethal methods) and productivity will be quantitatively assessed. Through working with other sites, methods for collecting productivity information will be selected to continue to minimize human presence within the nesting areas.

Although lethal predator management will 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. Management actions will be the minimum necessary and will be evaluated annually through a minimum requirements analysis.

Strategies

Continue to:

- Minimize impacts to least terns by continuing the closure of the Monomoy Islands to dogs and pets.
- Patrol and enforce closed areas during the nesting season.
- Facilitate and participate in surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can 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 will be modified from other successful designs to address the most common predators on Monomoy NWR.

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 1.5
(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 annual 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 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 preferred 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).

In 2000, the refuge, due to the presence of large, relatively undisturbed beaches, was selected as a suitable recipient site to establish a new population of northeastern beach tiger beetles. Reintroduction efforts began that year, with larvae translocated from Squibnocket Beach on Martha's Vineyard to South Monomoy Island east of Hospital Pond (see map 3.4). Translocations of larvae occurred annually through 2003. 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 3.4). 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 3.4 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. Wilderness designation on the refuge currently protects tiger beetle habitat from damage or "take" due to OSV use while providing for emergency access on the refuge property.

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. 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. By enabling work on this subject, the refuge will assist researchers in understanding the metapopulation structure of this species over time. Necessary additional research includes an analysis of the habitat currently being utilized on Monomoy NWR. Recent analysis done in Chesapeake Bay may provide a model for future research at the refuge. This project 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 the Geographic Information System (GIS) (Drummond, personal communication 2011).

We will provide protection to northeastern beach tiger beetles, address research needs identified in the most recent 5-year review and work 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 will not be viable unless they are able to provide permanent protection for the beetle population. We will work with the New England Ecological Services Field Office to serve as a donor population for newly identified sites by providing beetle larvae. Though the Monomoy population is considered stable, precautions will be taken to continue protection for the population while acting as a donor site for new locations.

As the only permanently protected population in the Northeast, continuing and expanding protections provided by this plan 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 (*Cicindela hirticollis hirticollis*), which is listed as a species of special concern in Connecticut, and the hairy-necked subspecies (*Cicindela hirticollis rhodensis*). Both species are 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, Commonwealth of Massachusetts, USCG, 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 officials and the public about areas occupied by tiger beetles on the refuge 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 surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Within 1 year of CCP implementation:

- Meet annually with the Town and NPS to discuss any proposed changes in refuge, Cape Cod National Seashore, or Town coastal management and regulations.

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 NWR 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 1.6 (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 non-native rugosa rose approximately 3 feet tall, which is used by nesting wading birds, including black-crowned night-herons and snowy egrets.

Rationale

Neotropical Migrant Songbirds

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 NWR'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. We will continue 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).

Wading Birds

Throughout the Commonwealth 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 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 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. According to Melvin (2010a) the wading bird populations in Massachusetts are small, "given the State's extensive coastline and abundant and diverse nesting and feeding habitats." 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 equaling 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 non-native 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 non-native 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. We will carefully evaluate appropriate buffer distances and increase current buffer distances if needed. Maintaining the wading bird colony as a disturbance free area 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 non-native 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.
- Minimize impacts to wading birds by continuing closure of the Monomoy Islands to dogs and pets.
- Facilitate and participate in surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can 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 NWR if buffers are not sufficient.
- Evaluate regional importance of maritime shrubland on Monomoy NWR to migrating land birds and, if appropriate, periodically evaluate habitat conditions (including species composition, non-native plant presence, and community structure).
- Utilize biological, mechanical, chemical, and fire management to reduce non-native 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 1 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 Island from August through November to quantify abundance of neotropical migrants and evaluate importance of Monomoy NWR to shrubland-dependent birds.
- Map locations and record abundance of invasive/non-native 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 1.7
(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 red knot, black-bellied plover, piping plover, American oystercatcher, ruddy turnstone, 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

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 $13,320 \pm 2,250$ in 2007) and southward migration ($43,290 \pm 6,030$ in 2006 and $46,440 \pm 5,760$ 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.

Of particular concern is the *rufa* subspecies of the red knot, now a threatened species for Federal protection under the ESA. 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 NWR 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 NWR 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.



USFWS

American oystercatcher

Another species of particular concern at Monomoy NWR 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).

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).

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 61 m for least sandpiper to 186 m for black-bellied plover (Koch and Paton 2014). It is important to note that the point in time when a foraging shorebird flies or runs away is not generally the beginning of the disturbance. Typically, a foraging bird stops foraging and trades off foraging behavior for alert behavior, before ultimately making the decision to fly or run away from the foraging habitat. We chose to use flight-initiation distances as our metric of disturbance because it is a more easily recognizable change in behavior that is easily standardized across different observers. However, disturbance impacts to shorebirds are realized well before they actually take flight (especially in lost foraging time). Therefore, these buffer distances are necessarily larger than the flush distances observed in the field to provide disturbance-free foraging habitat, rather than just preventing abandonment of habitat.

Shellfish harvesters, like all refuge users, may cause disturbance to birds using intertidal and nearshore open water habitats on the refuge. However, shellfish harvesters spend most of their time bent over at the waist or on hands and knees harvesting patches of shellfish, and traverse the exposed mudflats only to move among patches (Burger 1981, Leavitt and Fraser 2004). They generally spend less time traversing mudflats than other users, such as bird watchers, anglers, and beachcombers, who also occupy these mudflats. We investigated the potential impacts of shellfish harvesters, raking for softshell clams on mudflats where shorebirds actively foraged, separate from other users. 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. However, observed densities of shorebirds in microhabitats of shellfishing activity do not necessarily translate to increases in density of these birds across a large landscape.

Refuge staff will continue to implement seasonal closures to public use to protect wildlife. Generally, these closures have occurred between April 1 and September 30. Map 3.7 depicts approximate closure areas implemented in 2014. 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 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 NWR, 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.

It is not feasible or practical to close the entire 2,500 acres of intertidal habitat to public users, therefore, we will adaptively manage this acreage to ensure relatively disturbance-free habitat for the majority of migrating shorebirds of conservation concern. 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. At the current time, public use and perceived disturbances from use is generally very low on the intertidal flats of Monomoy NWR. Much of the foraging habitat likely already provides these recommended buffer distances. However, refuge staff will implement closures in the future if areas of high public use and high shorebird foraging activity overlap, and we observe more than 10 percent of shorebirds being disturbed regularly and frequently.

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 (Spendelow 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 this period (Spendelow 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 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.

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) 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, personal communication 2011) (table 4.1). 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 4.1. Gut Samples From Shorebirds at Monomoy NWR Examined During Migration.

	Number Sampled	With Eggs
Northward Migration		
Black-bellied plover	2	0
Semipalmated sandpiper	1	1
Sanderling	3	3
Willet	1	0
Dunlin	14	12
Southward Migration		
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, personal communication 2011) including killifish species (Finley, personal communication 2011) 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 (Shuster Jr. 1982), and loggerhead sea turtles (ASMFC 1998 and Musick et al 1983). 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 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). 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).

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 Island 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 CD, but a summary of some of these studies is included here. A 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 bled horseshoe crabs 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 larger 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.

In addition to the protections described above, we will 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). 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, personal communication 2012). Thus, intertidal flats remain extremely important to successful population recruitment.

Strategies

Continue to:

- Work with partners to document the importance of Monomoy NWR to migrating red knots and contribute to research that would inform species' recovery.
- Work with partners to determine the relative importance of tern staging sites on Cape Cod, identify problematic disturbances, and develop solutions to minimize disturbances.



USFWS

Red knot

- Maintain closure of the refuge to mussel harvesting to preserve the food source for red knots and American oystercatchers.
- Review 5-year reviews and recovery plan updates for roseate terns, red knots 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.
- 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 Island.
- Review 5-year reviews and recovery plan updates for roseate terns and red knots within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.

- Facilitate and participate in surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Within 1 year of CCP implementation:

- Minimize impacts to migrating and staging birds by expanding the prohibition of dogs and pets on the refuge to include Morris Island from May 1 to September 15.
- Maintain and enforce closure of the refuge to mussel harvesting to preserve food sources for red knots and American oystercatchers.
- Use temporary symbolic fencing to implement seasonal closures to public use to protect wildlife. There may be a small expansion in time and/or space to existing seasonal closures to better minimize disturbance to shorebirds and terns in intertidal and adjacent habitats. For example, we may expand current seasonal closures to extend 150 m from existing saltmarsh edges (instead of the current 50 to 100 m) where shorebirds may roost or forage in very concentrated flocks during an incoming tide. Areas include (but can change) the western and southern salt marsh edge of North Monomoy Island and the salt marsh edge of Minimoy Island. Similarly, seasonal closures of upland habitat may be extended later in the season to provide a sufficient buffer for roosting shorebirds.
- 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:

- Collect data on shorebird use, high tide roosting areas using International Shorebird Survey protocols, and low tide foraging areas using refuge protocols.
- Initiate an outreach campaign to provide information to all visitors about the importance of minimizing disturbance to migrating and staging birds; the outreach message will 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 to all human use that are subject to high levels of disturbance; a rapid-assessment method of identifying areas will be developed and implemented.

Monitoring Elements

- Resight and report banded shorebirds to *bandedbirds.org* (accessed October 2015), 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 Island and report new primary roost sites as they occur on the refuge.

- 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 AMOY WG to better understand Monomoy NWR's importance during migration and staging.
- 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 to monitor changes in intertidal habitat every year.

Objective 1.8 (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

Gray seals were found along the northwestern Atlantic coast until the 17th century, and were considered locally extinct until the 1980s (see Lafond 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 NWR 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, personal communication 2013). 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 (Lafond Wood 2009).

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. 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.

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.
- Conduct partner-led pupping counts and aerial surveys of haulout sites to track use by seals refugewide.

- Facilitate and participate in surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- 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.
- Minimize impacts to marine mammals by expanding the prohibition of dogs and pets on the refuge to include Morris Island from May 1 to September 15.

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 1.9 (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

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 2009).

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 2009).

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 non-native 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 2009). 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; accessed November 2013). We do not know if purple marsh crabs are present in salt marshes on Monomoy NWR.

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.

Salt marsh on North Monomoy Island provides important nesting habitat for American oystercatchers (see objective 1.3 for refuge importance to American oystercatcher) and saltmarsh sparrows. Saltmarsh sparrows are a species of highest conservation priority in BCR 30. PIF 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 NWR’s 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 (Maureen Correll, personal communication 2013). North Monomoy Island is also one of the only places to reliably detect seaside sparrows, another salt-marsh obligate, within Massachusetts (Maureen Correll, Ph.D. student, University of Maine, personal communication 2013). 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 NWR 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 (Oksana Lane, BRI, personal communication 2011). 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 (Jen Walsh, personal communication 2013).

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 (Wells National Estuarine Research Reserve (WNERR) 2002).

We will expand management to include control of non-native 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 will investigate salt marsh health through installation of salt marsh elevation tables and participation in nationwide studies of salt marsh integrity.

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, American oystercatchers, and roosting shorebirds.
- 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 surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.
- Monitor saltmarsh elevation tables in refuge salt marshes to evaluate the effects of various factors on salt marshes' ability to keep pace with sea level rise.

Within 1 year of CCP implementation:

- Minimize impacts to salt marsh wildlife by expanding the prohibition of dogs and pets on the refuge to include Morris Island from May 1 to September 15.
- Evaluate expansion of areas of temporary symbolic fencing to include protection for salt marshes refugewide which will benefit roosting shorebirds. Consider maintaining closures through October at important roost sites.
- 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.
- 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 objective 1.3.
- 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 saltmarsh elevation tables and evaluate the need for remediation and to evaluate the effects of various factors on the salt marshes' ability to keep pace with sea level rise.
- 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/non-native species; monitor changes in species composition, and evaluate effectiveness of control techniques implemented.
- Record the number of mosquito samples monitored on Morris Island for WNV or other arboviruses that pose a potential human health risk.
- Update a cover-type map refugewide every 5 to 10 years.

Objective 1.10 (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 NWR includes approximately 150 acres of freshwater ponds and associated emergent and shrub wetlands, mostly located at the south end of South Monomoy Island. 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 NWR has one of the most diverse suites 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 Island, 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, personal communication 2013) also nest in the freshwater marshes, and pied-billed grebe and American coot use these habitats for migration (Nikula, personal communication 2011).

The freshwater wetlands and associated habitats at the south end of South Monomoy Island 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 have not analyzed the data yet.

Many of the freshwater ponds on South Monomoy Island are fringed with non-native 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 NWR 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; accessed March 2012). On Monomoy NWR, 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 NWR to migrating bats and determine if future monitoring is warranted.

- Control non-native 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 surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Monitoring Elements

- Map locations and record abundance of invasive/non-native 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 1.11 (Nearshore Marine Open Water)

Protect, manage, and restore 2,000 acres of nearshore marine open water, SAV 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 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 within 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 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. 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.

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 boundary. Therefore, the refuge will continue to actively engage with local, State, and Federal agencies to express Service concerns regarding open water uses and recommend how impacts to Service trust resources can be minimized.

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, beach, 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, common, roseate, and least terns utilizing dune grasslands or beaches for nesting rely on nearshore marine waters to find forage fish for themselves and young they are raising on Monomoy NWR. 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 the 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).

In addition to the rationale above, chapter 2 includes a summary of the importance of Monomoy NWR's nearshore marine, subtidal bottom, and SAV 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.
- Maintain closure of the refuge to mussel harvesting to preserve food sources for red knots, common eiders, white-winged and black scoters, and American oystercatchers.
- 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, fin fish stocks, marine mammals including seals, and great white sharks.
- 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 (New England Aquarium and Mass Audubon) to rescue stranded sea turtles and to collect dead sea turtles recovered from refuge waters for scientific research.
- Facilitate and participate in surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Within 1 year of CCP implementation:

- Meet annually with the Town and MDMF to discuss any proposed changes in refuge or fisheries management.
- Work with partners including the Town and local weir fishermen to evaluate and minimize the impact of the weir fishery on SAV within the Declaration of Taking.
- Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to provide wildlife habitat.
- Support partner efforts to study potential impacts of offshore wind or tidal energy development outside the Declaration of Taking to refuge resources of concern.
- Evaluate aquaculture and boat mooring requests in open water-submerged bottom areas within the Declaration of Taking boundary for compatibility and benefits to refuge resources on a case-by-case basis.
- Support partner efforts to work with local weir fishermen to explore opportunities to document or study sea turtles, especially Loggerheads, that become captured in fish weirs within the Declaration of Taking.

Within 5 years of CCP implementation:

- Reinstall permanent markers visually delineating the Declaration of Taking boundary in open waters based on the Regional Surveyor's coordinates; commercial Global Positioning System (GPS) software vendors would be provided with digital map layers for incorporation into their software products.
- Work with partners to evaluate and map the current and historic extent of 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.

Monitoring Elements

- Monitor the impact and record the number of aquaculture activities initiated within refuge waters.
- 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.
- Conduct opportunistic surveillance year-round to detect field mortality events of marine wildlife, including sea turtles; document observations of sick or dying turtles, and identify, collect, and submit these for analysis at the National Wildlife Health Center in collaboration with the Mass Audubon Sea Turtle Stranding 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 2.1 (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 and South Monomoy Islands, and Minimoy Island while implementing a concessionaire system that accommodates an anticipated visitor increase of up to 25 percent. Maintain seasonal closures that reduce disturbance to wildlife from visitors and protect suitable nesting, roosting, and foraging 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.

Most of Morris Island is privately owned, and access to the refuge headquarters and visitor contact station is provided via right-of-ways over private roadways. Some neighboring land owners have disputed the Service's right to allow general public and visitor access over the right-of-ways, voicing concern over levels of visitation and traffic.

The USDOT 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. The strategies outlined below 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. The causeway is narrow, and cars parked on the side impede traffic flow and can be a safety issue for pedestrians. Some visitors simply go elsewhere. The absence of both directional and informational signs can make Monomoy NWR difficult to locate. No signs on highways or local roads 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 Quitteset 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 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.

Leashed dogs will be allowed only on Morris Island from September 16 through April 30. Dogs may also be used to retrieve game shot by waterfowl hunters. Dogs and pets will not be allowed elsewhere on the refuge year-round. 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 have been present on the Morris Island portion of the refuge on-leash year-round, even though the use itself has not been found to be compatible. We close most of the refuge to pets because many visitors unleash their dogs 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 Bryant 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.

Strategies

Continue to:

- Open all of North Monomoy Island to the public from October to March. During the April to September nesting season, 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.
- Allow motorized and non-motorized boating (includes kayaks, canoes, and paddleboards) in refuge waters with landings prohibited in areas that are seasonally closed. Provide a map that shows recommended sites for safe landings.
- Maintain and enforce closure of the refuge to operation and landings of motorized personal watercraft (e.g., wave runners, jet skis).
- Maintain and enforce closure of the refuge to kiteboarding.

- Use the existing right-of-ways 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.
- Facilitate enforcement of the Marine Mammal Protection Act through regular communication and coordination with staff from partner agencies and organizations, including the NMFS, NOAA, and International Fund for Animal Welfare.

Within 1 year of CCP implementation:

- Utilizing adaptive management, strive to keep Morris Island and large portions of South Monomoy Island open year-round, and open 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.
- Meet annually with the Town and NPS to discuss any proposed changes in refuge, Cape Cod National Seashore or Town coastal management and regulations.
- 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.

Along Morris Island Trail



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- Prohibit dogs and pets on Morris Island from May 1 to September 15 and elsewhere on the refuge year-round; allow leashed dogs on Morris Island September 16 to April 30; dogs may be used to retrieve game while waterfowl hunting.
- Include parking requirements in all SUPs.

Within 3 years of CCP implementation:

- Provide vehicle parking at the Morris Island refuge headquarters and visitor contact station lot 24 hours daily; require paid parking from 9 a.m. to 6 p.m. daily with a 4-hour time limit during the June 1 to September 15 peak visitor season; parking will be free at other times.
- Replace the current motorized ferry system from the refuge headquarters on Morris Island with a competitive, multi-year concession, or SUP holders if no concessionaire is identified. The concession could operate from refuge headquarters, but shuttle visitors from an off-refuge parking site to Morris Island and ferry visitors to North and South Monomoy Islands, conduct interpretative natural and cultural history tours, coordinate guided fishing and waterfowl hunting, rent kayaks, and provide other visitor-related services. Provide two parking spaces for the concessionaire and shuttle vans. The concessionaire will be encouraged to manage guide services that facilitate hiking, paddling, or sailing, and encourage visitors to engage in non-motorized boating in order to promote a wilderness experience.
- Require all commercial wildlife watching tours, passenger ferry service, kayak or paddling tours, and hunting and fishing guides to obtain a refuge permit to operate within the refuge's intertidal waters, shore or uplands, regardless of whether vessels or passengers make a refuge landfall.

Within 5 years of CCP implementation:

- With partners, staff, volunteers or through a concession, provide a local-area shuttle serving Morris Island refuge facilities (and possibly other destinations in Chatham) from secure, satellite parking locations during the June 1 to September 15 peak visitor season.
- Pursue use of a Town-owned or private parking facility to serve as a satellite parking location for a shuttle service that will bring visitors to the refuge.
- Encourage and support improvements to the Morris Island Road causeway to better accommodate emergency vehicles, parked cars, pedestrians, and shuttle passage.
- Encourage the Town to create a multi-use bicycle and pedestrian path on one side of the causeway and provide assistance as possible to help implement this project.
- Provide bicycle and pedestrian facilities and amenities through local and regional partners at and around refuge headquarters, Chatham area shuttle stops, and other high priority downtown locations.
- Through local and regional partners, improve motor vehicle, bicycle, and pedestrian route directional signs to the refuge on Morris Island, including designated trails, satellite parking and shuttle stops, and the concessionaire's off-refuge facilities; this may involve erecting new signs within Service right-of-ways.

- Through local and regional partners, add directional and informational signs throughout Chatham, along Route 6, and elsewhere on Cape Cod; improve traveler information on Service and refuge Web and social media sites.
- Complete a visitor services plan for the refuge which includes compatible public access and establishes thresholds of acceptable change to resources resulting from all public uses; develops monitoring strategies to measure change, measures achievement of objectives, provides for adaptation of public access and use to minimize impacts to wildlife and wilderness, and evaluates visitor experiences.
- Encourage paddling as a means of transportation to the Monomoy Wilderness by collaborating with local and regional partners or the refuge concessionaire to provide kayaking launch facilities, rentals, instruction, and access to the Monomoy Wilderness.
- Explore the feasibility of constructing waterfront access meeting Americans with Disabilities Act (ADA) requirements at the refuge headquarters.
- Extend an ADA-compliant boardwalk segment from the existing Morris Island Trail boardwalk to the Nauset/South Beach-Outermost Harbor overlook trail stops.

Within 7 years of CCP implementation:

- Work with partners to evaluate possible locations closer to Main Street in Chatham or somewhere in Harwich to establish a new visitor contact station. When funding allows, construct or renovate a new facility, which could be shared space with partner groups, and transfer exhibits from the current refuge headquarters, which will then primarily serve as administrative offices.

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 SUPs.
- Conduct a daily patrol of the Morris Island parking lot for vehicles displaying valid parking passes and enforce parking fee requirements when violations are detected.
- Monitor and report daily parking fee collections and number of parking passes issued.
- Record the number of visitors who utilize concession services.

**Objective 2.2
(Interpretation)**

Ensure that at least 75 percent of refuge visitors receive high-quality information about the purposes and mission of the refuge, Refuge System, and the Monomoy Wilderness. Visitors would have increased opportunities to recognize the unique natural resources of the refuge and its importance to the recovery and management of migratory birds, including the recovery of listed species, plus Monomoy NWR's importance to the enduring wilderness resource and coastal resource stewardship of the outer Cape region.

Rationale

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. Interpretation is a priority public use identified in the Refuge Improvement Act and is one of the most effective ways we can raise our visibility, convey our mission, and identify the significant contribution the refuge makes to wildlife conservation. Public understanding of the Service and its activities in the Commonwealth of Massachusetts is currently low. Many are unaware of the Refuge System and its scope, and most do not understand the importance of the refuge in the conservation of migratory birds.

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 USFWS 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 WHSRN site, an IBA, and a MPA; these designations can be highlighted in our interpretive programs. Monomoy NWR is also part of the NWPS. 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.

Providing increased high-quality opportunities for the public to engage in interpretive activities promotes stewardship of natural resources, and an understanding of the refuge’s migratory bird, endangered species recovery, and wilderness stewardship purposes. Interpretive activities also garner support for refuge programs and help raise public awareness of the role of the refuge in the Cape Cod and Islands region, and its contribution to inter-continental migratory bird conservation.

We define high-quality interpretive programs as those that increase public awareness and understanding of the Refuge System; develop a sense of stewardship leading to actions and attitudes that reflect concern and respect for wildlife resources, cultural resources, and the environment; provide an understanding of the management of our natural and cultural resources; and provide safe, enjoyable, accessible, meaningful, and high-quality experiences for visitors that increase their awareness, understanding, and appreciation of fish, wildlife, plants, and their habitats. The National Association of Interpreters defines “interpretation” as a communication process that forges emotional and intellectual connections between the interests of the audience and the inherent meanings in the resource.

Many of the interpretive materials at the visitor contact station are 10 years old and need to be updated to current Service standards and refuge management operations. Guided tours will further increase opportunities for interpretation. In order to maintain the integrity of wilderness, no kiosks will be constructed on North Monomoy Island or South Monomoy Island. Information will be available through the use of technology, such as podcasts and handheld devices such as Personal Digital Assistants.

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 with refuge volunteers.
- Inform the public about the refuge and Refuge System, its purpose and mission, and its resources using brochures, rack cards, interpretative panels on trails, videos, 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, staging, 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 new or replacement interpretive panels along the Morris Island Trail.
- Develop temporary, portable exhibits designed to describe Monomoy's biotic diversity, including wildlife, plants, fish, natural processes, wilderness character, and management at Monomoy NWR.
- Provide an informational kiosk on Morris Island containing signs and literature that orient visitors to the refuge and inform them of public use regulations.
- Issue press releases to inform the public about refuge activities and accomplishments.

Within 1 year of CCP implementation:

- Improve informational materials at the Morris Island kiosk to highlight the importance of the Monomoy Wilderness and the importance of the refuge as a migration stopover site for threatened and endangered species.
- Issue permits for interpretive commercial water-based and land-based natural history and cultural history tours until a concessionaire contract is awarded.
- Work with concessionaire or professional guide services to provide natural history, cultural history, and wildlife day trip tours of the islands and the Monomoy Lighthouse and associated buildings.
- Conduct seasonal interpretive programs at the refuge using refuge staff, interns, and volunteers, and provide roving interpreters on the Morris Island Trail; include information about wilderness.
- Increase public awareness of the Monomoy Wilderness through outreach and social media, including outreach to audiences who engage in water-dependent activities (e.g., anglers, divers, paddlers).
- Provide comment boxes and an online form for refuge visitors to provide feedback about their refuge experience. Evaluate comments and respond appropriately to address issues affecting the quality of the visitor experience.

- Develop voluntary guidelines and an interactive game for visitors that address visitor behavior and the importance of maintaining bird and wildlife buffers, practicing “leave no trace,” and other wilderness ethics.
- Initiate an outreach campaign to provide information to all visitors about the importance of minimizing disturbance to migrating and staging birds; the outreach message will focus on a recommended viewing distance of at least 50 m (150 feet) to allow birds to remain undisturbed in their resting and foraging areas which are critical to successful migration.

Within 5 years of CCP implementation:

- Complete a visitor services plan for the refuge which includes the development of an interpretative program and materials.
- Create and disseminate fact sheets about key refuge resources (e.g., endangered and threatened species, barrier island ecosystem, salt marsh habitat), refuge management (e.g., predator management, seasonal closures), Monomoy Wilderness, and watchable wildlife.

Within 7 years of CCP implementation:

- Use virtual technology such as text tours, podcasts, and virtual geocaching and letterboxing to conduct interpretation.
- Explore the option of creating a smartphone application (or other future technology) with Monomoy Wilderness geographic coordinates and information.
- Develop podcasts and other materials designed to provide portable interpretation to refuge visitors about refuge resources (e.g., species of concern, migratory birds) and the Monomoy Wilderness.
- Develop a self-guided interpretive kayak trail and brochure.
- Provide additional summer programs on and offsite that include guided nature walks and an evening lecture series on timely refuge topics.
- Redesign current visitor contact station interpretive materials and displays using formal storyline and professionally-designed exhibits.

Within 10 years of CCP implementation:

- Develop seasonal paddling tours/routes using podcasts to describe refuge wildlife, habitats, and management actions.

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 people who report use of geocaching trail or stamp the letterbox.
- Record the daily number of visitors to the visitor contact station.
- Record the annual number of refuge brochures/rack cards ordered.
- Record the number of visitors who participate in concessionaire-led tours.

- Record the number of participants on tours guided by refuge staff and volunteers.
- Record visitor feedback and actions taken to improve visitor experiences based on feedback.

**Objective 2.3
(Environmental Education)**

Develop a minimum of two curriculum-based programs for local and regional school districts to use that will focus on Monomoy NWR, Monomoy Wilderness, the Refuge System, NWPS, endangered species, species of conservation concern, migratory birds, refuge management, and wilderness stewardship. Students who participate in the refuge’s environmental education program would be able to: (1) understand the importance of wildlife conservation, with a focus on migratory birds; (2) understand the need for wilderness stewardship; (3) identify the refuge’s role in the Refuge System and NWPS; (4) explain the unique characteristics of the Monomoy Wilderness; and (5) name at least one endangered species for which the refuge conducts management.

Rationale

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> (accessed October 2015). 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 will foster an appreciation of conservation and encourage them to make environmentally responsible decisions.

Environmental education is a process designed to develop citizenry with the awareness, concern, knowledge, attitudes, skills, motivations, and commitment to work toward solutions of current environmental problems and the prevention of new ones. Providing high-quality environmental education opportunities for the public on a refuge can promote stewardship of natural resources, develop an understanding of the refuge’s purposes and the mission the Refuge System, and help raise awareness, understanding, and an appreciation of the refuge’s role along the Massachusetts coast and its contribution to migratory bird conservation. Environmental education can also garner support for other refuge programs. Investing in youth and providing unique opportunities in a structured learning environment is a top priority in the Service; the refuge staff will explore additional opportunities to support agency goals.

There are multiple national and international efforts to connect children with the outdoors, and to utilize natural resources as outdoor classrooms. In March 2010, President Obama issued “A Blueprint for Reform: The Reauthorization of the Elementary and Secondary Act” (also referred to as No Child Left Behind). This blueprint addresses the need for leadership, equality, and innovation in the school systems. The President has challenged the country “that by 2020, the United States will once again lead the world in college completion,” (U.S. Department of Education 2010). President Obama clearly states that this is not a job for teachers, parents, and principals alone—this should be done collaboratively.

There are additional efforts that have been introduced, such as the Commonwealth of Massachusetts’ “No Child Left Inside” initiative, the Massachusetts Department of Conservation and Recreation’s “Great Park Pursuit,” and the Children and Nature Network, which provides free resources and tool kits and encourages organizations to reconnect children to nature. National wildlife refuges are an ideal venue to provide students and teachers with

a hands-on learning environment while achieving scholastic goals. As concerns about nature-deficit disorder and child obesity rise (Louv 2005), it is imperative now more than ever that local organizations facilitate and provide opportunities for children to explore and learn in the outdoors.

This objective focuses on creating curriculum-based programs on and off the refuge with local schools, teachers, and other educators, utilizing available resources provided by organizations such as the Children and Nature Network and the Massachusetts Department of Conservation and Recreation. The refuge can provide local teachers with educational material that supports existing curricula on the importance of the Monomoy NWR and an enduring wilderness resource for rare habitats and waterfowl, shorebirds, seabirds, other wildlife, and plant communities.

Strategies

Continue to:

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

Within 5 years of CCP implementation:

- Complete a visitor services plan which includes an environmental education program.
- Host one to two teacher workshops each year on threatened and endangered species and other topics relevant to the refuge's mission.
- Provide assistance for teacher workshops upon request and coordinate with area educators to survey existing programs; develop curricula and programs that will enhance or complement other environmental education programs.
- Provide access to Children and Nature Network tool kits in English and Spanish.
- Determine what environmental education subjects are already being delivered to which age group audiences in the surrounding communities or where gaps remain in program subjects or age groups being served.

Within 7 years of CCP implementation:

- Work with partners to conduct a pilot study to determine age-appropriate curriculum content and strategize to target education efforts to age groups not currently being served by other education organizations.

Within 10 years of CCP implementation:

- Create at least two curriculum-based environmental education programs in coordination with partners which, based on the findings of the pilot study, can be utilized on or offsite by local and regional school districts. The programs will incorporate the Massachusetts curriculum frameworks along with key refuge messages.
- Expand efforts to coordinate with area environmental educators to integrate refuge programs with local environmental education programs.

Monitoring Elements

- Record the number of students and teachers who participate in refuge environmental education programs and field trips.
- Maintain a listing of curriculum-based programs that refuge staff, interns, or volunteers develop with partners or on their own.

- 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.
- Record the number of teacher workshops and the number of attendees.
- Record the number of times tool kits are checked out.

Objective 2.4 (Wildlife Observation and Photography)

Provide opportunities for refuge visitors to engage in wildlife observation and photography in a manner that minimizes disturbance to refuge habitats and wildlife, striving to ensure that 75 percent of visitors report a high-quality experience.

Rationale

Wildlife observation and photography are identified in the Refuge Improvement Act as priority public uses. Priority public uses are to receive enhanced consideration when developing goals and objectives for 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> (accessed October 2015), respectively.

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 Island. 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 WHSRN, and has been recognized as a globally significant IBA by the National Audubon Society.

SUPs are required whenever the photographic images will or can be marketed (e.g., sale of copyrighted images, including videography). Issuing SUPs 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.

We will enhance infrastructure and visitor services (i.e., concessionaire services) to increase wildlife observation and photography opportunities in a manner consistent with preserving wilderness character. We will establish a concessionaire in order to facilitate enhanced and increased opportunities for the public to observe and photograph wildlife on the refuge. Monomoy NWR and neighboring Nauset/South Beach are known worldwide for the magnificent and dynamic landscape, and offer the chance to participate in premier bird watching. Those who visit the refuge experience something unique and find a sense of true escape and solitude in the wilderness.

The refuge facilitates opportunities for wildlife observation and photography through self-guided nature trails, observation areas, and water-based tours. We strive to provide safe, accessible wildlife observation and photography opportunities while protecting wildlife and their habitats at sensitive times in sensitive places. We intend to provide opportunities to experience solitude, unconfined recreation, and naturalness on the refuge and in the Monomoy Wilderness. Providing additional or enhanced high-quality opportunities for

visitors to engage in these activities on the refuge promotes visitor appreciation and support for refuge programs.

High-quality wildlife observation and photography can be defined as:

- Observation that occurs in a primitive setting and provides an opportunity to view wildlife and habitats in a natural setting.
- Observation facilities that are safe and maximize opportunities to view the spectrum of species and habitats of the refuge.
- Observation opportunities that promote public understanding of and increase public appreciation for America's natural resources.
- Viewing opportunities that inspire increased stewardship of our refuge resources.
- When provided, facilities that blend with the natural setting and provide viewing opportunities for all visitors, including persons with disabilities.
- Observers who understand and follow procedures that encourage the highest standards of ethical behavior in natural and wilderness areas.
- Viewing opportunities that exist for a broad range of visitors.
- Observers who have minimal conflict with other priority wildlife-dependent recreational uses or refuge operations.

In 2009, the Service reported that 48 million birdwatchers across America spent \$35 billion in 2006 pursuing one of the Nation's most popular outdoor activities. The report, *Birding in the United States: A Demographic and Economic Analysis*, is based on data collected during the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

The refuge staff receives multiple requests for commercial filming and photography each year. Commercial filming and photography on the refuge must have a direct benefit to the refuge or the Service and in wilderness, it can only occur when necessary to provide educational information about wilderness uses and values and is conducted in a manner that does not degrade wilderness. Issuance of SUPs to allow commercial filming and photography must meet these requirements and will contain stipulations to protect refuge wildlife resources and wilderness character.

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 hour after sunset; prohibit touching, feeding, or harassing wildlife.
- Maintain the two viewing platforms on Morris Island.
- Allow commercial filming and photography on the refuge by SUP only when there is a direct benefit to the refuge or the Service; and in wilderness, only when necessary to provide educational information about wilderness uses and values in a manner which does not degrade wilderness.
- Allow recreational photography in any area of the refuge open to the public.
- Host a youth or adult photography contest.

Within 3 years of CCP implementation:

- Develop flexible closures to minimize disturbance to migrating and staging shorebirds.
- Work with local photography and birding clubs to promote awareness of wildlife and wilderness values of the refuge and refuge regulations.

Within 5 years of CCP implementation:

- Complete a visitor services plan for the refuge that includes wildlife observation and recreational photography opportunities that are compatible with refuge wildlife and wilderness management objectives.
- Provide trails on Morris Island for wildlife observation; wilderness trails will not be maintained.
- Evaluate use of critter cam(s) so the public can observe nesting behavior online, which could facilitate a connection to animals they may not be able to view in person.
- Work with visiting clubs to ensure disturbance is minimized when birding expeditions occur.
- Develop guidelines for group visits into the Monomoy Wilderness and for local organizations that conduct photography trips on the refuge.
- Work with a concessionaire to highlight prime wildlife photography and observation opportunities.
- Develop a portal for eBird Web site (*www.ebird.org*) information that is reported by visitors to the refuge.

Within 7 years of CCP implementation:

- Evaluate and implement opportunities for universally accessible observation; improve the existing boardwalk at the refuge headquarters to make it ADA-accessible for better observation opportunities at the Morris Island Trail overlook.
- Install an additional viewing platform or photography blind on Morris Island.

Monitoring Elements

- Record the number of visitors engaged in wildlife observation and photography annually.
- Record visitor feedback and actions taken to improve visitor experiences based on feedback.
- Record the number of SUPs issued for commercial photography and guided wildlife observation tours.
- Record the number of passengers and participants who utilize guides or the concessionaire in trips to the refuge.
- Record the number of photography contest submissions.
- Record information collected for the eBird Web site.

Objective 2.5 (Fin Fishing)

Provide opportunities for fishing, and strive to ensure that 50 percent of visitors engaged in recreational fishing report having a high-quality experience.

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> (accessed October 2015). 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. 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 Island, although access is difficult due to their location and the prevalence of poison ivy throughout the area.

The official process for opening refuges to hunting and fishing changed with the passage of the 1997 Refuge Improvement Act. At this time, Monomoy NWR is only open by regulation to sport fishing. Refuge fishing is allowed in accordance with State and local regulations. While most fishing is dependent on access by boat, Morris Island offers 24-hour-a-day fishing opportunities.

The waters off of Monomoy NWR have a deserved reputation as a world-class surf fishery. Novice and experienced anglers alike visit Monomoy NWR every year. Many recreational anglers are also accompanied by commercial guides. Most fishing visits are for surf fishing.

Since fishing is a priority use, every effort will be made to accommodate fishing when it does not hinder our compliance with Federal law to protect migratory birds and other federally listed species, preserve wilderness character, or protect cultural or historic resources. When necessary to protect refuge resources, symbolic fencing can be placed or moved to accommodate both nesting birds and fishing access across space and time, depending upon the location and duration of nesting birds.

Anglers may fish on their own or with the assistance of a commercial guide. Fishing with the use of a commercial guide will be regulated on the refuge through a SUP, which will be required for any guide operating from shore or with disembarking passengers. The SUP will identify refuge rules, regulations, and closed areas. It will highlight habitats and species of concern that should be avoided by anglers to reduce disturbance, and will explain wilderness so all activities conducted by anglers are consistent with preserving the wilderness character of refuge lands and waters. Refuge staff will establish a fair and equitable system for commercial fishing guides to operate on the refuge. The refuge expects that these guides will help increase fishing opportunities on the refuge with an added level of safety, reduce conflicts with refuge wildlife, protect sensitive refuge habitats, and ensure greater protection and appreciation of wilderness character.

We will endeavor to promote fishing on the refuge by participating in local fishing tournaments, approving a concessionaire or special use permittees to provide guided fishing tours for the general public, and distributing materials that describe local sport fish of interest and applicable fishing regulations. We will explore partnerships with local angler organizations and other groups to ensure high-quality fishing opportunities and experiences on the refuge.

We define a high-quality fishing program as one that:

- Maximizes safety for anglers, other visitors, and refuge staff.
- Causes no adverse impacts on populations of resident or migratory species, native species, threatened and endangered species, or habitat.
- Encourages the highest standards of ethical behavior in regard to catching, attempting to catch, and releasing fish.
- Is available to a broad spectrum of the public that visits, or potentially would visit, the refuge.
- Provides reasonable accommodations for individuals with disabilities to participate in refuge fishing activities.
- Reflects positively on the Refuge System.
- Provides un-crowded conditions.
- Creates minimal conflict with other priority, wildlife-dependent recreational uses or refuge operations.
- Provides reasonable challenges and harvest opportunities.
- Increases visitor understanding and appreciation for the fishery resource.

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, which includes possessing a saltwater or freshwater fishing license recognized by the Commonwealth of Massachusetts.
- 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 Island during daylight hours.

Within 1 year of CCP implementation:

- Conduct outreach about new fishing opportunities on the refuge.
- Provide seasonal information (e.g., conditions, species, fish runs) on the refuge's Web site and at the Morris Island kiosk, and distribute to local fishing organizations, guides, and shops; this will include closed areas maps and any additional refuge-specific regulations.
- Require all commercial fishing guides to obtain a refuge permit if they plan to make landfall, operate from shoreline, or allow passengers to disembark from their vessels.

Within 2 years of CCP implementation:

- Update the refuge fishing plan to reflect new fishing opportunities and refuge regulations.

Within 3 years of CCP implementation:

- Replace the motorized ferry system from the refuge headquarters on Morris Island with a competitive, multi-year concession, or SUP holders if no concessionaire is identified; the concession could arrange for refuge-permitted fishing guides and provide a system to bring anglers and their guides to the refuge, along with providing other visitor-related services.
- Establish a station at headquarters for recycling monofilament and safe disposal of fish line.

Within 5 years of CCP implementation:

- Work with partners and coordinate with the State to develop a fishing brochure that informs anglers about refuge resources and seasonal closures and will be available on the refuge's Web site and at the Morris Island kiosk.
- Work with partners to establish an annual fishing event on the refuge.

Within 10 years of CCP implementation:

- Evaluate the fishing program; modify or restrict access, or adapt management strategies as warranted.

Monitoring Elements

- Report the estimated number of fin fishing visits to refuge.
- Record feedback from the concessionaire to document number of anglers transported to the refuge and comments received about each individual's experience per trip.
- Record actions taken to improve visitor experiences based on feedback.
- Record the number of SUPs for commercial guides awarded annually.
- Record harvest data and information that is voluntarily reported to the refuge.
- Record the number of fishing guides distributed.
- Record the number of attendees to fishing events.
- Record the number of offsite locations receiving information.
- Record the amount of monofilament collected from the recycling station.
- Have refuge law enforcement officers ensure that anglers possess the proper license requirements.

Objective 2.6 (Shellfishing)

Allow refuge visitors to harvest subterranean shellfish (softshell clams, quahogs, razor clams, and sea [surf] clams) using non-mechanized hand raking tools only and no artificial means of extraction (such as salt and chlorine), otherwise in accordance with State and Town Shellfishing Rules and Regulations or additional refuge regulations.

Rationale

In recent years, visitors have primarily harvested softshell 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 occasionally bay scallops, razor clams, and sea (surf) clams using a variety of harvest methods. Although not shellfish, some sea worms are regulated by Town shellfish regulations and have been harvested on the refuge, despite the refuge never having been open to this use. Horseshoe crabs, which also are not shellfish, were harvested by SUP until 2002.

The Town 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 [accessed October 2015] for more information). The refuge staff does not directly manage shellfish harvest activity on refuge lands, but instead relies on indirect management through the Town. Details regarding this use are found in the Shellfishing Compatibility Determination in appendix D.

We will officially open the refuge to non-mechanized harvest of subterranean species (softshell clams, quahogs, razor clams, and sea [surf] clams). To the best of our knowledge, razor clam and sea (surf) clam harvesting is not currently occurring on the refuge. However, razor and sea clams have previously been harvested on the refuge, are harvested locally off-refuge, and may be again in the future, as regional conditions change.

We will also enforce the existing closure on harvesting of marine (sea) worms. Marine worms are a primary prey item of many species of shorebirds that also rely on Monomoy NWR during migration (Placyk and Harrington 2004). Please refer to chapter 3 and chapter 4 (Objective 1.8) for more details about the importance of the refuge to shorebirds species of concern.

We will not open the refuge to the harvest of mussels. Mussels are an important food source for many migratory birds. We provide additional protection for priority wildlife species by not allowing harvest of these species. For example, blue mussels are the most important food item during the winter for common eiders (a Service focal species) congregating in Nantucket Sound (MA DFG 2006). Mussel spat is also one of the most important food items for southward migrating red knots (a threatened species) using Cape Cod from July through October (Harrington et al. 2010b). Mussels are a common food of American oystercatchers as well; they typically visually site these prey in slightly submerged shellfish beds (<http://amoywg.org/american-oystercatcher/food-habits/>; accessed March 2013). Ribbed mussels are an important component of the salt marsh ecosystem. If additional information becomes available about the importance of subterranean shellfish species to priority wildlife species, we would reevaluate this objective.

The refuge will also remain closed to artificial extraction methods, including use of dilute saline solution for harvesting razor clams and sea (surf) clams in waters above MLW as currently permitted under Town regulations. There is a scarcity of information documenting potential impacts (positive, negative or neutral effects) of salting on target species, non-target species, and the benthic environment. A harvester cannot determine if a razor clam in a burrow meets the Town's 4 1/2-inch minimum size, until it after it has been salted, and the clam has expelled itself and can be measured. Thus, we are additionally concerned about impacts of salting to undersized (and thus discarded) razor clams. Krzyewski et al. (2005) studying salt harvest in Pleasant Bay found that salt solutions of 100 ppt affected the cilia and cell membranes, and that that Pleasant Bay harvesters typically use a salt solution of 100 to 200 ppt. Town regulations require that (table) salt be diluted with water, but does not regulate the concentration of salt that can be used. Current Town regulations do not relieve our concerns about

impacts of salting to other species sharing this ecosystem, or to undersized razor clams. Razor clams are an important food source to several priority species utilizing Monomoy NWR, including horseshoe crabs (Botton 1984, Walls et al. 2002) and American Oystercatchers (Nol and Humphrey 1994). The importance of the refuge to these species is described in elsewhere in chapters 3 and 4. Impacts to the razor clam population (either inadvertent or direct harvesting pressure) could impact these species as well. We are concerned that the efficiency of harvesting with salt could lead to increased pressure on this resource, and this, combined with our understanding that there are no daily limits for commercial harvesters, could result in the depopulation of razor clam beds.

Although not as efficient as salting, it is still possible to harvest razor clams with hand tools such as the clam shovels and clam tubes (guns) used to harvest a similarly fast moving and deep digging razor clam (*Silqua patula*) in Oregon and Washington (<http://www.dfw.state.or.us/resources/fishing/docs/ClammingFlyer.pdf>, http://wdfw.wa.gov/fishing/shellfish/razorclams/howto_dig.html (accessed October 2015)). Town regulations deem hand tools are adequate for harvesting the maximum allowable weekly recreational limit of one 12-quart pail. Clam tubes can be homemade or purchased through a variety of common retailers. Limiting the harvest of razor clams and sea clams on the mudflats to only hand tools is also consistent with our efforts to maintain the quality of our wilderness character.

We will take a more proactive approach to minimizing disturbance to migrating and staging birds on the intertidal flats. The rationale in objective 1.7 discusses the importance of minimizing human disturbance to shorebirds, but here we include a discussion specific to shellfish harvesters and harvesting activity. Shellfish harvesters, like all refuge users, may cause disturbance to birds using intertidal and nearshore open water habitats on the refuge. However, softshell clam harvesters spend most of their time bent over at the waist or on hands and knees harvesting patches of shellfish, and traverse the exposed mudflats only to move among patches (Burger 1981, Leavitt and Fraser 2004). They generally spend less time traversing mudflats than other users, such as bird watchers, anglers, and beachcombers, who also occupy these mudflats.

Previous research has shown that shorebirds reduce their foraging rates, flush more easily, and abandon areas with increased human presence (Burger 1981, Burger and Gochfeld 1991b, Lafferty 2001a, 2001b; Thomas et al. 2003), and that the degree of shorebirds' response varies with different anthropogenic activities (Burger 1981, Burger 1986, Pfister et al. 1992, Lafferty 2001b). Fast-paced activities involving rapid movements, such as jogging, were more likely to disturb waterbirds than slow-moving activities, such as worm and clam harvesting (Burger 1981). At a non-breeding site in California, stationary people along the beach disturbed shorebirds less frequently (and fewer birds overall for each disturbance) than did mobile people (Lafferty 2001b). Softshell clams inhabit intertidal and shallow subtidal mudflats where shorebirds often forage (Leavitt and Peters 2005). Studies conducted at Monomoy NWR also provide evidence that shorebirds tolerate slow moving or stationary shellfish harvesters at much closer distances than they tolerate pedestrians traversing intertidal habitat (Koch and Paton 2014, Leavitt et al. 2010).

Additionally, anecdotal observations of shorebirds congregating in recently shellfished areas at Monomoy NWR (Leavitt and Peters 2005, Koch 2010) led to the hypothesis that sediment turnover associated with softshell clam harvesting may expose additional prey for shorebirds that would normally be at unavailable depths, thereby providing a net benefit to foraging shorebirds (Leavitt and

Peters 2005). We tested this hypothesis by conducting surveys of shorebirds in areas that had and had not been shellfished since the last tidal inundation from August to November 1, 2007. For shellfished areas, we quantified the total area that had been shellfished. For each shorebird present in the survey area, we recorded the behavior when it was first seen (foraging or other) and if it was observed foraging in shellfishers' holes or sediment piles adjacent to holes. The mean density of most shorebird species was not dependent on the percent area shellfished, but the mean density of American oystercatchers and ruddy turnstones was positively related to the percent area shellfished. The increased abundance of these species in shellfished areas probably reflects increased foraging opportunities that outweigh the risks of closer approaches to humans. The presence of shellfish holes and sediment piles is likely appealing to American oystercatchers that frequently feed on shellfish (AMOY WG 2012). It also likely complements ruddy turnstones' foraging strategy of flipping objects and digging deep into sediment with their bills and heads (Nettleship 2000, Paulson 2005).

We did not detect any differences in the proportion of birds that were foraging in shellfished and non-shellfished areas, but observations in shellfished areas showed that most species foraged in shellfish holes or on sediment piles (Koch and Paton 2014). Based on this data, we conclude that the hand harvest of shellfish, if conducted as described here, can provide a benefit to certain migratory birds by expanding their access to prey.

We will also start to enforce a prohibition on the use of wheeled carts and other mechanical transport in the Wilderness Area. The Wilderness Act prohibits the use of mechanical transport in Wilderness Areas. Mechanical transport (610 FW1 1.5) includes, but is not limited to, sailboats, hang gliders, parachutes, bicycles, carts, and wagons (it does not include wheelchairs used by individuals with disabilities that require wheelchairs).

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 Shellfish Warden as needed to discuss shellfish resource management, harvest levels, harvest regulations and enforcement.
- The refuge will remain closed to mussel and horseshoe crab harvest.

Within 1 year of CCP implementation:

- Meet annually with the Town and MA DMF to discuss any proposed changes in refuge or fisheries management.
- Coordinate with the MA DMF and the Town Shellfish Warden to review annual use, obtain harvest records, and promote and ensure the sustainability of the shellfish resource on the refuge.
- Ensure information about the refuge's prohibition on the use of salt above MLW or chlorine or other artificial means of extraction to harvest razor clams is transmitted to local clammers.
- Enforce the prohibition on the use of wheeled carts and other forms of mechanical transport in Monomoy Wilderness.
- Coordinate with the Town Shellfish Warden to provide all permitted shellfishers using Monomoy NWR with information about the refuge purpose and mission, regulations, seasonal closures, and wilderness ethics and stewardship.

Within 2 years of CCP implementation:

- Update the refuge fishing plan and regulations to allow the hand harvest of subterranean shellfish using methods that preserve wilderness character. Do not allow extractive methods such as salt above the MLW line or chlorine.

Monitoring Elements

- Record the number of annual shellfish harvest permits issued by the Town Shellfish Warden.
- Monitor impacts to wildlife, particularly staging shorebirds such as red knots, and nesting shorebirds such as American oystercatchers.

Objective 2.7 (Waterfowl Hunting)

Officially open up to 40 percent of the refuge within the Declaration of Taking to waterfowl hunting in accordance with Federal law and Massachusetts regulations.

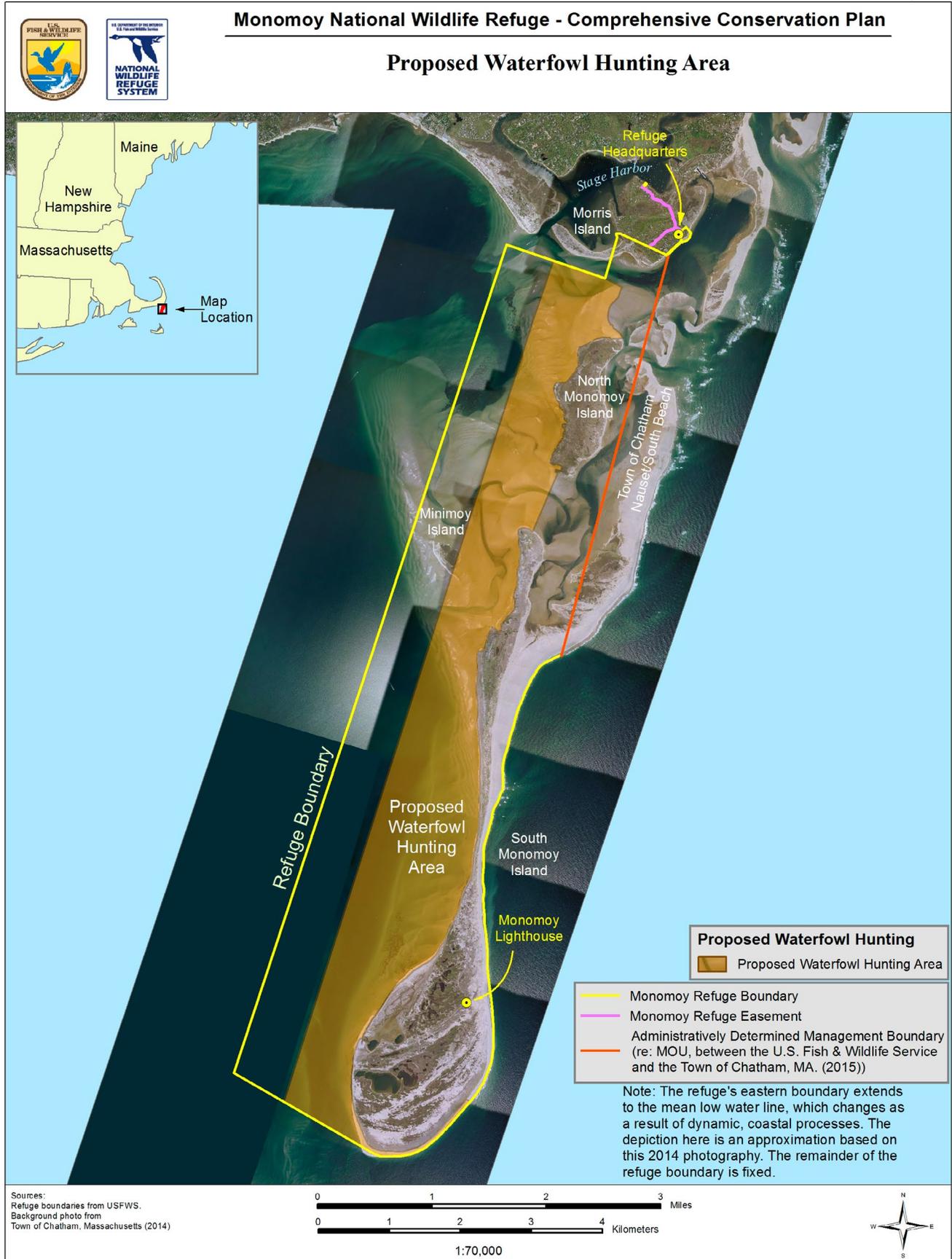
Rationale

Waterfowl hunting has regularly occurred within the Monomoy NWR Declaration of Taking boundary since the refuge was established. However, all areas included in the Refuge System are closed to public access until and unless we open the area for a use or uses in accordance with the Administration Act of 1966 (16 U.S.C. § 668dd-668ee) and the Refuge Recreation Act of 1962 (16 U.S.C. § 460k-460k-4). Monomoy NWR has never been opened for waterfowl hunting by regulation, individual permit, or public notice as required by law.

The Administration Act of 1966 as amended by the Refuge Improvement Act of 1997 (16 U.S.C. § 668dd et seq.) provides authority for the Service to manage the refuge and its wildlife populations. The Refuge Improvement Act directs managers to increase recreational opportunities, including hunting, on national wildlife refuges when compatible with the purposes for which the refuge was established and the mission of the Refuge System. Hunting is recognized by the Service as a traditional form of wildlife-related outdoor recreation. We anticipate a low degree of hunting pressure to occur as a result of officially opening the refuge for these activities. Increasing hunting opportunities at Monomoy NWR will provide more wildlife-dependent recreational opportunities for the public and promote better understanding and appreciation of refuge habitats and their associated fish and wildlife resources.

The refuge weighs a number of factors in opening an area to hunting or fishing, including safety considerations. The refuge manager may, upon annual review of the hunting program, impose further restrictions on hunting activity, recommend that the refuge be closed to hunting, or further liberalize hunting regulations within the limits of State and Federal regulations. Restrictions will occur if hunting becomes inconsistent with other higher priority refuge programs or endangers refuge resources or public safety. The approximate area we propose to open to waterfowl hunting is presented in map 4.1.

Refuge law enforcement officers will conduct patrols and enforce Federal and State hunting regulations. Enforcement patrols may also be conducted by Massachusetts Environmental Police officers. The frequency of patrols will be determined by hunter use, the level of compliance observed during patrols, and information obtained from participants, visitors, and other sources. Refuge brochures and hunter orientation prior to the hunting seasons will emphasize refuge specific regulations, safety considerations, and the protection of wildlife species found on the refuge.



Strategies

Within 3 years of CCP implementation:

- Develop a hunt opening package, conduct NEPA analysis and public review, and develop a hunt plan; develop monitoring strategies to measure change, measure achievement of objectives, and evaluate the hunt program; modify or restrict access, or adapt management strategies as warranted. Retrieving dogs will be allowed while waterfowl hunting.
- Establish a system for issuing permits to waterfowl hunters. There will be no fee for individual permits but there will be a minimal processing fee charged by the third party vendor that issues refuge hunt permits.
- Require all commercial hunting guides providing guiding services within North Monomoy Island and South Monomoy Island to apply for and receive a SUP to conduct guiding on the refuge (50 CFR 27.97). The fee for this SUP will not be less than \$100 or more than \$500, with all monies minus administration costs to enhance the hunting program and the hunters' experience.

Monitoring Elements

- Record the number of SUPs issued.
- Record the number of each species harvested.
- Record the number of individual waterfowl hunt permits issued.

REFUGE GOAL 3:

Communicate and collaborate with local communities, Federal and State agencies, and conservation organizations to promote natural resource conservation and support the goals of the refuge and the mission of the Service.

Objective 3.1 (Public Outreach)

Over the next 10 years, expand public information dissemination efforts with a target of annually reaching 100,000 people, and participate in at least five offsite opportunities within the local community or the outer Cape region so residents and visitors can learn about the refuge's unique coastal barrier ecosystem, the Refuge System, and the NWPS.

Rationale

The Service is America's voice for wildlife, speaking for the wild creatures that cannot speak for themselves. To be effective, we must do so in a way that provokes public understanding and support (USFWS 1997). Outreach is two-way communication between the Service and the public to establish mutual understanding, promote involvement, and influence attitudes and actions, with the goal of improving joint stewardship of our natural resources. Communication is essential to the refuge resource mission. Good communication builds understanding, helps the public make informed decisions about the future of fish and wildlife resources, and supports the actions of the refuge.

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.

This objective focuses on achieving positive awareness for the refuge through better communication. Although the refuge must manage many controversial issues, it also enjoys significant strengths, including dedicated staff and volunteers and strong public interest in fish and wildlife. To meet the refuge's challenges and leverage its strengths, the strategies under this objective seek

a more unified and strategic communications program that will help the refuge carry out its resource conservation mission. Our approach is to make the most effective use of staff time and resources by focusing our messages into something people can easily understand, and making sure that message is delivered to concerned people in a timely manner.

Local businesses that cater to the users of Monomoy NWR are important potential constituents who can help promote responsible, nature-based tourism, provide guidance on the area's sensitive natural resources, and encourage responsible behavior around sensitive wildlife habitats and populations and within wilderness. We will promote the refuge and provide information at partner locations, such as the Chamber of Commerce, public library, Marconi Maritime Museum, Salt Pond Visitor Center at Cape Cod National Seashore, Cape Cod Museum of Natural History, Nickerson State Park, Massachusetts Audubon Society's Wellfleet Bay and Long Pasture Sanctuaries, USCG Heritage Museum, Provincetown Center for Coastal Studies, WHOI, Waquoit Bay National Estuarine Research Reserve, New England Aquarium, and other applicable locations.

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 on-line.
- 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 the Friends group and volunteers to increase refuge activities and funding opportunities.
- Speak about the refuge and its purposes to local service and civic organizations and regionwide conservation partners.

Within 1 year of CCP implementation:

- Promote an outreach campaign (already initiated by the NMFS, NOAA, International Wildlife Coalition, and Cape Cod Stranding Network) to provide information to all visitors about the importance of abiding by the Marine Mammal Protection Act to minimize disturbance to marine mammals. The outreach message will focus on a recommended viewing distance of at least 150 feet to allow marine mammals undisturbed resting and foraging areas which are critical for survival.

Within 5 years of CCP implementation:

- Develop and distribute rack cards and refuge brochures throughout Chatham and neighboring towns to increase awareness of the refuge, its importance to federally listed threatened and endangered species, opportunities for refuge visitors, and the Monomoy Wilderness.
- Provide and maintain refuge informational displays at other frequently visited refuge partner locations.

- Initiate an outreach campaign to provide information to all visitors about the importance of minimizing disturbance to migrating and staging birds. The outreach message will focus on a recommended viewing distance of at least 50 m (150 feet) to allow birds to remain undisturbed in their resting and foraging areas which are critical for successful migration.

Within 7 years of CCP implementation:

- Deliver refuge information through select video clips or live-streaming, real-time wireless wildlife camera images.
- Develop tools to conduct outreach on refuge issues and updates via modern technology such as text messages, virtual tours, podcasts, and smartphone applications.
- Work with birding clubs to disseminate refuge information, and retrieve any sighting information from such clubs.

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.
- Record the number of visits to refuge Web site.

Objective 3.2 (Community Support)

Over the next 15 years, with the aim of increasing the public’s understanding of our purpose and management activities, support the Friends group and volunteers, increase refuge partnerships, and take other actions to improve refuge communications and effectiveness by increasing volunteer hours and the number of partnerships by 50 percent.

Rationale

Greater outreach efforts will increase recognition of the refuge, the Refuge System, and the Service among neighbors, local leaders, conservation organizations, and elected officials. We will strive annually to increase outreach efforts toward the local citizenry. This publicity will also help generate support for similar conservation efforts in the region.

It is particularly important that local residents understand, appreciate, and support the Refuge System mission and this refuge’s unique contribution to that mission, concurrent with wilderness stewardship. In addition, our volunteer program could grow and our Friends group could see enhanced membership and support. The proposed relocated refuge headquarters and visitor contact facility will serve as an important resource for refuge visitors and the local community, providing educational and recreational opportunities and meeting and exhibit space for local conservation organizations.

Refuge management decisions are based on sound science and Service policy and regulations. It is important to maintain regular communication to inform and update the public about refuge actions. We strive to explain the reasons for our actions and decisions. We hope to achieve informed consent, which ensures that because stakeholders understand our issues and actions, they do not oppose them and hopefully support them. Participation beyond informed consent involves those who are actively engaged with the refuge through volunteering, supporting

funding, and attending programs and events. An even higher level of community support is expressed in the establishment and maintenance of a refuge Friends group. Ultimately, it is the goal of the refuge staff to have an active Friends group that can assist in garnering public support for the refuge.

Gaining support for refuge programs from the local community, private landowners, conservation groups, congressional, State, and local elected officials is essential for us to meet our goals. This can only happen when these elected officials understand and appreciate the nationally significant contribution of the refuge and its programs to the permanent protection of Federal trust resources. We need to impress upon these individuals the importance of refuge lands to current and future generations of Americans.

Refuge Friends groups play a vital role in supporting the mission of a refuge, providing volunteers and community support. The Friends of Monomoy NWR, a registered 501(c)(3) nonprofit corporation, is an important part of the refuge, providing some financial support for interpretation and habitat management projects on the refuge. The Friends of Monomoy NWR reorganized and re-established itself in 2011, and is working to grow membership and revenue sources to help further the refuge purpose and Service mission.

In 2011, people conducting wildlife management, habitat management, public use, or maintenance activities contributed nearly 5,300 volunteer hours to Monomoy NWR. New community partnerships such as with the American Lighthouse Foundation, which resulted from 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 NWR so that they may actively support refuge activities.
- Implement current Friends and volunteer policies according to Service Friends Policy 633 FW 1-4 and National Wildlife Refuge System Volunteer and Partnership Enhancement Act of 1998.
- 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.

Within 2 years of CCP implementation:

- Develop and implement volunteer position descriptions to increase volunteer opportunities.

Within 10 years of CCP implementation:

- Collaborate with the Friends of Monomoy NWR to create a jointly staffed visitor contact facility in Chatham or Harwich that allows visitors to receive information on nature-based opportunities on the refuge and in the local area.

Monitoring Elements

- Record the number of volunteers and volunteer hours contributed annually.

- Track number of members of the Friends group.
- Record the number of organizations partnering with Monomoy NWR.
- Record the number of individuals participating in the Monomoy Point Light Station history interpretative tours and programs, both off and onsite.
- Record the number of volunteer position descriptions created.
- Record the number of events and number of participants at each event.

REFUGE GOAL 4:

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

Objective 4.1 (Wilderness Implementation and Designation)

Manage the Monomoy Wilderness to enhance its wilderness character and values, in a manner consistent with refuge establishment purposes (migratory birds and wilderness) 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 and primitive recreation. The Refuge System manages refuge wilderness 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 Monomoy Wilderness retains its primeval character and influence, without permanent improvements (except for the light house, which Congress acknowledged in 1970 needed to be preserved) or permanent human habitation, and its natural conditions are preserved. The Service is to manage the Monomoy Wilderness 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; find outstanding examples of ecological, geologic, scientific, educational, scenic, or historic features; and can seek and experience solitude or primitive and unconfined recreation.

Refuge management activities in the Inward Point and Powder Hole inventory areas will remain largely unchanged from those employed since the 1970 designation of the adjoining Monomoy Wilderness. 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. Maintaining the historic light station structures may require periodic mechanized transport or motorized equipment use, and access to the worksite along a temporary overland trail or road through the Monomoy Wilderness. We will analyze all activities associated with light station upkeep and determine, through use of the minimum requirements decision guide process, how to minimize impacts on the Monomoy wilderness.

As mentioned under Conducting Resource Management and Public Use Activities Consistent with Wilderness Principles, we will complete minimum requirements analyses when needed for refuge administrative and management activities conducted within wilderness that are essential to fulfilling the purposes (migratory birds and endangered species recovery) of the refuge to ensure they are the minimum necessary.

Strategies

Continue to:

- Manage the Monomoy Wilderness for naturalness, wildness, and outstanding opportunities for solitude or primitive and unconfined recreation by managing refuge operations and visitor uses in a manner that protects wilderness character.
- Continue managing the Inward Point and Powder Hole inventory areas as wilderness, to the extent that it will not prevent fulfilling refuge establishment purposes or the Refuge System mission.
- Review all refuge management activities proposed within the Monomoy Wilderness and the Inward Point and Powder Hole inventory areas to ensure they are consistent with wilderness management; use the minimum requirements analysis process presented previously.
- Review and implement actions recommended in the Monomoy Wilderness Character Report.
- 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 human-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.
- Implement management activities that involve temporary rather than permanent uses or site occupancy, that create no new surface disturbance, and do not involve placement of permanent structures or installations or use of motorized equipment or mechanized transport unless it is the minimum tool necessary.
- Provide refuge staff with wilderness stewardship training appropriate for their positions.

Within 1 year of CCP implementation:

- Enforce the prohibition on the use of wheeled carts and other forms of mechanized transport in Monomoy Wilderness.
- Maintain wilderness boundary signs at three locations at two boat landings and a third at the Nauset/South Beach management boundary identified in the June 2015 MOU with the Town.

Within 2 years of CCP implementation:

- Create and post an additional wilderness information station or kiosk at the Monomoy Point Light Station.
- Create additional materials, offer public programs, and distribute information about wilderness to target audiences to raise awareness of the wilderness designation and wilderness ethics.

Within 3 years of CCP implementation:

- Complete a wilderness stewardship plan for the Monomoy Wilderness; establish thresholds of acceptable change to resources resulting from public

use; develop monitoring strategies to measure change, measure achievement of objectives, and evaluate visitor experiences.

- Work with regional airports and the FAA to increase pilot awareness of and compliance with the 2,000-foot flight ceiling advisory over the Monomoy Wilderness.

Within 5 years of CCP implementation:

- Explore opportunities with the Arthur Carhart Center to recruit a wilderness ranger and develop programs that promote Wilderness Act principles such as wilderness education workshops for local/regional educators.
- Explore the feasibility of a wilderness access pass as a means of educating and informing the public about wilderness designation and management on the refuge, appropriate uses by visitors while in refuge wilderness, and as warranted, the need for further restrictions, such as potentially limiting the number of visitors in order to maintain solitude and other wilderness characteristics.
- Explore the option of creating a smartphone application with Monomoy Wilderness coordinates and information about the wilderness designation.

Monitoring Elements

- Maintain a listing of completed minimum requirement analyses for the refuge, and document the annual minimum requirement analysis review process.
- Record the number of staff receiving wilderness orientation and number of training records for all refuge staff, volunteers, and interns.
- Record the number of educators completing wilderness education teacher workshops.

REFUGE GOAL 5:

**Objective 5.1
(Archaeological Resources
and Historical Structures)**

Protect cultural resources that exist on the refuge.

Prevent the loss of cultural resources on Monomoy NWR when possible over the next 15 years, in keeping with the Service’s legal responsibility (under Sections 106 and 110 of NHPA) to identify, evaluate, and preserve all cultural resources and historic properties on the refuge. To the extent that it is prudent and feasible within the context of projected sea level rise and climate change, protect, and preserve Native American and historical archaeological resources that are threatened by coastal erosion. Protect and preserve significant archaeological resources threatened by proposed ground-disturbing activities or subject to potential artifact looting. Maintain the Monomoy Point Light Station (listed on the NRHP) to meet the historic preservation standards of the Secretary of the Department of the Interior.

Rationale

The Service has a legal responsibility, under Section 106 of the NHPA, 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, including the preservation of structures listed on the NRHP. Considering the topography of the area and its proximity to inter-tidal areas and estuaries, additional archaeological sites may be found in the future. Some archaeological sites probably were located in areas already 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.

We propose to maintain the National Register light station structures in place in perpetuity, which requires annual maintenance and periodic major repairs and refurbishments that may require mechanized or motorized transport and equipment use and access through the Monomoy Wilderness to the worksite.

Strategies

Continue to:

- Comply with Section 106 of the NHPA prior to conducting any ground-disturbing activities on the refuge; compliance may entail any combination of SHPO/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 ARPA 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 a historic site management plan for the Monomoy Point Light Station structures and associated archaeological structures, following NHPA 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.

Within 1 year of CCP implementation:

- Develop a Memorandum of Agreement (MOA) collaboratively with the SHPO and Advisory Council on Historic Preservation that identifies the steps the Service will take to systematically reduce, avoid, or mitigate the adverse effects from natural weathering, erosion, and decay processes on the Monomoy Point Light Station structures and associated archaeological structures.
- Establish a protocol with the Massachusetts Board of Underwater Archaeological Resources for examination and assessment of historic shipwreck remains that may appear.

Within 5 years of CCP implementation:

- Develop a cultural resource management plan for the archaeological sites and historic structures on the refuge that includes periodic monitoring of known archaeological sites.
- In accordance with NHPA Section 110, conduct proactive archaeological surveys to determine the limits and integrity of the Whitewash Village archaeological site group on South Monomoy Island, and assess the conditions of known Native American sites on Morris Island.
- Establish a law enforcement protocol for any unexpected discovery of human remains due to erosion.

Within 10 years of CCP implementation:

- Once interior construction within the building is complete, allow public use during daylight hours of the Monomoy Point Light Station; implement interpretive signs, day, and virtual tours, etc., to support the interest of the public in this nationally significant historic resource.

Monitoring Elements

- Track NHPA Section 106 compliance actions and archaeological surveys conducted prior to proposed ground-disturbing activities.
- Record the number of cultural resource protection violations that are detected or investigated in accordance with the ARPA.
- Monitor erosion damage or threat of erosion to recorded sites and report any newly revealed sites, including historic vessel remains.

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 6.1 (Staffing)

Over the next 15 years, if funding allows, fill seven additional permanent full-time positions and continue to employ seasonal and term biological staff and interns to implement the activities outlined above (see appendix G for proposed staffing chart). Provide a diverse and inclusive workplace through annual training, support, and awareness.

Rationale

Although volunteers are an integral part of making many refuge programs possible, additional staffing is needed to consistently complete the additional workload required to reach the expanded objectives proposed above. Three permanent staff at Monomoy NWR include a refuge manager, a wildlife refuge specialist, and a wildlife biologist. A 2008 national staffing model for the Refuge System indicated that Monomoy NWR, 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 achieve that staffing level, and immediate budgets are not likely to provide the funding needed to fully meet our responsibilities under Federal law to protect wildlife, serve the American public, and maintain our facilities. Nevertheless, with any additional staff increase, we will provide more services and implement more resource actions, depending on the type of position filled.

In 2011, the Service released a Diversity and Inclusion Implementation Plan. It 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 dedicated 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, they are treated with respect and fairness, and they can develop to their full potential.

Strategies

Continue to:

- Recruit and employ seasonal and term biological, visitor services, interns, and volunteers.
- Work with organizations such as the Student Conservation Association (SCA) and the Federal Pathways program to hire talented college students for seasonal 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.

Within 15 years of CCP implementation, if funding allows:

- Fill one Visitor Services Manager position.
- Fill one Visitor Services Specialist.
- Fill one Maintenance Worker/Boat Operator position.
- Fill one Administrative Assistant position.
- Fill two Park Ranger-Law Enforcement positions.
- Fill one Biological Science Technician position.

Monitoring Elements

- Record the number of temporary, term, and permanent staff.
- Record the number of volunteer hours.

Objective 6.2 (Facilities and Maintenance)

Over the next 15 years, ensure that the refuge office, support facilities, and other infrastructure are maintained and sufficient to support staff and volunteers, their programs and activities while sharing a headquarters site co-located with the NWS.

Rationale

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 light 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 fleet 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 Island 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 sport utility vehicle, and a hybrid car.

Adequate, properly functioning facilities are needed to support staff, volunteers, the visiting public, and the co-located NWS upper air sounding operations. Current space is barely able to accommodate current staffing plus co-location of visitor contact station and headquarters staff offices during the peak (April to October) field and visitation seasons. This peak season also coincides with very high seasonal rental rates. The Cape Cod region has very high housing costs, and affordable seasonal rental rates in the outer Cape are in very short supply. Refuge-provided housing is and will remain essential to the refuge's ability to recruit the best-qualified candidates for our positions by offsetting housing costs. Expanding current infrastructure at Morris Island headquarters, such as a second story on the office, or establishing an alternative visitor contact station in the local community, would help alleviate the crowding that will occur with increased staff.

The NWS, an agency within the Department of Commerce's NOAA has been co-located with the refuge at the Morris Island administrative complex since 1971, with this joint tenancy expected to continue at least through the plan period. An MOU guides the dual use of the Morris Island facilities. The current refuge headquarters/visitor contact station building was first constructed and occupied as an administrative office for the Environmental Science Services Administration, forerunner to the NWS. Weather Service personnel launch radiosonde-equipped weather balloons at least twice daily, observing upper atmospheric conditions and entering them into computer forecast models from which daily weather forecast products are derived. Any facility/infrastructure modifications at the Morris Island site will impact these NWS operations.

The refuge administrative and NWS facilities on Morris Island stand atop an east-facing, eroding coastal bluff. While current erosion rates along this bluff are lessened by the barrier against direct ocean wave action provided by Nauset/South Beach, the forecasted geomorphological changes in the Nauset-Monomoy barrier complex caused by sea level rise suggest a return over the longer term to the active and rapid erosion rates of the past. As recently as the mid-1950s, the historic Chatham Coast Guard Station building used as residential quarters and a signal tower stood near the bluff edge with no outer barrier beach, exposed to the full impact of ocean waves. This structure was demolished in 1959, and portions of the foundation and tile drainpipe now rest mid-slope and at the bluff base, a result of subsequent erosion of the bluff. Expected sea level rise and the resulting geomorphological changes (appendix I) point to a progressive westward migration over several decades of what is now Nauset/South Beach across Outermost Harbor and reconnecting to Morris Island. When the westward migration of the protective barrier beach is complete, the Morris Island bluff would once again be exposed to undiminished coastal storm wave energy and rapid rates of erosion. Use of dredge material at the beach would preserve ownership title by the United States and the corridor for visitor use it provides, as previously discussed in chapter 3.

The NWS's white-domed upper air sounding building and current refuge public restroom building (and associated sewage disposal field) stand closest to the edge of the bluff, and would be the first threatened by further bank erosion. This Morris Island property is effectively built out, with little room for facility expansion except vertically. The site presently is operating near or at safe capacity for people and vehicles each June to August, when operational inefficiencies from congestion are already common. Any further reduction in useable space on this small lot without a corresponding reduction in use will create unsafe conditions for visitors and staff, worsen operational inefficiencies, and eventually entirely preclude some critical refuge operations at this site. The potential impact of further erosion of the Morris Island bluff is not a crisis demanding immediate action. However, this planning period is an opportunity for



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Setting nets

the refuge and NWS to explore options deliberately. Formulating and initiating a thoughtful plan of action to relocate some or all of our water-dependent operations and shoreline access points for refuge visitors to another waterfront site in Chatham and surrounding vicinity would avoid a crisis when the options are fewer and solutions costlier.

The remaining historic Monomoy Point Light Station structures present on South Monomoy Island, consisting of a lighthouse, a keeper's house, and former oil shed, serve as a reminder of the important role the remote Monomoy Point outpost played in maritime history. Stabilization and historic restoration of these National Register buildings began in 2010. Funding was insufficient to complete the keeper's house renovations, and a deck, heating system, and interior walls are still to be completed. The intent of the project was to prolong the structures while providing additional functionality, especially considering the expanded public uses that are part of interpretive tours. A renewable, solar electric-powered, radiant heating system that maintains interior temperature and humidity levels during the winter season is expected to significantly increase the current interval of 15 to 20 years between major maintenance events. The repairs initiated in 2010 were necessary to preserve the structural integrity and historical appearance of the wood-frame lightkeeper's house. To further aid structural preservation and increase intervals between major maintenance events, onsite renewable electricity generation is needed to power a radiant heat system for interior climate and humidity control in the lightkeeper's house.

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 NWS through an MOU for use of Service-owned land on Morris Island. Should the NWS at any point decide to relocate their existing operation, the refuge will look into re-utilizing their current buildings and space 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 and South Monomoy Islands, 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 USCG to establish new docks, covered boat storage, and maintenance with secure marine equipment storage and additional parking.
- Work to acquire additional parking and waterfront boat access, either next to our current Stage Island lot, or elsewhere in a convenient location.

Within 5 years of CCP implementation:

- Conduct 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 shoreline armoring and its possible impacts to determine the most cost-efficient option the refuge could implement.
- Increase the number of motor vehicles or boats to accommodate staff increases as needed.
- Explore additional refuge staff housing opportunities within the local commuting area.

Within 10 years of CCP implementation:

- Conduct a cost-benefit analysis to evaluate three options: (1) establishment of a stand-alone visitor contact station that supports refuge visitor services staff; (2) renovation of existing facilities (headquarters/visitor contact station and dormitory/maintenance building) to provide additional office and living space with or without establishing a separate visitor contact station; and (3) acquisition of a new headquarters site and funding to relocate the entire refuge operation, including visitor contact station and shuttle parking. This last will include exploring opportunities to co-locate with existing or future refuge partners.
- If cost effective, establish a visitor contact station in Chatham or Harwich (utilizing existing Service standard designs) that accommodates sufficient parking space, workshop space, meeting room, staff and Friends offices, a welcome area, and parking that supports a shuttle service to Morris Island.
- If a new visitor contact station is established in Chatham or Harwich, convert the existing headquarters/visitor contact station to support only administrative functions, while maintaining the ability to provide information to visitors who come to Morris Island.
- Until a visitor contact station is established off Morris Island, support the Friends of Monomoy in their efforts to establish a storefront in downtown Chatham or Harwich that will also provide refuge information; this building would not support refuge visitor services staff.

Objective 6.3 (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. 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, to achieve a smaller carbon footprint at refuge headquarters. Reduce metered, potable (treated) water consumption at refuge facilities. Refuge facilities will themselves demonstrate renewable “green” energy measures; similar to those a residential homeowner or small business owner might install, and move refuge operations and facilities toward 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 continue to evaluate the possibility of developing alternative energy at the Morris Island visitor contact station and the Monomoy Point Light Station on South Monomoy Island.

The strategies that follow are part of a comprehensive effort to incorporate energy conservation technologies into the design of new and renovated facilities on national wildlife refuges in the Northeast Region of the USFWS, while simultaneously stimulating economic recovery.

Sources of renewable energy at refuge facilities will utilize available natural resources to generate electrical power at those facilities, reducing power consumption from the utility grid. On South Monomoy Island, we propose the installation of solar panels at the Monomoy Point Light Station to restore electrical power for heat, sanitation, water distribution, hot water, and lights without connecting to the utility grid or using fossil fuels. It is the intent of the Service to extend the useful life and reduce maintenance demands of existing refuge island structures. These improvements will provide a remote base of operations for refuge staff, visiting scientists, and volunteers when conducting refuge management and operations and making visitor contacts.

Public water treatment technology needed to ensure public health currently requires high per gallon energy input, and that energy is largely derived from fossil fuel consumption. Not all current refuge water uses (washing/rinsing refuge vehicles, boats, and other equipment) require drinkable/potable water. Collecting and redistributing rainwater can replace a significant proportion of the refuge’s current potable (metered) water consumption and associated fossil fuel consumption without risking human health.

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. As new or replacement vehicles and boat motors are purchased, converting to more fuel efficient technologies such as alternative fuel capable models will reduce fossil fuel consumption and associated atmospheric carbon emissions. Driving or using motorboats less, and walking, bicycling, or paddling more, while accomplishing the refuge purposes, will also reduce fossil fuel consumption.

The use of alternative energy conservation technologies will provide public demonstrations of methods for reducing dependence on nonrenewable energy sources. Established public visitation at the headquarters site also affords a unique opportunity to demonstrate small-scale wind-solar energy systems typical of a residential or small business application while reducing the facility carbon footprint (greenhouse gas emissions) that contribute to global climate change.

Strategies

Continue to:

- Pursue feasibility and seek funding to install a solar photovoltaic system at the Monomoy Point Light Station site.
- 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.

Within 5 years of CCP implementation:

- Use the Climate Leadership in Refuges (CLIR) tool to calculate refuge greenhouse gas emissions, and develop and implement actions to reduce the release of these gases from refuge operations.
- Seek renewable energy project assistance to conduct a feasibility study to determine the technical performance of solar panels at the Monomoy Point Light Station.

Within 10 years of CCP implementation:

- Transition the fleet to use hybrid and electric alternative fuel vehicles and boat motors when feasible to meet the needs of managing the refuge.
- Install an electric car charging station at the Morris Island parking lot.

Within 15 years of CCP implementation:

- Install solar panels at the Monomoy Point Light Station site if technology proves feasible and funding exists.
- Determine feasibility of installing alternative energy technologies at Morris Island headquarters.
- Conduct bird and bat surveys at Morris Island if wind energy seems an efficient and cost-effective alternative.
- If we decide to move forward with alternative energy on Morris Island, conduct the appropriate level of NEPA analysis, documentation, and public involvement warranted by the proposal.
- Reduce metered/potable water consumption by installing rainwater collection and distribution systems at refuge administrative facilities.

Monitoring Elements

- Calculate the amount of electricity generated onsite through alternative energy 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 the total annual atmospheric carbon footprint for all refuge facilities and operations.
- Submit an annual Environmental Management System management review report that calculates green actions taken during the year, including the amount of waste that is recycled.

General Refuge Management Direction

We primarily developed our management direction hierarchically, from goals to objectives to strategies. However, we also found that some important actions either relate to multiple goals or represent general administrative or compliance activities. Thus, below we list actions that may be 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. We present them below.

Conducting Resource Management and Public Use Activities Consistent with Wilderness Principles

We will manage the existing Monomoy Wilderness to simultaneously secure an enduring resource of wilderness and accomplish refuge purposes in a way that preserves wilderness character. 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 portion of Nauset/South Beach lying west of the agreed upon management boundary identified in the June 2015 MOU between the Service and the Town (appendix L).

The 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 Wilderness Stewardship Policy). The Service is responsible for ensuring that the Monomoy Wilderness: firstly, retains its primeval character and influence, without the 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 purpose of the refuge, including Wilderness Act purposes. Please refer to appendix E; part II includes the complete list of MRAs for the Monomoy Wilderness.

Adaptive Management

We 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.

This 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 will 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, 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.

Baseline data collection on wildlife populations and habitats will be implemented where necessary. These data will update the often limited, existing records of wildlife species using the refuges, their habitat requirements, and seasonal use patterns. This data will also be used in evaluating the effects of visitor use and habitat management programs on wildlife populations. Refuge habitat management programs will 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 will 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 this final CCP may warrant additional NEPA analysis and public comment.

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, measureable 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 NALCC in which Monomoy NWR is located, include the American oystercatcher, common tern, horseshoe crab, piping plover, red knot, saltmarsh sparrow, and semipalmated sandpiper.

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, EEE or 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 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 Island has grown larger and nesting birds are being recruited from several neighboring colonies, the potential for disease transmission has increased. Incidence of salmonellosis has 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 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 USDA Animal and Plant Health Inspection Service (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. We will continue to opportunistically monitor for and report seabird mortality events on refuge

Common eider



Bill Thompson

beaches. We will 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 will be minimal, and the occurrence of any wildlife or habitat disease element will be responded to only if it posed an immediate or serious threat to indigenous wildlife and habitat. The Service will 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 3, we have allowed many research projects that meet these criteria. 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. SUPs, and when necessary an MRA, will 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 non-native invasive species.

Integrated Pest Management

In controlling pests, whether non-native 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 Habitat Management Plan (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, will be approved for use on the refuge when there likely will 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 will 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 EO, 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. 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 NPS (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.
- (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 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-20th 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).

We are 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.

We will continue to strive to understand how climate change might be affecting Monomoy NWR 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 (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 NWR. The information yielded from baseline surveys, assessments, and monitoring efforts will be used to develop specific adaptive and mitigation strategies to minimize the impacts of a changing climate on refuge resources. It will be important to coordinate with the State’s climate change strategies as they are further refined. The establishment of the NALCC will also facilitate the exchange of information and coordination among agencies in the region to implement climate change strategies.

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 will directly impact the refuge, we know that these factors will continue to increase relative to 20th century trends (CCSP 2008b, appendix I). Sea level rise alone will 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 2009a). At Monomoy NWR, sea level rise will likely impact piping plovers, roseate terns and other beach nesting species, such as American oystercatcher and least tern.

Our increasing awareness of sea level rise as well as the information included in the Provincetown Center geomorphological study (appendix I) led us to consider the possible role of dredge material use at Monomoy NWR. When the Town and the USACE began discussing the possible dredging of the Morris Island

channel several years ago, we raised the possibility of using dredge material to restore or enhance endangered species habitat. We are open to accepting dredge material on the refuge when it is consistent with our purposes. We will evaluate the potential to elevate areas outside of the Monomoy Wilderness that are most at risk from inundation due to sea level rise, for the purpose of restoring and/or providing habitat for endangered species (roseate terns and piping plovers in particular) and other species of special concern (American oystercatchers and least terns). The deposition will occur in non-wilderness (primarily subtidal) areas within the Declaration of Taking to create additional nesting habitat above the storm surge tide line. Shoreline monitoring will allow us to pinpoint areas of deposition and erosion and possible appropriate locations for depositing dredge material. In particular, we are interested in exploring the use of dredge material on Minimoy Island, on the flats adjacent and west of Minimoy Island, and along the beach on Morris Island.

Should we determine that the use of dredge material is feasible, we will conduct a separate NEPA analysis before making a decision. We will also 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 as well as the benefit to focal species of habitat created on the refuge using dredge material.

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. Only with this type of assistance can the refuge achieve its goals and objectives, support the missions of the 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. We will maintain the existing partnerships identified in chapter 3 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

The management direction outlined in this plan does 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 3 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 we describe below pertain to staffing, administration, and operations. Implementing them supports all our refuge goals.

Permanent Staffing and Operational Budgets

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 CCP. We have 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 (LWCF) and the Migratory Bird Conservation Fund (MBCF). 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 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 will 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.

Within the constraints or opportunities of our budget and in conformance with future workforce plans, we will fill any currently approved but vacant positions that we believe are necessary to accomplish our highest priority projects. We 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 H. Appendix G identifies the proposed staffing to fully implement this plan.

Facilities Construction and Maintenance

We will conduct 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 3. They include refuge headquarters/visitor contact station, the dormitory and maintenance buildings, and the Monomoy Point Light Station, the headquarters parking lot, the Stage Island parking area, the 3/4-mile Morris Island Trail, signs, stairs, overlooks, and moorings. Any new facilities recommended in this CCP, once constructed, will be placed on the maintenance schedule. All maintenance and upgrades of facilities will 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 will 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

Monomoy NWR will remain open for visitation from ½ hour before sunrise to ½ hour after sunset, 7 days a week, to insure visitor safety and protect refuge resources. Surf fishing will continue to be allowed 24 hours per day on Morris Island. The refuge manager may issue SUPs 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.

Access or Right-of-Way

The refuge will use and maintain its existing right-of-ways 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 Quitneset homeowners association to improve the potentially confusing signs at the Quitneset 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 by adjoining landowners under a 1998 permit. 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 5 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 possible actions that will protect and restore the beach habitat.

Boundary Issues/Overlapping Jurisdiction

As described in chapter 3, the gradual southward migration and ultimate connection of South Beach (the southerly portion of the NPS Cape Cod National 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 then again in 2014, and could break at other locations as well. It is also possible there could be a reconnection of these landforms in the future. The NPS jurisdiction extends 1/4-mile offshore, and in the area where the Cape Cod National Seashore's jurisdiction might overlap with refuge land above MLW, we have reached agreement with the NPS that the more restrictive rule of either agency will prevail.

The geomorphological changes from gradual erosion and accretion of sand sediments along Nauset/South Beach/South Monomoy Island landforms have considerably complicated the property ownership boundaries as discussed in chapters 1 and 3, and appendix K. Map 1.1 displays the eastern agreed to in the June 2015 MOU between the Service and the Town, pending settlement of the complex legal boundary and ownership questions. The eastern boundary is

ambulatory (moving), set at MLW, that will continue changing location through these same geomorphological processes throughout the 15-year plan period. The fixed western boundary of the refuge is the Declaration of Taking line (map 1.1).

Distributing Refuge Revenue Sharing Payments

As we describe in chapter 3, we pay the Town 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. We 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.

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 associated level of funding and staffing to complete them. We will also develop a habitat management plan, an annual habitat work plan and an inventory and monitoring plan as the highest priority step-down plans. 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.

The following plans 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 2016. Please see appendix F for general fire program direction.

- Safety Plan, updated annually; last updated in 2015
- Continuity of Operations Plan (Complex), updated in 2015
- Emergency Action Plan, updated annually; last updated in 2015
- Hurricane Action Plan, updated annually; last updated in 2015
- Spill Prevention and Countermeasure Plan (Complex), completed in 2005; updated in 2012
- Avian Influenza Surveillance and Contingency Plan, completed in 2007

Step-down plans scheduled for completion include:

- Habitat Management Plan, within 2 years of CCP approval (see discussion below)
- Annual Habitat Work Plan, annually after HMP approval (see discussion below)
- Inventory and Monitoring Plan, within 2 years of CCP approval (see discussion below)
- 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
- Cultural Resources Management Plan, within 7 years of CCP approval

Habitat Management Plan

The 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. 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.

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. An IMP is vital for measuring our success in meeting objectives. 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.

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.

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 10 standards and 4 optional standards that are used to judge and plan visitor services 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 3 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.

Protecting Cultural Resources

Under the NHPA, 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. We will comply with Section 106 of the NHPA by considering potential adverse effects. Compliance may require any or all of the following: review of SHPO records, consultation with Native American Tribal Historic Preservation offices, literature survey, or field survey.

In addition, in compliance with Section 110 of the NHPA, 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. 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 already 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. On Monomoy Island, we are using 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.

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

We will continue to explore options 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. This could include solar, wind or geothermal energy. We propose to investigate the possibility of developing alternative energy options to provide additional clean energy at the Monomoy headquarters. We will continue bird and bat surveys to help us determine the presence of species that could potentially be impacted by wind development.

We have made no decision to further develop these sources at this time, and believe improvements in all these technologies must occur before we dedicate staff resources to this effort. We will want to ensure the efficiency and the cost-effectiveness of whatever alternative energy technologies we might employ. This evaluation could take up to 15 years to complete. Once we establish a proposed action, we will conduct the appropriate level of NEPA analysis, documentation, and public involvement that is warranted by the proposal.

Solar panels, wind turbine generator, geothermal or other energy conservation technologies will provide public demonstrations of methods for reducing dependence on non-renewable energy sources.

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

The Refuge 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 findings of appropriateness and compatibility determinations. Most Monomoy NWR 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 contains the signed findings of appropriateness and compatibility determinations to identify and explain the decisions about which public uses the refuge is open for and those for which the refuge is closed.

Activities Allowed (Uses the Refuge is Officially Opened to)

The refuge manager has 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—but will initiate additional NEPA analysis, planning and public outreach that could establish a waterfowl hunt program on the refuge.

Wildlife observation, photography, environmental education, and interpretation, fin fishing, and hand harvest of subterranean shellfish, such as softshell clams, quahogs, razor clams and sea (surf) clams from intertidal areas have all been found to be compatible uses of the Monomoy NWR. Commercial tours, ferry service, guided trips and outfitting, boat launching and landing, virtual geocaching and letterboxing, some commercial wildlife photography, beachcombing, hiking and walking, dog walking seasonally on Morris Island,

research, sunbathing and swimming, and mosquito monitoring and management have also been found appropriate and compatible.

At this time, there is no compelling Service interest necessitating further regulation of fishing in open waters and submerged lands below MLW within the Declaration of Taking. Included fishing activities are: demersal long line fishing; mid-water trawl fishing, hook and line/rod and reel fishing; weir/fish traps, lobster, crab, and whelk pot fishing; scalloping, and mechanical harvest of quahogs and sea (surf) clams. These activities do not disturb the submerged lands when conducted in compliance with the existing regulations imposed by other Federal and State agencies (e.g., the NMFS, the MA DMF and/or the Town.) We do not believe that the purposes of the Endangered Species Act, the Migratory Bird Treaty Act, or the Refuge System Improvement Act of 1997 are compromised by these fisheries in the waters within the refuge boundary. Also at this time, they do not conflict with refuge wildlife management objectives. We will seek an annual meeting with the Town and MA DMF to ensure that they understand issues and opportunities associated with the management of wildlife resources on Monomoy NWR and that we understand changes in fisheries management, including harvest and techniques.

The refuge will 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 Refuge System are closed to public access until and unless we open the area for a use or uses in accordance with the Administration Act of 1966 (16 U.S.C. § 668dd-668ee) and the Refuge Recreation Act of 1962 (16 U.S.C. § 460k-460k-4). The refuge will remain closed to all forms of hunting except possibly waterfowl hunting, as 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.

*Monomoy lighthouse
at a distance*



Yianni Laskaris/USFWS

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, it can be denied without determining its compatibility. In 2002, we found horseshoe crab harvesting to be not compatible, and it has not been allowed since. In appendix D we identify 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); mussel harvesting; camping; fires; fireworks; bicycling; beach use activities such as beach sports, kite flying, grilling, and use of shade tents; organized picnicking; kiteboarding, OSV, and motorized personal watercraft (e.g., wave runner and jet skis) in refuge waters within the Declaration of Taking boundary. We will end dinghy storage on both Morris and Stage Islands and parking in Stage Island Lot 7b. 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 necessarily eliminate the opportunity.

Waterfowl Hunting

Monomoy NWR has never been officially opened for waterfowl hunting by regulation, individual permit, or public notice as required by law. We propose to open 40 percent of the open waters on the refuge to sea duck hunting in compliance with the Migratory Bird Conservation Act of 1929, which was the establishing authority for the refuge, and in accordance with Federal, State, and local hunting regulations. See map 4.1. Retrieving dogs will be allowed for waterfowl hunting. A hunt plan will be drafted as part of the opening package that will include a public comment period.

Special Use Permits

The refuge manager will evaluate activities that require a SUP for their appropriateness and compatibility on a case-by-case basis. We will continue to only approve permit requests that are both appropriate and compatible, with the preference 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.

Mosquito Management

Mosquito control through larvicide has been allowed for many years on Morris Island, but not on North Monomoy Island or South Monomoy Island. The 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 SUP to control salt marsh mosquitoes has been issued annually since at least 1983 (2003 CD 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 WNV and EEE. Recent monitoring (CO₂ 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 SUPs 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.

Proposed Land Acquisition The Service has a need for additional property to provide for staff, seasonal intern and volunteer housing, and for 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, transfer, or fee acquisition. Funding for land acquisition could come from the LWCF and the MBCC under the Migratory Bird Conservation Act.

New Visitor Contact Facility We will 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 will 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.

We propose 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. There could also be a small expansion of the current infrastructure at Morris Island (such as a second story on the office) to meet refuge needs. Offsite shuttle parking could be acquired, and we will 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.

Additional NEPA Analysis For all major Federal actions, NEPA requires site-specific analysis and disclosure of expected impacts, either in a categorical exclusion, EA, or EIS. NEPA provides for categorically excluding other routine activities from that requirement. The draft and final CCP/EIS's that preceded this CCP described alternatives in enough detail to comply with NEPA, and additional environmental analysis is not required for most of our actions. 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 renovating 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 will be required if we were to implement a significant public action or construction project not considered in detail in this document. The following actions will require further NEPA analysis before a final decision is made to undertake them:

- Opening the refuge to waterfowl 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.
- Use of dredge material for habitat restoration to benefit migratory birds.