U.S. Fish & Wildlife Service

Monomoy National Wildlife Refuge

Draft Comprehensive Conservation Plan and Environmental Impact Statement

Volume 1—Chapters 1 through 6

including Bibliography, Acronyms, and Glossary

April 2014

Front cover:
Monomoy Lighthouse at sunset
Ravin Thomasson

This blue goose, designed by J.N. "Ding" Darling, has become the symbol of the National Wildlife Refuge System.

The U.S. Fish and Wildlife Service (Service) is the principal Federal agency responsible for conserving, protecting, and enhancing fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The Service manages the National Wildlife Refuge System comprised of over 150 million acres including over 560 national wildlife refuges and thousands of waterfowl production areas. The Service also operates 70 national fish hatcheries and over 80 ecological services field stations. The agency enforces Federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign governments with their conservation efforts. It also oversees the Federal Assistance Program which distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state wildlife agencies.

Comprehensive Conservation Plans (CCPs) provide long-term guidance for management decisions on a refuge and set forth goals, objectives, and strategies needed to accomplish refuge purposes. CCPs also identify the Service's best estimate of future needs. These plans detail program levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. CCPs do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

U.S. Fish & Wildlife Service

Monomoy National Wildlife Refuge

Draft Comprehensive Conservation Plan and Environmental Impact Statement

April 2014

Draft Vision Statement

Extending from the elbow of Cape Cod, Monomoy National Wildlife Refuge consists of an assembly of barrier beaches that includes some of New England's last remaining wild seacoast. This dynamic, wilderness system of ocean, intertidal flats, salt and freshwater marshes, dunes and freshwater ponds, provides vital habitat for a vast array of diverse species. Monomoy NWR is world-renowned for its range of seasonal wildlife inhabitants. Seabirds, waterfowl, shorebirds, wading birds, land birds, horseshoe crabs, and seals rely upon the refuge for survival during various times of the year. Given the vital role that these lands and waters play in the survival of so many endangered, threatened, and special species, wildlife conservation and management will always be our first priority at Monomoy NWR.

The unique area that is Cape Cod allows us to reach large numbers of visitors from all over the world. Visitors will learn about the rich history of the refuge, experience unique recreational opportunities, view wildlife in a natural setting, and learn about the positive and negative impacts of human interactions with the refuge. Visitors will understand and appreciate how we manage the refuge, its habitats, and wildlife species. We will ensure that the number of visitors on the refuge is appropriate so as not to detract from a rich wilderness and wildlife experience.

As a regional and national role model, the refuge will provide scientific and technical leadership for wildlife and resource management that is adaptable to changing conditions. Talented, knowledgeable staff will continue to develop and foster partnerships with local, regional, national, and international organizations to assist in the management of Monomoy NWR and inform the conservation community of the work that we do. Monomoy NWR will continue to play a crucial role in the National Wildlife Refuge System by protecting this critical nesting, feeding, and resting area for migratory birds along the Atlantic Coast.

U.S. Fish & Wildlife Service

Monomoy National Wildlife Refuge

Draft Comprehensive Conservation Plan and Environmental Impact Statement

April 2014

Summary

Type of Action: Administrative—Development of a Comprehensive Conservation Plan

Lead Agency: U.S. Department of the Interior, Fish and Wildlife Service

Location: Monomoy National Wildlife Refuge
Chatham, Massachusetts

Administrative Headquarters: Eastern Massachusetts National Wildlife Refuge Complex
Sudbury, Massachusetts

Responsible Official: Wendi Weber, Regional Director, Region 5

For Further Information:
Carl Melberg, Natural Resource Planner
Eastern Massachusetts National Wildlife Refuge Complex
73 Weir Hill Road
Sudbury, Massachusetts 01776
Phone: 978/443 4661 ext. 32
Email: *northeastplanning@fws.gov*

This draft comprehensive conservation plan (CCP) and environmental impact statement (EIS) analyzes three alternatives for managing the 8,321-acre Monomoy National Wildlife Refuge (NWR, refuge) over the next 15 years. This document also contains 10 appendixes that provide additional information supporting our analyses. Following is a brief overview of each alternative:

Alternative A: Current Management—Alternative A satisfies the National Environmental Policy Act requirement of a "no-action" alternative, which we define as "continuing current management." It describes our existing management priorities and activities for Monomoy NWR, and serves as a baseline for comparing and contrasting alternatives B and C.

Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred Alternative)—Alternative B represents an extension and progression of all areas of refuge management. Under alternative B, new biological program activities would be initiated. Special emphasis would be placed on obtaining baseline data of wildlife populations and habitat conditions, or filling in information gaps as needed. The new information would be used to develop the detailed step-down plans proposed under this CCP. Wildlife population and habitat monitoring surveys and inventories would be continued on an on-going basis to provide the data needed to evaluate the effectiveness of refuge programs and practices, and to adapt management as warranted to achieve long-range refuge goals and objectives.

Under alternative B, new compatible wildlife-dependent recreational opportunities would be provided consistent with wilderness designation. Special emphasis would be placed on providing enhanced, but sustainable, opportunities for all six priority wildlife-dependent recreational uses defined in the Administration Act. Staffing would be modestly increased to accommodate new programs and activities, and proposed new visitor contact facilities would provide better access to information and support quality educational and interpretive programs.

Alternative C: Natural Processes—Alternative C proposes less intensive management on all refuge lands. It would be guided by a philosophy of allowing natural processes and succession of habitats to progress, consistent with preserving wilderness character, and to the extent that it does not compromise refuge purposes and goals. Generally, wildlife and habitat management, and inventories and monitoring efforts, would be reduced from those planned under alternative A. We would manage the refuge visitor services program with an emphasis on providing opportunities for wildlife-dependent recreation that uses primitive tools and non-motorized equipment, provides solitude, and increases emphasis on non-motorized access to the Monomoy Wilderness Area.

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Chapter 1

USFWS

Monomoy Lighthouse

The Purpose of, and Need for, Action

- Introduction
- The Purpose of, and Need for, Action
- The Service and the Refuge System: Policies and Mandates Guiding Planning
- Conservation Plans and Initiatives Guiding Our Planning
- Refuge Establishment Purposes and its Land Acquisition History
- Refuge Administration
- Refuge Operational Plans ("Step-down" Plans)
- Complex and Refuge Vision Statements
- Refuge Goals
- The Comprehensive Conservation Planning Process
- Wilderness Review
- Issues, Concerns, and Other Opportunities

Introduction

Monomoy National Wildlife Refuge (Monomoy NWR, refuge) stretches for 8 miles off the elbow of Cape Cod in the Town of Chatham, Barnstable County, Massachusetts. The refuge was established in 1944 as a sanctuary for birds with an emphasis on threatened, endangered, and migratory birds. This 8,321-acre refuge includes South Monomoy, North Monomoy Island, Minimoy Island, 40 acres on Morris Island where the headquarters and visitor contact station are located (map 1.1 and map 1.2), and all waters within the Declaration of Taking. Nearly half (47 percent) the refuge, including most of refuge land above the mean low water (MLW) mark, is designated as a wilderness area, currently the only wilderness area in southern New England (map 1.3). The refuge is also designated as a Western Hemisphere Shorebird Reserve Network Regional (WHSRN) site, an Important Bird Area (IBA), and a Marine Protected Area (MPA). The decommissioned Monomoy Point Lighthouse and keeper's house on South Monomoy are listed on the National Register of Historic Places.

The refuge boundary includes those areas above the mean low water line on the eastern boundary and all lands and waters to the Declaration of Taking on the western boundary (map 1.1). However, years of accretion on the eastern shoreline of South Monomoy, where Nauset/South Beach eventually connected in 2006 and where a breach subsequently occurred in 2013 after frequent overwashing, has altered the eastern boundary of the refuge. We describe the new eastern refuge boundary of the refuge in chapter 2.

Monomoy NWR is one of eight refuges that make up the Eastern Massachusetts NWR Complex, which is headquartered in Sudbury, Massachusetts (map 1.4). The barrier islands are part of a dynamic coastal zone, characterized by an ever-changing landscape. Salt and freshwater marshes, dunes, and ponds provide nesting, resting, and feeding habitat for migratory birds.

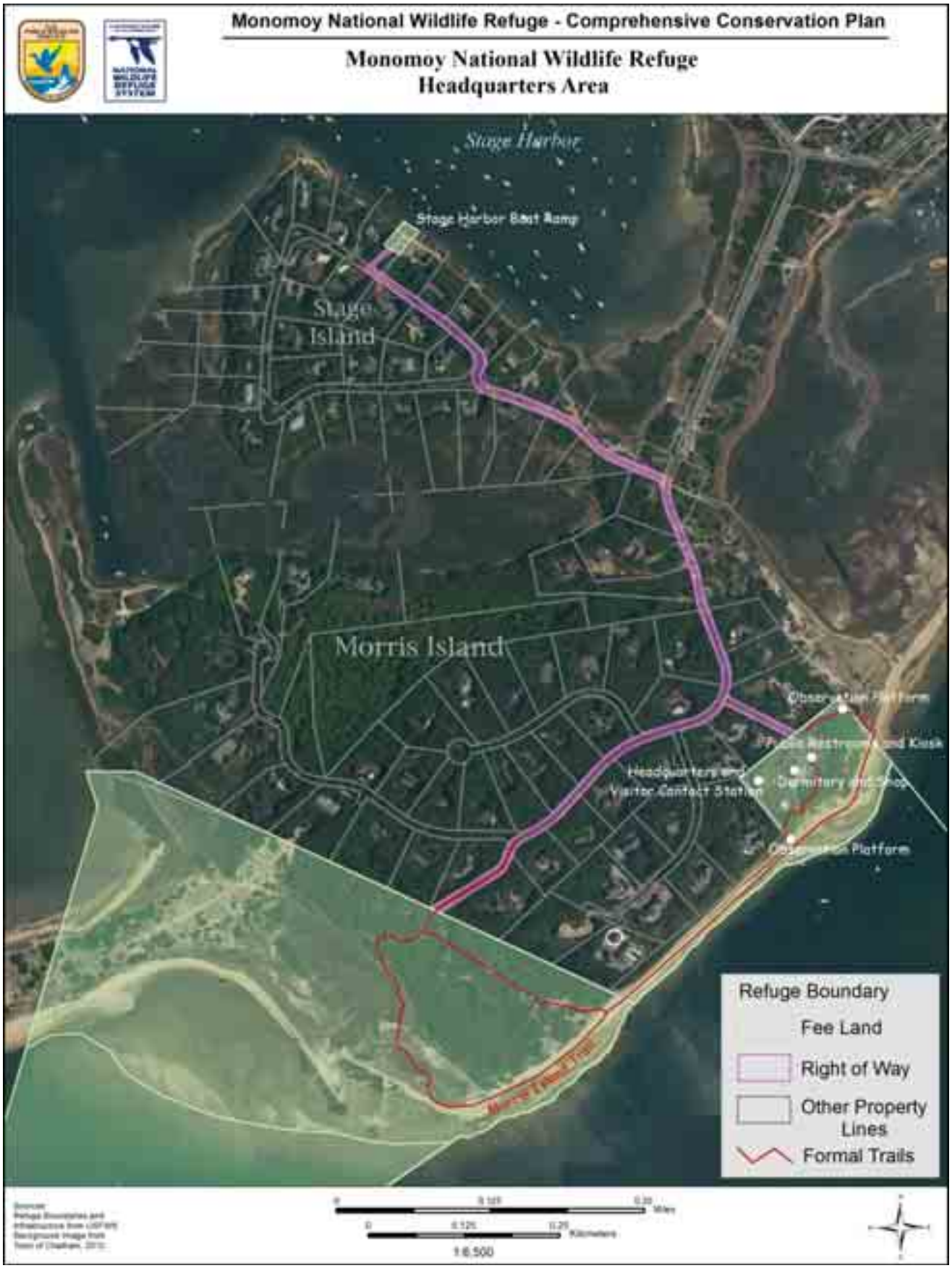
This draft Comprehensive Conservation Plan (CCP) and Environmental Impact Statement (EIS) for Monomoy NWR combines two documents required by Federal law:

- A draft CCP, required by the National Wildlife Refuge System Administration Act of 1996 (16 U.S.C. § 668dd-668ee; Administration Act), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law (PL) 105-57; 111 Stat. 1253; Improvement Act).

- An EIS, required by the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. § 4321 et seq.; 83 Stat. 852), as amended.

Following public review of this draft CCP/EIS, our Regional Director will select an alternative based on the Service and Refuge System missions, the purposes for which the refuge was established, other legal mandates, and public and partner responses to this draft CCP/EIS. The alternative selected could be the preferred alternative presented in this draft CCP/EIS, the no action alternative, or a combination of actions or alternatives. The final decision will identify the desired combination of species protection, habitat management, public use and access, and administration for the refuge. The final CCP will guide refuge management decisions over the next 15 years. We will also use it to promote understanding and support for refuge management among Massachusetts State agencies, our conservation partners, local communities, and the public.

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Monomoy National Wildlife Refuge
Maine
New Hampshire
Massachusetts
Map Location
Refuge Headquarters
Lake Harbor
Morris Island
Cape Cod National Seashore
Approximate size and location of break in Nauset/South Beach February, 2013
North Monomoy Island
Chase Garzas
Minomoy Island
Baselines for Equitable Apportionment will change as coastal processes alter the former "Southway"
Refuge Boundary
South Monomoy Island
Monomoy Lighthouse
Monomoy Boundary (fee)
Monomoy Boundary (easement)
Cape Cod NS
Note: The refuge's eastern boundary extends to the mean low water line, which changes as a result of dynamic, coastal processes. The depiction here is an approximation based on this 2012 photography. The remainder of the refuge boundary is fixed.
Miles
Kilometers
1:70,000


Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Monomoy National Wildlife Refuge
Headquarters Area
Stage Harbor
Stage Harbor Boat Ramp
Stage Island
Morris Island
Headquarters and Visitor Contact Station
Refuge Boundary
Fee Land
Right of Way
Other Property Lines
Formal Trails
1:6,500

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Monomoy National Wildlife Refuge
Morris Island
North Monomoy Island
South Beach
Refuge Boundary
South Monomoy Island
Monomoy Lighthouse
Monomoy NWR Boundary
Easement
Fee
Wilderness Boundary
Maine
New Hampshire
Massachusetts
Map Location
Note: The refuge's eastern boundary extends to the mean low water line, which changes as a result of dynamic, coastal processes. The depiction here is an approximation based on this 2012 photography. The remainder of the refuge boundary is fixed. Other than in the exceptions, the Monomoy Wilderness extends to the mean low water line along its entire boundary.
1:70,000

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Eastern Massachusetts National Wildlife Refuge Complex
Maine
New Hampshire
Massachusetts
Map Location
Lawrence
Lowell
Rockport
Gloucester
Danvers
Billerica
Bedford
Marblehead
Concord
Maynard
Great Meadows NWR
Revere
Massachusetts Bay
Boston
Sudbury
Natick
Atlantic Ocean
Braintree
Brockton
Mansfield
Provincetown
Plymouth
Taunton
Massasoit NWR
Pawtucket
Providence
Cape Cod Bay
Sagamore
Sandwich
Orleans
Brewster
Bourne
Fall River
Chatham
Centerville
Hyannis
Harwich Port
Falmouth
Woods Hole
Mashpee NWR
Monomoy NWR
Buzzards Bay
Newport
Vineyard Haven
Nantucket Sound
Edgartown
Nantucket NWR
Martha's Vineyard
Nantucket
Nantucket Island
Nomans Land Island NWR
Miles
Kilometers
1:850,000

This draft CCP/EIS has 6 chapters and 10 appendixes. The first chapter sets the stage for the subsequent chapters. Specifically, Chapter 1, Purpose of, and Need for, Action:

- Explains the purpose of and need for a CCP/EIS for the refuge.
- Defines our planning analysis area.
- Presents the Service mission, policies, and mandates affecting the development of the plan.
- Identifies other conservation plans and initiatives we used as references.
- Lists the purposes for which the refuge was established and its land acquisition history.
- Clarifies the vision and goals that drive refuge management.
- Describes refuge operational (or "step-down") plans.
- Describes our planning process and its compliance with NEPA regulations.
- Identifies public issues or concerns that surfaced during plan development.

Chapter 2, Affected Environment, describes the physical, biological, cultural, and socioeconomic environments of the refuge.

Northern flicker

Dave Menke

Chapter 3, Alternatives Considered, Including the Service-preferred Alternative, describes and evaluates three management alternatives, each with different strategies for meeting refuge goals and objectives and addressing agency, partner, and public issues. It also describes the activities that we expect to occur regardless of the alternatives selected for the final CCP. The range of alternatives includes continuing our present management of the refuge, enhanced management of habitat and wildlife with new visitor use opportunities, and less frequent and intensive management with a focus on natural processes and wilderness stewardship.

Chapter 4, Environmental Consequences, evaluates the effects on the environment from implementing each of the three management alternatives. It predicts the foreseeable benefits and consequences affecting the physical, biological, cultural, and socioeconomic environments described in chapter 2.

Chapter 5, Consultation and Coordination with Others, summarizes how the Service involved the public and its partners in the planning process; their involvement is vital for the future management of this refuge and all national wildlife refuges.

Chapter 6, List of Preparers, credits Service and non-Service contributors to the draft CCP/EIS.

Ten appendixes, a glossary with acronyms, and a list of references provide additional documentation to support the developed narratives and analysis in the plan.

The Purpose of, and Need for, Action

We propose to develop a CCP for the refuge that, in the Service's best professional judgment, best achieves the purposes, goals, and vision of the refuge and contributes to the National Wildlife Refuge System's mission, adheres to the Service's policies and other mandates, addresses identified issues of significance, and incorporates sound principles of fish and wildlife science.

As NEPA requires, this draft CCP/EIS evaluates a reasonable range of management alternatives and describes their foreseeable impacts on the socioeconomic, physical, cultural, and biological environments in the project area. We designed each alternative with the potential to be fully developed into a final CCP.

The *need* for a CCP is manifold. First, the Refuge Improvement Act requires us to write a CCP for every national wildlife refuge to help fulfill the mission of the Refuge System. New policies to implement the strategic direction in the Improvement Act have developed since the refuge was established. The *purpose* of this CCP is to provide strategic management direction for the next 15 years by:

- Providing a clear statement of desired future conditions for habitat, wildlife, visitor services, staffing, and facilities.
- Providing state agencies, refuge neighbors, visitors, and partners with a clear understanding for the reasons for management actions.
- Ensuring refuge management reflects the policies and goals of the Refuge System and legal mandates.
- Ensuring the compatibility of current and future public use.
- Providing long-term continuity and direction for refuge management.
- Providing direction for staffing, operations, maintenance, and annual budget requests.

Second, Monomoy NWR has an environmental assessment/master plan (USFWS 1988) that is more than 25 years old and lacks an updated plan to formally establish and ensure strategic management of the refuge. The refuge's 1978 wilderness plan is also outdated. Furthermore, the refuge environment continues to change. For example, erosion has shifted the refuge boundary line; the economy has changed; pressures for public access have continued to grow; and new ecosystem and species conservation plans bearing directly on refuge management have been developed.

Third, the refuge has developed strong partnerships vital for its continued success, and the vision for the refuge must be conveyed to those partners and the public. A vision statement, goals, objectives and management strategies are all necessary for successful refuge management. The CCP planning process incorporates input from the natural resource agencies of Massachusetts, affected communities, individuals and organizations, our partners and the public. Public and partner involvement throughout the planning process also helps us resolve various management issues and public concerns.

These reasons underscore the need for the strategic direction a CCP provides. At its completion, the CCP will be reviewed, evaluated, and subsequently updated at least every 15 years in accordance with the Service and Refuge System policies.

The Service and the Refuge System: Policies and Mandates Guiding Planning

The U.S. Fish and Wildlife Service and its Mission

The U.S. Fish and Wildlife Service administers the National Wildlife Refuge System (Refuge System). The Service is a division of the U.S. Department of the Interior. The Service's mission is as follows:

"Working with others, to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."

Congress entrusts natural resources to the Service for conservation and protection. These include migratory birds, federally listed endangered or threatened species, interjurisdictional fish, wetlands, certain marine mammals, and national wildlife refuges. The Service also enforces Federal wildlife laws and international treaties on importing and exporting wildlife, assists states with their fish and wildlife programs, and helps other countries develop conservation programs.

The Service Manual, available online at: *http://www.fws.gov/policy/manuals* (USFWS 2011a; accessed December 2011) contains the standing and continuing directives on implementing our authorities, responsibilities, and activities. The 600 series of the Service Manual addresses land use management and sections 601 to 610 specifically address management of national wildlife refuges and wilderness. We publish special directives that affect the rights of citizens or the authorities of other agencies separately in the Code of Federal Regulations (CFR). Most of the current regulations that pertain to the Service are issued in 50 CFR parts 1 to 99; available online at: *http://www.gpoaccess.gov/cfr/index.html*.

The National Wildlife Refuge System and its Mission and Policies

The Refuge System is the world's largest collection of lands and waters set aside specifically for the conservation of wildlife and the protection of ecosystems. The Refuge System began in 1903 when President Theodore Roosevelt designated Pelican Island, a pelican and heron rookery in Florida, as a bird sanctuary. Today, 561 refuges are part of the National Wildlife Refuge System. They encompass more than 150 million acres of lands and waters in all 50 states and several island territories. Each year, nearly 41 million visitors hunt, fish, observe and photograph wildlife, or participate in environmental education and interpretive activities on refuges across the nation.

In 1997, President William Clinton signed into law the National Wildlife Refuge System Improvement Act (Public Law 105-57). This act establishes a unifying mission for the Refuge System and a new process for determining the compatibility of public uses on refuges, and requires us to prepare refuge Comprehensive Conservation Plans. The mission of the Refuge System is:

"To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." —Improvement Act

The Refuge System Manual provides a central reference for current policy governing the operation and management of the Refuge System that the Service Manual does not cover, including technical information on implementing refuge policies and guidelines on enforcing laws. This manual can be reviewed at refuge headquarters.

The pertinent policies from the Service Manual are summarized in the following paragraphs.

Policy on the National Wildlife Refuge System Mission, Goals, and Purposes

This policy (601 FW 1) sets forth the Refuge System mission noted above, how it relates to the Service mission, and explains the relationship of the Refuge System mission and goals, and the purpose(s) of each unit in the Refuge System. In addition, it identifies the following Refuge System goals:

- Conserve a diversity of fish, wildlife, and plants.
- Develop and maintain a network of habitats.
- Conserve those ecosystems, plant communities, and wetlands that are unique within the United States.
- Provide and enhance opportunities to participate in compatible, wildlife-dependent recreation.
- Help to foster public understanding and appreciation of the diversity of fish, wildlife, and plants and their habitats.

This policy also establishes management priorities for the refuge system:

- Conserve fish, wildlife, and plants and their habitats.
- Facilitate compatible wildlife-dependent recreational uses.
- Consider other appropriate and compatible uses.

Policy on Refuge System Planning

This policy (602 FW 1, 2, 3) establishes the requirements and guidance for refuge system planning, including CCPs and step-down management plans. It states that all refuges will be managed in accordance with an approved CCP that, when implemented, will help:

- Achieve refuge purposes.
- Fulfill the Refuge System mission.
- Maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System.
- Achieve the goals of the National Wilderness Preservation System and the National Wild and Scenic Rivers System.
- Conform to other applicable laws, mandates, and policies.

This planning policy provides step-by-step directions and identifies the minimum requirements for developing all CCPs, including reviewing any existing special designation areas such as wilderness and wild and scenic rivers, specifically addressing the potential for any new special designations, conducting a wilderness review, and incorporating a summary of that review into each CCP (602 FW 3).

Policy on Appropriate Refuge Uses

Federal law and Service policy provide the direction and planning framework for protecting the Refuge System from inappropriate, incompatible, or harmful human activities and ensuring that visitors can enjoy its lands and waters. This policy (603 FW 1) provides a national framework for determining appropriate refuge uses in an effort to prevent or eliminate those uses that should not

occur in the Refuge System. It describes the initial decision process the refuge manager follows when considering whether or not to allow a proposed use on a refuge. An appropriate use must meet at least one of the following four conditions:

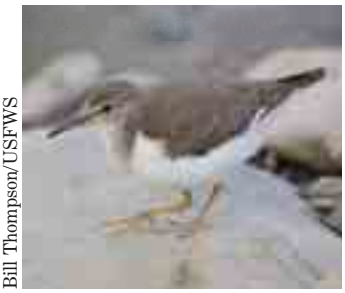
(1) The use is a wildlife-dependent recreational use as identified in the Improvement Act.

(2) The use contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997.

(3) The use involves the taking of fish or wildlife under state regulations.

(4) The use has been found to be appropriate after concluding a specified findings process using 10 specific criteria included in the policy.

You may view this policy on the Web site: *http://www.fws.gov/policy/603fw1.html* (accessed July 2011).



Bill Thompson/USFWS

Spotted Sandpiper

This policy (603 FW 2) complements the appropriate use policy. The refuge manager must first find that a use is appropriate before undertaking a compatibility review of that use. If the proposed use is not appropriate, the refuge manager will not allow the use and will not prepare a compatibility determination (CD).

The direction in 603 FW 2 provides guidance on how to prepare a compatibility determination. Other guidance in that chapter is as follows:

- The Improvement Act and its regulations require an affirmative finding by the refuge manager on the compatibility of a public use before we allow it on a national wildlife refuge.
- A compatible use is one, "that will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge."
- The act defines six wildlife-dependent uses that are to receive enhanced consideration on refuges: hunting, fishing, wildlife observation and photography, and environmental education and interpretation.
- The refuge manager may authorize those priority uses on a refuge when they are compatible and consistent with public safety.
- When the refuge manager publishes a compatibility determination, it will stipulate the required maximum reevaluation dates: 15 years for wildlife-dependent recreational uses or 10 years for other uses.
- The refuge manager may reevaluate the compatibility of a use at any time, for example, sooner than its mandatory date or even before completion of the CCP process, if new information reveals unacceptable impacts or incompatibility with refuge purposes (602 FW 2.11, 2.12).
- The refuge manager may allow or deny any use, even one that is compatible, based on other considerations such as public safety, policy, or available funding.

You may view this policy and its regulations, including a description of the process and requirements for conducting compatibility reviews, on the Web site: *http://www.fws.gov/policy/603fw2.html* (accessed July 2011).

Policy on Maintaining Biological Integrity, Diversity, and Environmental Health

This policy (601 FW 3) provides guidance on maintaining or restoring the biological integrity, diversity, and environmental health of the Refuge System, including the protection of a broad spectrum of fish, wildlife, and habitat resources in refuge ecosystems. It provides refuge managers with a process for evaluating the best management direction to prevent the additional degradation of environmental conditions and restore lost or severely degraded environmental components. It also provides guidelines for dealing with external threats to the biological integrity, diversity, and environmental health of a refuge and its ecosystem.

Policy on Wildlife-Dependent Recreation

This policy (605 FW 1) presents specific guidance about wildlife-dependent recreation programs within the refuge system. We develop our wildlife-dependent recreation programs on refuges in consultation with state fish and wildlife agencies and stakeholder input based on the following specific criteria:

(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.

You may view this policy on the Web site: *http://www.fws.gov/policy/605fw1.html* (accessed July 2011).

Policy on Wilderness Stewardship

This policy (610 FW 1-3) provides guidance for managing Refuge System lands designated as wilderness under the Wilderness Act of 1964 (16 U.S.C. § 1131-1136; PL 88-577). The Wilderness Act created the National Wilderness Preservation System (NWPS) that protects federally owned areas designated by Congress as wilderness areas. The act directs each agency administering designated wilderness to preserve the wilderness character of areas within the NWPS, and to administer the NWPS for the use and enjoyment of the American people in a way that will leave those areas unimpaired for future use and enjoyment as wilderness. Our wilderness stewardship policy also provides guidance on development of wilderness stewardship plans and explains when generally prohibited uses may be necessary to employ for wilderness preservation or fulfilling the refuge purpose.

Service planning policy requires that we evaluate the potential for wilderness on refuge lands, as appropriate, during the CCP planning process (610 FW 1). Section 610 FW 4 of our Wilderness Stewardship Policy provides guidance on the wilderness review process. Sections 610 FW 1-3 provide management guidance for designated wilderness areas. You may view this policy on the Web site: *http://www.fws.gov/policy/610fw1.html* (accessed July 2011).

The Monomoy Wilderness Stewardship Plan will be based upon the Arthur Carhart National Wilderness Training Center's *Four Cornerstones of Wilderness Stewardship* (*http://www.wilderness.net/fundamentals*; accessed January 2013) and the widely accepted (13) Wilderness Stewardship Principles by Hendee and Dawson (2002):

Four Cornerstones of Wilderness Stewardship:

(1) Manage wilderness as a whole.

(2) Preserve wildness and natural conditions.

(3) Protect wilderness benefits.

(4) Provide and use the minimum necessary.

Wilderness Stewardship Principles:

(1) Manage wilderness as the pristine extreme of the land modification spectrum.

(2) Manage wilderness comprehensively, not as separate parts.

(3) Manage wilderness, and sites within, under a non-degradation concept.

(4) Manage human influences, a key to wilderness protection.

(5) Manage wilderness to produce human values and benefits.

(6) Favor wilderness-dependent activities.

(7) Guide management with written plans that state objectives for specific areas.

(8) Set carrying capacities as necessary to prevent unnatural change.

(9) Focus management on threatened sites and damaging activities.

(10) Apply only minimum regulations and tools necessary to achieve objectives.

(11) Involve the public as a key to acceptance and success of wilderness management.

(12) Monitor conditions and experience opportunities for long-term stewardship.

(13) Manage wilderness in relation to management of adjacent lands.

Fulfilling the Promise and Conserving the Future: Wildlife Refuges and the Next Generation

In the summer of 2011, the U.S. Fish and Wildlife Service held a vision conference—an opportunity for creating a new strategic mission for the Refuge System that will guide refuge management through the next decade. The Service now has a great opportunity to improve upon its planning legacy by incorporating a new vision and set of conservation strategies in the next generation of CCPs. This new vision requires that we keep several principles in mind. First, the new plans must integrate the conservation needs of the larger landscape and ensure

that we function as a system. Second, they must be flexible enough to address new environmental challenges and contribute to the ecological resiliency of fish and wildlife populations and their habitats. Third, the plans must be written so those who read them will clearly understand what is expected and be inspired to take action to become a part of our conservation legacy. Fourth, they should explore ways to increase recreational opportunities, working closely with regional recreation, trails, and transportation planners to leverage resources that make refuges more accessible to the public.

The 1999 report *Fulfilling the Promise: The National Wildlife Refuge System; Visions for Wildlife, Habitat, People and Leadership* (USFWS 1999a) culminated a year-long process by teams of Service employees to evaluate the Refuge System nationwide. The report contained 42 recommendations packaged with three vision statements dealing with wildlife and habitat, people, and leadership. *Conserving the Future: Wildlife Refuges and the Next Generation* (USFWS 2011b) is a vision designed to guide the management of the Refuge System during the next decade and beyond. This document contains 23 recommendations on themes such as the relevance of the National Wildlife Refuge System to a changing America, the impact of climate change, the need for conservation at a landscape scale, the necessity of partnership and collaboration, and the absolute importance of scientific excellence. These recommendations have provided much of the guidance for developing this draft CCP/EIS.

Native American Policy

The Service developed and adopted a Native American Policy in 1994. The Service's intent in creating this policy is to:

"…help accomplish its mission and concurrently to participate in fulfilling the Federal Government's and the Department of the Interior's trust responsibilities to assist Native Americans in protecting, conserving, and utilizing their reserved, treaty guaranteed, or statutorily identified trust assets. This Policy is consistent with Federal policy supporting Native American government self-determination. The Service has a long history of working with Native American governments in managing fish and wildlife resources. These relationships will be expanded, within the Service's available resources, by improving communication and cooperation, providing fish and wildlife management expertise, training and assistance, and respecting and utilizing the traditional knowledge, experience, and perspectives of Native Americans in managing fish and wildlife resources."

The Native American Policy of the U.S. Fish and Wildlife Service (1994) is outlined as follows:

- The Service recognizes the sovereign status of Native American governments.
- There is a unique and distinctive political relationship between the United States and Native American governments…that differentiates Native American governments from other interests and constituencies.
- The Service will maintain government-to-government relationships with Native American governments.
- The Service recognizes and supports the rights of Native Americans to utilize fish and wildlife resources on non-reservation lands where there is a legal basis for such use.
- While the Service retains primary authority to manage Service lands, affected Native American governments will be afforded opportunities to participate in the Service's decision-making process for Service lands.

- The Service will consult with Native American governments on fish and wildlife resource matters of mutual interest and concern to the extent allowed by the law. The goal is to keep Native American governments involved in such matters from initiation to completion of related Service activities.

- The Service will assist Native American governments in identifying Federal and non-Federal funding sources that are available to them for fish and wildlife resource management activities.

- The Service will involve Native American governments in all Service actions that may affect their cultural or religious interests, including archaeological sites.

- The Service will provide Native Americans reasonable access to Service managed or controlled lands and waters for exercising ceremonial, medicinal, and traditional activities recognized by the Service and by Native American governments. The Service will permit these uses if the activities are consistent with treaties, judicial mandates, or Federal and tribal law and are compatible with the purposes for which the lands are managed.

- The Service will encourage the use of cooperative law enforcement as an integral component of Native American, Federal, and state agreements relating to fish and wildlife resources.

- The Service will provide Native American governments with the same access to fish and wildlife resource training programs as provided to other government agencies.

- The Service's basic and refresher fish and wildlife law enforcement training courses that are provided to other governmental agencies will also be available to Native Americans.

- The Service will facilitate the education and development of Native American fish and wildlife professionals by providing innovative educational programs and on-the-job training opportunities. The Service will establish partnerships and cooperative relationships with Native American educational institutions. The Service will also ensure that Native American schools and children are included in its environmental education outreach programs.

- The Service will actively encourage qualified Native Americans to apply for jobs with the Service, especially where the Service is managing fish and wildlife resources where Native Americans have management authority or cultural or religious interests.

- The Service will work with Native Americans to educate the public about Native American treaty and federally reserved rights, laws, regulations, and programs related to fish and wildlife.

You may view this policy on the Web site: *http://www.fws.gov/northeast/nativeamerican/imp_plan.html* (accessed July 2011).

On December 1, 2011, the Secretary of the Interior issued a policy on consultation with Indian Tribes, requiring Department of the Interior agencies to strengthen their government-to-government relationship with Indian Tribes. The policy reflects a commitment to consultation, recognition of Indian Tribes' right to self-governance, and Tribal sovereignty.

Other Mandates

Although Service and Refuge System policies and the purpose(s) of each refuge provide the foundation for its management, other Federal laws, executive

orders, treaties, interstate compacts, and regulations on conserving and protecting natural and cultural resources also affect how we manage refuges. Federal laws require the Service to identify and preserve its important historic structures, archaeological sites, and artifacts. NEPA mandates our consideration of cultural resources in planning Federal actions. The Improvement Act requires the CCP for each refuge to identify its archaeological and cultural values. All Service policies can be found at: *http://www.fws.gov/refuges/policy* (accessed May 2012).

USFWS

Loggerhead sea turtle hatchlings

The following summaries were taken, in most cases, directly from our *Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service*, located at: *http://www.fws.gov/laws/Lawsdigest.html* (accessed July 2011), and from our Draft U.S. Fish and Wildlife Service Tribal Consultation Guide (Monette 2009).

The Antiquities Act of 1906 as amended (16 U.S.C. § 431-433; 34 Stat. 225; PL 59-209) is the earliest and most basic legislation for protecting cultural resources on Federal lands. It provides misdemeanor-level criminal penalties to control unauthorized uses. Appropriate scientific uses may be authorized through permits, and materials removed under a permit must be permanently preserved in a public museum. The 1906 act is broader in scope than the 1979 Archaeological Resources Protection Act (ARPA), which partially supersedes it. Uniform regulations in 43 CFR Part 3 implement the act.

The Historic Sites, Buildings and Antiquities Act (16 U.S.C. § 461–462, 464–467; 49 Stat. 666) of August 21, 1935, popularly known as the Historic Sites Act, as amended by PL 89–249, approved October 9, 1965, (79 Stat. 971), declares it a national policy for the first time to preserve historic sites and objects of national significance, including those located on refuges. It provides authorization to the Secretary of the Interior through the National Park Service to conduct archaeological surveys, and to designate, acquire, administer, protect, and purchase properties of historic significance. National Historic and Natural Landmarks are designated under the authority of this act, and eventually incorporated into the National Historic Register under the 1966 National Historic Preservation Act.

The Archaeological and Historic Preservation Act (16 U.S.C. § 469–469c; PL 86–523,) approved June 27, 1960, (74 Stat. 220) as amended by Public Law 93–291, approved May 24, 1974, (88 Stat. 174) carries out the policy established by the Historic Sites Act (see above). It directs Federal agencies to notify the Secretary of the Interior whenever they find that any alteration of terrain caused by a Federal or Federal-assisted licensed or permitted project may cause the loss or destruction of significant scientific, prehistoric, or archaeological data. This expands the number of Federal agencies responsible for carrying out this law. The act authorizes the use of appropriated, donated, or transferred funds for the recovery, protection, and preservation of those data.

The National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. § 470–470b, 470c–470n), PL 89–665, approved October 15, 1966, (80 Stat. 915) and repeatedly amended, provides for the preservation of significant historical properties (buildings, objects, and sites) through a grant-in-aid program to the states. It establishes a National Register of Historic Places and a program of matching grants under the existing National Trust for Historic Preservation (16 U.S.C. § 468–468d). This act establishes an Advisory Council on Historic Preservation, which became a permanent, independent agency in PL 94-422, approved September 28, 1976, (90 Stat. 1319). The act created the Historic Preservation Fund. It directs Federal agencies, and any state, local, or private entity associated with a Federal undertaking, to conduct a Section 106 review, or to identify and assess the effects of their actions on items or sites listed or eligible for listing on the National Register. Most significantly, this act established that archaeological preservation was an important and relevant component at all levels of modern society, and it enabled the Federal Government to facilitate and encourage archaeological preservation, programs, and activities in the state, local, and private sectors.

The NHPA also charges Federal agencies with locating, evaluating, and nominating sites on their land to the National Register of Historic Places. An inventory of known archaeological sites and historic structures is maintained in the Northeast Regional Office and file copies of the sites at each refuge. The regional historic preservation officer in Hadley, Massachusetts, oversees compliance with the NHPA and consultations with State Historic Preservation Offices (SHPOs).

The Archaeological Resources Protection Act (ARPA) (16 U.S.C. § 470aa–470ll; PL 96–95) approved October 31, 1979, (93 Stat. 721), largely supplanted the resource protection provisions of the Antiquities Act of 1906 for archaeological items. ARPA establishes detailed requirements for issuing permits for any excavation for, or removal of, archaeological resources from Federal or Native American lands. It also provides detailed descriptions of prohibited actions, thereby strengthening enforcement capabilities. It establishes more severe civil and criminal penalties for the unauthorized excavation, removal, or damage of those resources; for any trafficking in those removed from Federal or Native American land in violation of any provision of Federal law; and for interstate and foreign commerce in such resources acquired, transported, or received in violation of any state or local law.

The Native American Graves Protection and Repatriation Act (NAGPRA) of 1990, as amended (PL 101-601; 104 Stat. 3048; 25 U.S.C. § 3001, et seq.) establishes rights of American Indian tribes and Native Hawaiian organizations to claim ownership of certain cultural items, including human remains, funerary objects, sacred objects, and objects of cultural patrimony, held or controlled by Federal agencies and museums that receive Federal funds. It requires agencies and museums to identify holdings of such remains and objects, and to work with appropriate Native Americans toward their repatriation. Permits for the excavation and/or removal of cultural items protected by the act require Native American consultation, as do discoveries of cultural items made during Federal land use activities. The Secretary of the Interior's implementing regulations are at 43 CFR Part 10. In the case that human remains are discovered on the refuge, NAGPRA establishes a procedural framework to follow, and this process may also be coordinated with the Commonwealth of Massachusetts and its laws and procedural framework as necessary.

The Service also owns and cares for museum properties. The most common are archaeological collections, art, zoological and botanical collections, historical photographs, and historic objects. Each refuge maintains an inventory of its museum property. The regional museum property coordinator in Hadley, Massachusetts, guides the refuges in caring for that property, and helps the refuge comply with NAGPRA and Federal regulations governing Federal

archaeological collections. This program ensures that Service collections will continue to be available to the public for learning and research.

The Environmental Justice program, established by Presidential Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations), requires Federal agencies, including the Service, to ensure that all environmental policies and the disposal of toxic waste do not adversely impact minority and low-income communities, including Tribes. The common concern is that these communities are exposed to unfair levels of environmental risk arising from multiple sources, often coupled with inadequate government response.

Chapter 4, Environmental Consequences, evaluates this plan's compliance with the acts noted above, and with the Clean Water Act of 1977, as amended (33 U.S.C. § 1251, et seq.; PL 107–303), the Clean Air Act of 1970, as amended (42 U.S.C. § 7401 et seq.), and the Endangered Species Act (ESA) of 1973 (16 U.S.C. § 1531–1544), as amended. The refuge designed this draft CCP/EIS to comply with NEPA and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500–1508).

Conservation Plans and Initiatives Guiding Our Planning

Strategic Habitat Conservation

The Service has a goal of establishing and building capacity for science-driven landscape conservation on a continental scale. Our approach, known as Strategic Habitat Conservation, applies adaptive resource management principles to the entire range of species, groups of species, and natural communities of plants and animals. This approach is founded on an adaptive, iterative process of biological planning, conservation design, conservation delivery, monitoring, and research. The Service is refining this approach to conservation in a national geographic framework. We will work with partners to develop national strategies to help wildlife, with a focus on declining species populations, adapt in a climate-changed world. This geographic frame of reference will also allow us to more precisely explain to partners, Congress, and the American public why, where, and how we target resources for landscape-scale conservation, and how our efforts connect to a greater whole.

North Atlantic Landscape Conservation Cooperative (LCC)

The North Atlantic LCC is a conservation science-management partnership, consisting of Federal agencies, states, tribes, universities, and private organizations, focused on collaboratively developing science-based recommendations and decision-support tools to implement on-the-ground conservation. The North Atlantic LCC covers land in 12 of the 13 Northeast states and the District of Columbia. The goal of the North Atlantic LCC is for the Service to work with all conservation partners to sustain landscapes capable of maintaining abundant, diverse, and healthy populations of fish, wildlife, and plants. The North Atlantic LCC will integrate its work with a U.S. Geological Survey regional climate change impact response center to conduct studies and develop landscape-scale conservation plans. It will also address impacts to ecosystems beyond those of climate change, such as potential extirpation of wildlife populations from disease or habitat loss.

Climate Change

Secretarial Order 3289, issued on March 11, 2009, establishes a commitment by the Department of the Interior to address the challenges posed by climate change to tribes and to the cultural and natural resources the Department oversees. This order promotes the development and use of renewable energy on public lands, adapting land management strategies to mitigate the effects of climate change, initiating multi-agency coalitions to address issues on a landscape level, and incorporating climate change priorities in long-term planning. These and other actions will be overseen by a climate change response council, which is responsible for creating a Department wide climate change strategy.

As the principal agency responsible for the conservation of the Nation's fish, wildlife, and plant resources, the Service has drafted a Climate Change Strategic Plan and a 5-Year Action Plan to jump-start implementation of the strategic plan. These plans provide a framework in which the Service works with others on a landscape scale to promote the persistence of native species, habitats, and natural communities. Specifically, these plans are based on three overall strategies: adaptation (management actions the Service will take to reduce climate change impacts on wildlife and habitats), mitigation (consuming less energy and using fewer materials in administering land and resources), and engagement (outreach to the larger community to build knowledge and share resources to better understand climate change impacts). Both plans can be found at: *http://www.fws.gov/home/climatechange/response.html* (accessed July 2013). The Service was also a member of an intergovernmental working group of Federal, state, and tribal agency representatives who developed the new National Fish, Wildlife and Plants Climate Adaptation Strategy. This strategy can be viewed at: *www.wildlifeadaptationstrategy.gov* (accessed July 2013).

Birds of Conservation Concern (2008 Report)

The Service developed this report (USFWS 2008a) in consultation with leaders of ongoing bird conservation initiatives and such partnerships as Partners In Flight (PIF), the North American Waterfowl Management Plan (NAWMP) and Joint Ventures, the North American Waterbird Conservation Plan (NAWCP), and the U.S. Shorebird Conservation Plan. It fulfills the mandate of the 1988 amendment to the Fish and Wildlife Conservation Act of 1980 (100 PL 100–653, Title VIII), requiring the Secretary of the Interior, through the Service, to "identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973."

Bill Thompson/USFWS

White winged scoter

The report contains 46 lists that identify bird species of conservation concern at national, regional, and landscape scales. It includes a principal national list, regional lists corresponding to the regional administrative units of the Service, and species lists for each of the 35 bird conservation regions (BCRs) designated by the North American Bird Conservation Initiative (NABCI) in the United States, and two additional BCRs we created to fulfill the purpose of the report that include island "territories" of the United States. NABCI defined those BCRs as ecologically based units in a framework for planning, implementing, and evaluating bird conservation.

We hope those national and regional reports will stimulate Federal, state, and private agencies to coordinate, develop, and implement integrated approaches for conserving and managing the birds deemed most in need of conservation. This is one of the plans we considered in identifying species of concern in appendix A and developing management objectives and strategies in goal 1.

North American Waterfowl Management Plan [updated 2012] and Atlantic Coast Joint Venture Implementation Plan (ACJV 2005)

Originally written in 1986, the NAWMP describes a long-term strategy among the United States, Canada, and Mexico to restore and sustain waterfowl populations by protecting, restoring, and enhancing habitat. The plan committee, including representatives from each nation, has modified the 1986 plan four times to account for biological, sociological, and economic changes that influenced the status of waterfowl and the conduct of cooperative habitat conservation. The most recent revision, in 2012, (NAWMP 2012) establishes 3 overarching goals

for waterfowl conservation: 1) abundant and resilient waterfowl populations to support hunting and other uses without imperiling habitat; 2) wetlands and related habitats sufficient to sustain waterfowl populations at desired levels, while providing places to recreate and ecological services that benefit society; and 3) growing numbers of waterfowl hunters, other conservationists and citizens who enjoy and support waterfowl and wetlands conservation. You may review the plan at: *http://www.fws.gov/birdhabitat/NAWMP/files/NAWMP-Plan_EN-may23/pdf* (accessed December 2013).

To convey goals, priorities, and strategies more effectively, NAWMP 2004 is composed of two separate documents: Strategic Guidance and Implementation Framework. The former is geared toward agency administrators and policy makers who set the direction and priorities for conservation. The latter includes supporting technical information for use by biologists and land managers.

The plans are implemented at the regional level in 14 habitat joint ventures and three species joint ventures: Arctic goose, American black duck, and sea duck. Our project area lies in the Atlantic Coast Joint Venture (ACJV), which includes all the Atlantic flyway states from Maine to Florida and Puerto Rico. The waterfowl goal for the ACJV is:

"Protect and manage priority wetland habitats for migration, wintering, and production of waterfowl, with special consideration to black ducks, and to benefit other wildlife in the joint venture area."

In 2009, a revision of the original ACJV strategic plan (ACJV 2009) was completed. The ACJV 2009 plan presents habitat conservation goals and population indices for the ACJV consistent with the NAWMP update, provides status assessments of waterfowl and their habitats in the Joint Venture, and updates focus area narratives and maps for each state. That document is intended as a blueprint for conserving the valuable breeding, migration, and wintering waterfowl habitat present within the ACJV boundary based on the best available information and the expert opinion of waterfowl biologists from throughout the flyway. You may review the ACJV 2009 Strategic Plan at: *http://www.acjv.org/resources.htm* (accessed July 2011).

The ACJV Waterfowl Implementation Plan was published in 1988 and revised in 2005 (ACJV 2005). The plan also provides a baseline of information needed to move forward with a thorough approach for setting future habitat goals. Although Monomoy NWR is not within any of the identified Massachusetts waterfowl focus areas, this plan was used to identify species of concern listed in appendix A, and in developing management objectives and strategies. You may review the ACJV 2005 Waterfowl Implementation Plan at: *http://www.acjv.org/resources.htm* (accessed July 2011).

We considered these plans in identifying species of concern in appendix A, and in developing management objectives and strategies under goal 1.

North American Bird Conservation Initiative: New England/Mid-Atlantic Coast Bird Conservation Region (BCR 30) Implementation Plan

The refuge lies in the New England/Mid-Atlantic BCR 30 (see map 2.1). BCR 30 provides important resources for migratory birds whose ranges span the Western Hemisphere. The habitats associated with coastal ecosystems provide the highest habitat values and critical staging areas for migratory waterfowl, waterbirds, shorebirds, and land birds. Forested upland communities are the second most important habitats for migratory birds in this BCR. Though the plan specifically highlights the Chesapeake and Delaware Bays, the Massachusetts Cape Cod and Islands area provides crucial resources for many migrating birds as they journey from their breeding sites in the north to non-breeding sites in Mexico, Central America, the Caribbean, and South America.

This plan identifies the bird species and habitats in greatest need of conservation action in this region, activities thought to be most useful to address those needs, and geographic areas believed to be the most important places for those activities. Most priority species are associated with either coastal ecosystems (including beach, sand, mud flats, estuaries, bays, and estuarine emergent wetlands) or upland forested ecosystems. Geographic focus areas were identified for waterfowl, land birds, waterbirds, and shorebirds. Monomoy NWR supports 5 of the 11 priority habitat types: beach, sand, mud flat; estuarine emergent wetlands; freshwater emergent wetlands; marine open water; and shrubland/early successional communities. This plan is meant to start a regional bird conservation initiative of partners across BCR 30 communicating their conservation planning and implementation activities to deliver high-priority conservation actions in a coordinated manner. You may view the BCR 30 implementation plan at: *http://www.acjv.org/BCR_30/BCR30_June_23_2008_final.pdf* (accessed July 2011). We considered this plan in identifying species of concern in appendix A, and in developing management objectives and strategies under goal 1.

North American Waterbird Conservation Plan (Version 1, 2002)

This plan (Kushlan et al. 2002) represents a partnership among individuals and institutions with interest in and responsibility for conserving waterbirds and their habitats. The plan is just one element of a multi-faceted conservation program. Its primary goal is to ensure that the distribution, diversity, and abundance of populations and habitats of breeding, migratory, and non-breeding waterbirds are sustained or restored throughout the lands and waters of North America, Central America, and the Caribbean. It provides a framework for conserving and managing nesting water-dependent birds. In addition, it will facilitate continent-wide planning and monitoring, national, state, and provincial conservation, regional coordination, and local habitat protection and management. You may access the plan at: *http://www.pwrc.usgs.gov/nacwcp/pdfs/plan_files/complete.pdf* (accessed July 2011).

In 2006, the Mid-Atlantic New England Working Group developed the Waterbird Conservation Plan for the Mid-Atlantic/New England/Maritimes (MANEM) Region (MANEM 2007). This plan was implemented between 2006 and 2010. It consists of technical appendixes on waterbird populations including occurrence, status, and conservation needs; waterbird habitats and locations within the region that are crucial for waterbird sustainability; MANEM partners and regional expertise for waterbird conservation; and conservation project descriptions that present current and proposed research, management, habitat acquisition, and education activities. Summarized information on waterbirds and their habitats provides a regional perspective for local conservation action. You may access the plan at: *http://www.fws.gov/birds/waterbirds/manem/index.html* (accessed July 2011).

We considered this plan in identifying species of concern in appendix A, and in developing management objectives and strategies under goal 1.

U.S. Shorebird Conservation (2001, 2nd Edition), North Atlantic Regional Shorebird Plans, and Atlantic Flyway Shorebird Business Strategy

The U.S. Shorebird Conservation Plan (Brown et al. 2001) was developed by the Manomet Center for Conservation Science under a partnership of individuals and organizations throughout the United States. The plan develops conservation goals for each U.S. region, identifies important habitat conservation and research needs, and proposes education and outreach programs to increase public awareness of shorebirds and of threats to them. The plan has set goals at the hemispheric, continental, and regional levels. You may read the plan at: *http://www.lmvjv.org/library/usshorebirdplan.pdf* (accessed July 2011).

In the Northeast, the North Atlantic Regional Shorebird Plan (Clark and Niles 2000) was drafted to apply the goals of the national plan to smaller

scales, identify priority species and habitat and species goals, and prioritize implementation projects. Monomoy NWR is part of the North Atlantic Coastal Plain Planning Region. The North Atlantic Coastal Plain is critical for breeding shorebirds as well as for supporting transient species during both northbound and southbound migrations. The North Atlantic region is critical to the survival of hemispheric populations of some species, such as red knots, piping plovers, whimbrels, that would be greatly impacted by continued habitat degradation or catastrophic chemical or petroleum spills.

The highest priority birds that are found at Monomoy NWR include, piping plovers, American oystercatchers, and semipalmated sandpipers. In addition, the region includes important migration stopover sites for red knots, ruddy turnstones, sanderlings, semipalmated sandpipers, dunlins, and other shorebird species. The habitat goal under the North Atlantic Regional Shorebird Conservation Plan includes the following four highest priority objectives:

- Identify and manage sufficient breeding habitat (beachfront) for piping plover and American oystercatcher.
- Identify and manage foraging and roosting habitat (intertidal-mud) for whimbrel, Hudsonian godwit, red knot, and semipalmated sandpiper to maintain migration stopover integrity by protecting and managing key concentration areas.
- Provide foraging and roosting habitat (intertidal-marsh) for whimbrel through protection and management at key sites.
- Identify and manage sufficient foraging and roosting habitat (intertidal complexes and impoundments) to maintain and enhance regional populations important in the region for species with overlapping requirements (ruddy turnstone, semipalmated sandpiper, short-billed dowitcher, sanderling, dunlin, black-bellied plover, white-rumped sandpiper)

The plan also includes six high priority objectives, of which one is to identify and manage breeding and foraging habitat (intertidal-marsh) for willet throughout the region.

You may read the North Atlantic Regional Shorebird Plan at: *http://www.fws.gov/shorebirdplan/RegionalShorebird/RegionalPlans.htm* (accessed July 2011). These plans were consulted while identifying the species of concern listed in appendix A, and during the development of management objectives and strategies under goal 1.

The Atlantic Flyway Shorebird Conservation Business Strategy (Winn et al. 2013) identifies the most important actions and associated costs for shorebird conservation, with the goal of creating "a long-term platform for stability and recovery of focal species." Fifteen focal shorebird species are included in the business strategy, nine of which occur regularly on Monomoy refuge. Business strategies differ from standard conservation plans by focusing on a set of well-developed actions that link funding to specific, measurable conservation outcomes. Typically, a conservation plan describes the natural history of species, lists conservation threats and needs, and presents a painstaking approach that applies objective criteria to determine high priority species. A business strategy builds on the scientific foundation of conservation plans by presenting strategic conservation solutions as actionable investment opportunities. You may read the plan at: *http://manometcenter.pairserver.com/sites/default/files/publications_and_tools/AtlanticFlywayShorebirdBusinessStrategy.pdf* (accessed November 2013).

Partners in Flight Bird Conservation Plans

In 1990, PIF began as a voluntary, international coalition of government agencies, conservation organizations, academic institutions, private industries, and citizens dedicated to reversing population declines of bird species and "keeping common birds common." The foundation of its long-term strategy is a series of scientifically based bird conservation plans using physiographic areas as planning units.

The goal of each PIF conservation plan is to ensure the long-term maintenance of healthy populations of native birds, primarily non-game birds. The plan for each physiographic area ranks bird species according to their conservation priority, describes their desired habitat conditions, develops biological objectives, and recommends conservation measures. The priority ranking factors are habitat loss, population trends, and the vulnerability of a species and its habitats to regional and local threats.

The CCP project area lies in physiographic area 09 (see map 2.1), the Southern New England Region (Dettmers and Rosenberg 2000). The Southern New England Conservation Plan includes objectives for seven habitat types and associated species of conservation concern. Four of the seven priority habitats are found on Monomoy NWR: maritime marsh, beach/dune, freshwater wetland, and early successional/pitch pine barren. We referred to this plan in developing our list of species of conservation concern provided in appendix A, as well during the formulation of habitat objectives and strategies under goal 1 in the three alternatives. More information about PIF is available at: *www.partnersinflight.org* (accessed December 2013).

Massachusetts' Wildlife Action Plan (Revised September 2006)

In 2002, Congress created the State Wildlife Grant (SWG) Program, and appropriated $80 million in state grants. The purpose of the program is to help state and tribal fish and wildlife agencies conserve fish and wildlife species of greatest conservation need. The funds appropriated under the program are allocated to each state according to a formula that takes into account each state's size and population.

To be eligible for additional Federal grants, and to satisfy the requirements for participating in the SWG program, each state and U.S. territory was charged with developing a statewide comprehensive wildlife conservation strategy and submitting it to the National Advisory Acceptance Team by October 1, 2005. Each plan must address eight required elements, and each plan's purpose is to identify and focus on "species of greatest conservation need," while addressing the "full array of wildlife" and wildlife-related issues and "keep common species common."

The Massachusetts plan (MA DFG 2006), commonly referred to as the state wildlife conservation strategy and most often referred to as the state wildlife action plan (SWAP), resulted from that charge. It provides a blueprint and vision for effective and efficient wildlife conservation within Massachusetts, and stimulated other state and Federal agencies and conservation partners to think strategically about their individual and coordinated roles in prioritizing conservation.

In addressing the eight elements below, the Massachusetts SWAP helps supplement the information we gathered on species and habitat occurrences and their distribution in our area analysis, and helps identify conservation threats and management strategies for species and habitats of conservation concern in the CCP. The expertise convened to compile this plan and its partner and public involvement further enhance its benefits for us. We used the Massachusetts SWAP in developing our list of species of concern in appendix A, and the management objectives and strategies for goal 1. These eight elements are:

(1) Information on the distribution and abundance of species of wildlife, including low and declining populations as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the State's wildlife.

(2) Descriptions of locations and relative condition of key habitats and community types essential to the conservation of species identified in element one.

(3) Descriptions of problems that may adversely affect species identified in element one or their habitats, and priority research and survey efforts needed to identify factors that may assist in restoration and improved conservation of these species and habitats.

(4) Descriptions of conservation actions necessary to conserve the identified species and habitats, and priorities for implementing such actions.

(5) Plans proposed for monitoring species identified in element one and their habitats, for monitoring the effectiveness of the conservation actions proposed in element four, and for adapting those conservation actions to respond appropriately to new information or changing conditions.

(6) Descriptions of procedures to review the plan at intervals not to exceed 10 years.

(7) Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the plan strategy with Federal, State, local agencies, and Native American Tribes that manage significant areas of land and water within the State or administer programs that significantly affect the conservation of identified species and habitats.

(8) Plans for involving the public in the development and implementation of plan strategies.

The Commonwealth of Massachusetts submitted its CWCS in October 2005; it was revised in September 2006. You may view it at: *http://www.mass.gov/dfwele/dfw/habitat/cwcs/pdf/mass_cwcs_final.pdf* (accessed July 2011).

Natural Heritage BioMap2

The Massachusetts Department of Fish and Game's Natural Heritage and Endangered Species Program and The Nature Conservancy's Massachusetts Program developed BioMap2, an enhanced and comprehensive biodiversity conservation plan for Massachusetts that updates and broadens the biological and conceptual scope of the original *BioMap* report published in 2001. BioMap2 is "designed to guide strategic biodiversity conservation in Massachusetts over the next decade by focusing land protection and stewardship on the areas that are most critical for ensuring the long-term persistence of rare and other native species and their habitats, exemplary natural communities, and a diversity of ecosystems." BioMap2 builds on the original *BioMap*, *Living Waters*, and the state wildlife action plan to prioritize and guide biodiversity conservation in Massachusetts in the

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Piping plover

context of continued development and the anticipated effects of climate change. It includes the latest survey information and spatial analyses, and identifies the areas of highest conservation value for a range of biodiversity elements.

BioMap2 identifies core habitat, key areas that are critical for the long-term persistence of rare species and other species of conservation concern, as well as a wide diversity of natural communities and intact ecosystems across Massachusetts. Monomoy NWR includes the following priority natural communities: maritime beach strand community, maritime dune community, marine intertidal flats, and aquatic core habitat. Complementing core habitat, BioMap2 also identifies critical natural landscape, large natural landscape blocks that provide habitat for wide-ranging native species, support intact ecological processes, maintain connectivity among habitats, and enhance ecological resilience, as well as buffering land around coastal, wetland, and aquatic core habitats. Monomoy NWR contains the following critical natural landscapes: aquatic buffer, coastal adaptation area, landscape block, and tern foraging area—Arctic tern and least terns.

The BioMap2 interactive map and summary report can be found online at: *http://www.mass.gov/eea/docs/dfg/nhesp/land-protection-and-management/biomap2-summary-report.pdf* (accessed August 2011).

Species-Specific Recovery Plans

In addition to these regional and state plans, there are three species-specific recovery plans that were consulted during the development of this CCP.

Atlantic Coast Piping Plover Recovery Plan
In 1996, a revision was made to the original 1988 Atlantic Coast Piping Plover Recovery Plan (USFWS 1996a). The primary objective of the revised recovery program is to remove the piping plover population from the Service's List of Endangered and Threatened Wildlife and Plants. The plan hopes to do this by achieving well-distributed increases in numbers and productivity of breeding pairs, and providing for long-term protection of breeding and wintering plovers and their habitat. The strategies within the plan provide for the ensured long-term viability of piping plover populations in the wild. The Atlantic Coast Piping Plover Recovery Plan is available online at: *http://www.fws.gov/northeast/pipingplover/recovery.html*. The piping plover was included in a cursory 5-year review (USFWS 2009a); no new information regarding piping plover status was received, nor was a change in status recommended. The 5-year review can be found at: *http://ecos.fws.gov/docs/five_year_review/doc3009.pdf*.

The piping plover status in the Commonwealth of Massachusetts and on Monomoy NWR is described in chapter 2.

Northeastern Beach Tiger Beetle Recovery Plan
The Northeastern Beach Tiger Beetle Recovery Plan was written and approved in 1994. A 5-year status review of the northeastern beach tiger beetle was conducted in February 2009 (USFWS 2009b). The review recommends that the recovery plan be updated to include more detailed information to revise recovery strategies and criteria. Recommendations were also made to address specific research and data needs, and conservation actions. The review made the recommendation that the current classification status of threatened be reclassified to endangered, based on declining beetle numbers throughout their range and increased habitat loss and degradation. The Northeastern Beach Tiger Beetle Recovery Plan and the 5-year review can be accessed online at: *http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=I02C*.

The northeastern beach tiger beetle status in the Monomoy NWR is described in chapter 2.

Roseate Tern Recovery Plan (Northeastern Population)
The Roseate Tern Recovery Plan was published in 1989 and updated in 1998 (USFWS 1998a). A 5-year review was initiated in December 2008 (USFWS 2010a). The primary objective of the recovery program for the roseate tern is to promote an increase in breeding populations, distribution, and productivity so this species can be reclassified as threatened and eventually delisted. The updated recovery plan actions include: increasing roseate tern survival and productivity by overseeing breeding roseate terns and their habitat; developing a monitoring plan for wintering and migration areas; obtaining unprotected sites through acquisition and easements; developing outreach materials and implementing education programs; conducting scientific investigations that will help facilitate recovery efforts; and annually reviewing recovery progress and revising recovery efforts as necessary. The Roseate Tern Recovery Plan can be accessed online at: *http://ecos.fws.gov/docs/recovery_plan/981105.pdf*. The 5-year review can be found at: *http://ecos.fws.gov/docs/five_year_review/doc3588.pdf*.

The status of roseate terns on Monomoy NWR is described in chapter 2.

Alternative Transportation Study: Monomoy National Wildlife Refuge

The U.S. Department of Transportation (USDOT) Volpe National Transportation Systems Center completed their study, "Alternative Transportation Study: Monomoy National Wildlife Refuge" (May 2010) funded in 2007 through the Federal Transit Administration's Alternative Transportation in Parks and Public Lands program. The study examines existing transportation conditions, presents and evaluates transportation options, assesses partnership opportunities, and provides implementation considerations. That recent study identified 39 transportation interventions and evaluated 21 interventions in detail, addressing a variety of transportation safety and access issues at Monomoy NWR. The Volpe Center study identifies interventions that improve multi-modal access to Monomoy NWR and within Chatham, reduce traffic and parking congestion around Monomoy NWR and within Chatham, improve traveler safety, enhance the visitor experience, and develop and enhance partnerships with governmental and non-governmental agencies.

In 2012, the refuge received $400,000 to work with partners and the Town of Chatham to implement components of the study that are detailed below and in chapter 3. The award from the Department of Transportation to the Service for year 1 of a planned 3-year, public-private partnership demonstration project at Monomoy and in Chatham will be applied to the following:

- Establish and operate a peak-season, bio-diesel shuttle-bus system serving Monomoy NWR and town-owned Lighthouse Beach within Cape Cod National Seashore from satellite parking areas that will also pass through and make stops along Chatham's Main Street business-historic district.

- Improve finding the route and signs to the Monomoy refuge facilities and Lighthouse Beach, satellite parking areas, and other Town of Chatham parking.

- Make improvements to reduce existing vehicle-pedestrian safety concerns and improve traffic flow along Morris Island Road, ensuring parked vehicles are off the driving surface and on the road shoulder.

The interventions listed below, grouped into five categories, were used in formulating the alternatives presented in chapter 3.

Multimodal Roadway/Sidewalk Engineering Improvements
(1) Relocate and reinstall causeway fencing to better accommodate parked cars and emergency vehicles.

(2) Create a multi-use path on one side of causeway for bicycles and pedestrians.

(3) Construct sidewalk between Bridge Street parking areas and Lighthouse Beach.

(4) Paint "sharrow" or shared lane markings on the signed bicycle route.

(5) Provide bicycle facilities and amenities at shuttle stops.

(6) Provide pedestrian improvements at and around shuttle stops.

(7) Add bicycle and pedestrian facilities and enhanced amenities at the new visitor contact station.

(8) Provide additional bicycle racks at Monomoy NWR headquarters/visitor contact station, Lighthouse Beach, and high priority downtown locations.

Vehicular Parking Interventions

(1) Identify/secure satellite parking location.

(2) Implement parking restrictions at Monomoy NWR headquarters/visitor contact station.

Transit Service

(1) Operate shuttle service to Monomoy NWR (and other destinations in Chatham) from satellite parking.

(2) Contract with taxi service or other provider to offer demand responsive, shared taxi service to Monomoy NWR (and other destinations in Chatham) from satellite parking.

(3) Provide a multi-passenger shuttle from a new downtown visitor contact station to Morris Island.

Signs, Route Direction, and Information

(1) Use variable message signs at new/redesigned intersection to direct visitors to satellite parking.

(2) Improve bicycle route signs.

(3) Improve directional signs to Monomoy NWR headquarters/visitor contact station.

(4) Add directional and informational signs throughout Chatham.

(5) Add directional and informational signs throughout Cape Cod and along Route 6.

(6) Improve traveler information on the Monomoy NWR Web site.

Other

(1) Relocate the Monomoy NWR visitor contact station.

(2) Improve waterfront access.

Other Information Sources

We also consulted the plans and resources below, especially those with a local context, as we refined our management objectives and strategies.

Continental or National Plans

- National Audubon Society Watch List (Butcher et al. 2007); available at: *http://birds.audubon.org/sites/default/files/documents/watchlist2007-technicalreport.pdf* (accessed July 2011)
- Coastal Zone Management Act of 1972; available at: *http://www.nps.gov/history/local-law/FHPL_CstlZoneMngmt.pdf* (accessed July 2011)
- Marine Mammal Protection Act (MMPA) of 1972, as amended in 2007; available at: *http://www.nmfs.noaa.gov/pr/pdfs/laws/mmpa.pdf* (accessed July 2011)
- The National Wilderness Preservation System; Monomoy Wilderness; available at: *http://www.wilderness.net/index.cfm?fuse=NWPS&sec=wildView&wname=Monomoy*
- American Oystercatcher Focal Species Business Plan, summary available at: *http://acjv.org/Fact_Sheets/BP_Exec_Sum.pdf*

Regional Plans

- Western Hemispheric Shorebird Reserve Network Regional Site: Monomoy NWR; available at: *http://www.whsrn.org/site-profile/monomoy-nwr*

State Plans

- Massachusetts' Important Bird Areas Program; Monomoy NWR and South Beach; available at: *http://iba.audubon.org/iba/viewState.do?state=US-MA*
- Massachusetts Natural Communities (Swain and Kearsley 2001); available at: *http://www.mass.gov/dfwele/dfw/nhesp/natural_communities/natural_community_classification.htm* (accessed July 2011)
- Our Irreplaceable Heritage-Protecting Biodiversity in Massachusetts; available at: *http://mass.gov/dfwele/dfw/nhesp/nhesp.htm* (accessed July 2011)

Refuge Establishment Purposes and its Land Acquisition History

The Service established Monomoy NWR in 1944 under a Declaration of Taking for the following purposes and under the following authorities:

"… for use as an inviolate sanctuary, or for other management purpose, for migratory birds" —Migratory Bird Conservation Act (16 U.S.C. § 715d)

Throughout the initial designation process for the refuge, the Monomoy area was recognized as an "outstanding waterfowl area" and as "one of the finest shorebird beaches in North America" (Salyer 1938) and for the eelgrass (*Zostera* spp.) beds in shoal waters northwest of Inward Point on the Common Flats (Griffith 1938) that were described as "dense" beds in 1929 (Hotchkiss and Ekvall 1929). The biological values of this area helped define the refuge boundary.

The Declaration of Taking which was implemented through a condemnation action includes a detailed written description of an extensive western area containing upland, intertidal flats, and submerged lands and waters, as well as a map generally outlining those exterior limits and describing them as the "Limits of Area to be Taken." The eastern boundary is the mean low water line and is ambulatory, meaning it moves as the mean low water line moves. This taking was approved by the District Court of the United States in February 1944 and took immediate effect on June 1, 1944, when it was filed in Federal court.

The size and shape of Monomoy NWR has changed over time due to erosion and accretion. These changes are described in Chapter 2 under "Refuge Administration." With the latest change, the refuge boundary now includes portions of Nauset/South Beach and encompasses 8,321 acres. The refuge boundary is depicted on Map 1.1.

In 1970, Congress designated approximately 2,600 acres of land as wilderness to become part of the National Wilderness Preservation System, thereby preserving the wilderness character of the Monomoy Islands.

"In accordance with … the Wilderness Act…certain lands in the Monomoy National Wildlife Refuge, Massachusetts, which comprise about two thousand six hundred acres but excepting and excluding therefrom two tracts of land containing approximately ninety and one hundred and seventy acres, respectively and which are depicted on a map entitled "Monomoy Wilderness—Proposed" and dated August 1970, which shall be known as the Monomoy Wilderness"—an Act to Designate Certain Lands as Wilderness (Public Law 91-504, 16 U.S.C. § 1132(c)).

The Monomoy wilderness extends to the mean low water mark, as evidenced in records from the Service's first wilderness proposal and public hearing through to the officially certified description of the wilderness area. The size of the wilderness area has changed over time as the Monomoy landform and surrounding intertidal lands have changed. The Nauset/South Beach addition to the refuge is now part of the Monomoy wilderness because it attached to refuge lands that were designated wilderness (map 1.3).

With the designation of national wilderness at Monomoy, the original establishing purpose of the refuge—management and protection of migratory birds—was expanded to include management and protection of wilderness character and values.

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Ruddy turnstone

Refuge Administration

The Service administers Monomoy NWR as part of the Eastern Massachusetts NWR Complex, which also includes Assabet River, Great Meadows, Mashpee, Massasoit, Nantucket, Nomans Land Island, and Oxbow refuges. The refuge complex headquarters is located in Sudbury, Massachusetts, and has its complex visitor center at the Assabet River NWR.

The refuge complex has 15 permanent staff. Eleven are located at the complex in Sudbury, including project leader, deputy project leader, two biologists, visitor services manager, refuge planner, two law enforcement officers, two maintenance workers, and one administrative staff. Two of these positions are currently vacant. One permanent staff person—a visitor services specialist—is located at the Assabet River NWR. Monomoy maintains three onsite positions: refuge manager and two biologists. Seasonal biological technician and term staff positions and volunteer intern positions vary each year depending on funding. In addition, seasonal paid stipend and unpaid interns, volunteers, and Friends groups assist throughout the year.

Refuge Operational Plans ("Step-down" Plans)

Refuge planning policy lists more than 25 step-down management plans that may be required on refuges. These plans contain specific strategies and implementation schedules for achieving refuge goals and objectives. Some plans require annual revisions; others require revisions every 5 to 10 years. Some require additional NEPA analysis, public involvement, and compatibility determination before we can implement them.

This draft CCP/EIS incorporates by reference those refuge step-down plans that are up to date. Chapter 3 provides more information about the additional step-down plans needed for the refuge.

The following step-down plans have been completed, and apply to all eight refuges in the Eastern Massachusetts NWR Complex:

- Avian Influenza Surveillance and Contingency Plan—completed in 2007
- Continuity of Operations Plan—updated in 2012
- Fire Management Plan (FMP)—completed in 2003; will be updated in 2013
- Hurricane Action Plan—updated annually; updated in 2013
- Spill Prevention and Counter Measure Plan—completed in 2005; updated in 2012

We plan to complete the following step-down plans following approval of the CCP (see chapter 3):

- Habitat Management Plan
- Inventory and Monitoring Plan
- Annual Habitat Work Plan
- Hunting Plan
- Fishing Plan
- Mosquito Management and Control Plan
- Wilderness Stewardship Plan
- Sign Plan
- Law Enforcement Management Plan
- Migratory Bird Disease Contingency Plan
- Visitor Services Plan
- Cultural Resources Management Plan
- Integrated Pest Management Plan

Complex and Refuge Vision Statements

This section provides the vision statements of both the complex and Monomoy NWR.

Eastern Massachusetts NWR Complex Vision Statement

The following vision statement was developed in 2003 for the complex:

The complex will contribute to the mission of the Refuge System and support ecosystem-wide priority wildlife and natural communities. Management will maximize the diversity and abundance of fish and wildlife with emphasis on threatened and endangered species, migratory birds, and aquatic resources. The complex will have a well-funded and community-supported acquisition program that contributes to wildlife conservation. The refuges will be well known nationally and appreciated in their communities. They will be seen as active partners in their communities, school systems, and environmental organizations, which will result in high levels of support for the refuges. The refuges will be a showcase for sound wildlife management techniques and

will offer top-quality, compatible, wildlife-dependent recreational activities. Refuges open to the public will provide staffed visitor contact facilities that are clean, attractive, and accessible, with effective environmental education and interpretation.

Monomoy National Wildlife Refuge Vision Statement

Very early in the planning process, our team developed this vision statement for Monomoy NWR to provide a guiding philosophy and sense of purpose in the CCP.

Extending from the elbow of Cape Cod, Monomoy National Wildlife Refuge consists of an assembly of barrier beaches that includes some of New England's last remaining wild seacoast. This dynamic, wilderness system of ocean, intertidal flats, salt and freshwater marshes, dunes and freshwater ponds, provides vital habitat for a vast array of diverse species. Monomoy NWR is world-renowned for its range of seasonal wildlife inhabitants. Seabirds, waterfowl, shorebirds, wading birds, land birds, horseshoe crabs, and seals rely upon the refuge for survival during various times of the year. Given the vital role that these lands and waters play in the survival of so many endangered, threatened, and special species, wildlife conservation and management will always be our first priority at Monomoy NWR.

The unique area that is Cape Cod allows us to reach large numbers of visitors from all over the world. Visitors will learn about the rich history of the refuge, experience unique recreational opportunities, view wildlife in a natural setting, and learn about the positive and negative impacts of human interactions with the refuge. Visitors will understand and appreciate how we manage the refuge, its habitats, and wildlife species. We will ensure that the number of visitors on the refuge is appropriate so as not to detract from a rich wilderness and wildlife experience.

As a regional and national role model, the refuge will provide scientific and technical leadership for wildlife and resource management that is adaptable to changing conditions. Talented, knowledgeable staff will continue to develop and foster partnerships with local, regional, national, and international organizations to assist in the management of Monomoy NWR and inform the conservation community of the work that we do. Monomoy NWR will continue to play a crucial role in the National Wildlife Refuge System by protecting this critical nesting, feeding, and resting area for migratory birds along the Atlantic Coast.

Refuge Goals

In 2009, the CCP planning team developed the following draft goals after reviewing the refuge purposes, the mission of the Service and Refuge System, the proposed vision statement, public and partner comments, as well as the mandates, plans and conservation strategies summarized above.

Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.

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.

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 U.S. Fish and Wildlife Service.

Goal 4: Ensure that the spirit and character of the Monomoy Wilderness are preserved.

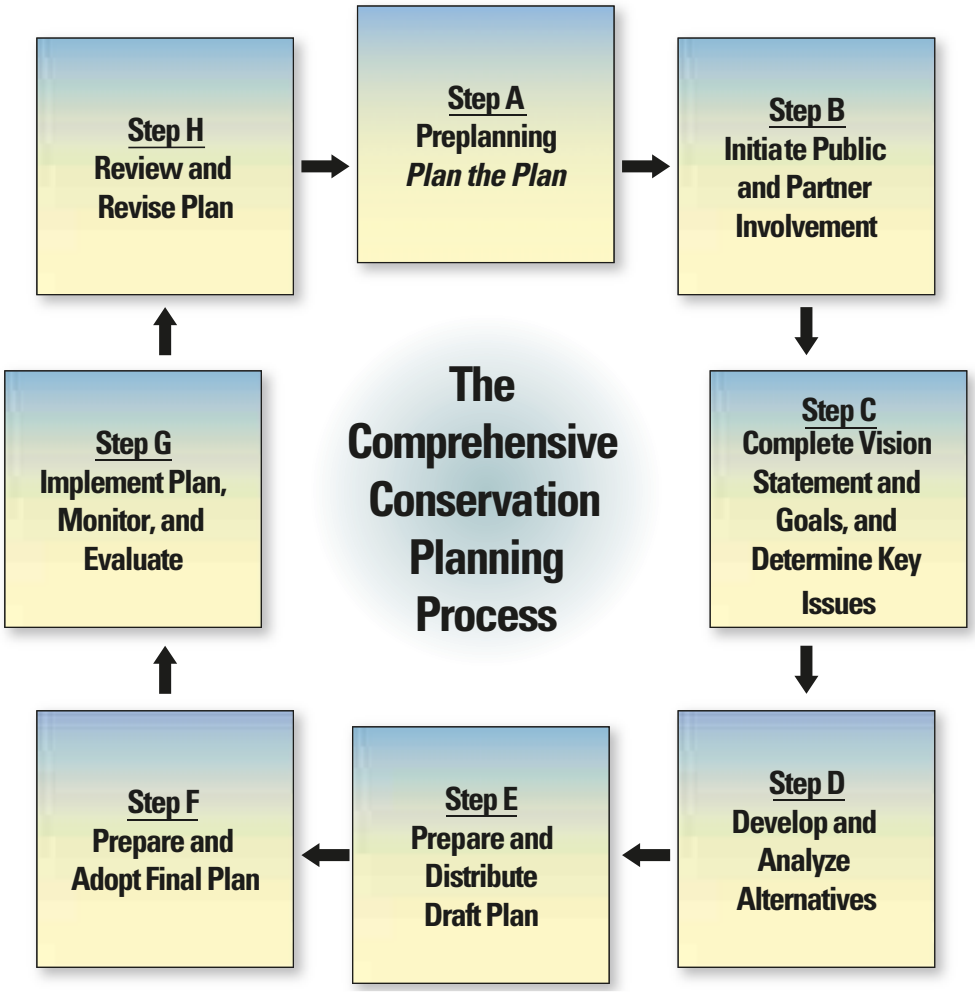
Goal 5: Protect cultural resources that exist in the refuge.

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.

The Comprehensive Conservation Planning Process

Service policy (602 FW 3) establishes an eight-step planning process that also facilitates compliance with NEPA (figure 1.1). Details on each step in the process are available on our Web site at: *http://www.fws.gov/northeast/planning*. The CCP development process is described below in more detail.

Figure 1.1. Steps in the Comprehensive Conservation Planning Process.



Since 1944, we have focused on conserving lands within the approved acquisition refuge boundary, managing habitat for migratory birds, and establishing relationships with the community of Chatham and other partners. Our planning process started in 1998 and included all eight of the refuges in the Eastern Massachusetts NWR Complex. We published a Notice of Intent in the *Federal Register*, and began public scoping. In February of 1999, we held open houses in each unit for public comment on different issues, including current and future management strategies, land protection, and public uses. We were pleased with the participation at many of our meetings, which ranged from 30 people to more than 100. We recognized that attending our open houses would be difficult for many, and designed an issues workbook to encourage additional comments from

those who were unable to attend. Those workbooks allowed people to share what they valued most about the refuge, their vision for its future and the Service's role in their community, and any other issues they wanted to raise. More than 8,000 people representing a variety of interests received workbooks. Workbooks were also available at open houses and at the refuge headquarters. We received more than 660 responses. The responses for Monomoy refuge were considered in the development of issues for this CCP.

In February 2001, we determined that writing a plan for eight refuges was too cumbersome, so we delayed our planning for Monomoy NWR and changed our focus on CCPs for the three northernmost refuges in the complex. The efforts for Monomoy NWR were halted until 2004, when, in an effort intended to initially "rescope" the issues surrounding management of the refuge, we asked the independent, nonpartisan, nonprofit facilitator, the Consensus Building Institute (CBI), to conduct an assessment that would provide specific, detailed recommendations for stakeholder involvement and participation in the planning process. Between November 15 and December 23, 2004, CBI conducted 15 interviews with 19 individuals either in-person or over the phone. We sought to provide CBI a diverse set of stakeholders who might identify many, if not most, issues relevant to management of the refuge. Some interviewees suggested additional individuals to interview. Thus, CBI interviewed a selection of stakeholders, from local businesses and residents to elected and appointed officials. CBI received several comments via email and phone. The results of these interviews are summarized in a brief report that is available on the refuge planning Web site at: *http://www.fws.gov/northeast/planning/monomoy_nomans/cbi.html*.

On December 13, 2004, we announced in the *Federal Register* that we were restarting the CCP process for Monomoy and Nomans Land Island refuges and that an EIS would be completed. We began preparations for developing a joint CCP by collecting information on refuge resources and convening our core planning team, which consisted of refuge complex staff, regional division staff, representatives from the Wampanoag Tribe of Gay Head (Aquinnah), and the Massachusetts Department of Fish and Game.

Public scoping meetings were held in April 2005 in Chatham, Sudbury, and Chilmark, Massachusetts. More than 300 people attended these meetings. Most of the planning effort during this period was focused on the CCP for the Monomoy refuge. We discussed management issues, drafted a vision statement and tentative goals, and compiled a project mailing list of known stakeholders, interested individuals, organizations, and agencies. These steps were part of "Step B: Initiate Public Involvement and Scoping."

In the fall of 2006, we reviewed the public comments received and used the information to firm up our key issues and develop our draft vision, goals, and objectives. A planning update was distributed with the draft goals and objectives. The Service put together a planning team composed of staff members, a representative from MassWildlife, and a representative from the Wampanoag Tribe of Aquinnah. This team worked to develop a refuge vision statement, which would be an achievable, future view of the refuge. This completed Step C, "Review Vision Statement, Goals, and Determine Significant Issues."

In September 2008, we resumed this process after a second delay due, in part, to the transfer of refuge personnel. We also further decided to split apart Monomoy and Nomans Land Island refuges into separate CCPs for efficiency. We provided an update to the 373 individuals on our Monomoy CCP mailing list ("Step B: Initiate Public Involvement and Scoping") in a fall 2008 newsletter. During this time, most of the planning efforts were focused on the Nomans Land Island

NWR CCP, but on Monomoy we continued scientific research and coordination with the Town of Chatham. We contracted with the Provincetown Center for Coastal Studies to conduct a geomorphological analysis of the Monomoy barrier system, an analysis was conducted to estimate the impact of sea level rise on the refuge, and we applied for and received funding to address significant transportation issues affecting the refuge and the Town of Chatham.

Next, we moved into Step D, "Develop and Analyze Alternatives." The purpose of this step is to develop alternative objectives and strategies for addressing the issues and achieving the goals. From April 2009 to June 2011, we worked to develop our three alternatives. In March 2013, we distributed a newsletter updating our planning timeframes.

We will complete Step E, "Prepare Draft Plan and NEPA document," by publishing our Notice of Availability (NOA) in the *Federal Register* announcing the release of this draft CCP/EIS and distributing it for public review. During the 60-day period of public review, we will hold a public hearing to obtain comments. We also expect to receive comments by regular mail or electronic mail. After the comment period expires, we will review and summarize all the comments we have received, develop our responses, and present them in an appendix to the final CCP.

After the public review of this draft CCP/EIS, our Regional Director will select an alternative based on the Service and Refuge System missions, the purposes for which the refuge was established, other legal mandates, and public and partner responses to this draft. The alternative selected could be the preferred alternative identified in this draft CCP/EIS, the no action alternative, or a combination of actions or alternatives presented. The final decision will identify the desired combination of species protection, habitat management, public use and access, and administration for the refuge. We will then release our final CCP/EIS for a 30-day public review period. Its availability will be announced in a NOA in the *Federal Register*.

Following public review of the final CCP/EIS, our Regional Director's decision on the management alternatives will be documented in a Record of Decision (ROD) indicating which management alternative is being adopted as the CCP that will guide refuge management decisions over the next 15 years. We will then announce the availability of the ROD in another NOA in the *Federal Register*, completing "Step F: Prepare and Adopt a Final Plan." We will also use the final plan to promote understanding and support for refuge management among State agencies in Massachusetts, our conservation partners, tribal governments, local communities, and the public.

"Step G: Implement Plan, Monitor and Evaluate" will begin once we notify the public in the *Federal Register*. We will modify this CCP following the procedures in the Service Manual (602 FW 1, 3, and 4) and NEPA requirements as part of "Step H: Review and Revise Plan." Minor revisions that meet the criteria for categorical exclusions (550 FW 3.3C) will require only an Environmental Action Memorandum. We must fully revise CCPs every 15 years.

Wilderness Review

The planning team initiated a Wilderness Review, as required by refuge planning policy, to determine if portions of Monomoy NWR that were excluded from the original 1970 wilderness designation lands and waters in fee title ownership were suitable to be proposed for designation as a wilderness area.

The purpose of a wilderness review is to identify and recommend for congressional designation National Wildlife Refuge System lands and waters that merit inclusion in the National Wilderness Preservation System. Wilderness

reviews (610 FW) are a required element of CCPs and conducted in accordance with the refuge planning process outlined in 602 FW 1 and 3, including public involvement and NEPA compliance.

There are three phases to the wilderness review process: inventory, study, and recommendation. Lands and waters that meet the minimum criteria for wilderness are identified in the inventory phase. These areas are called wilderness study areas (WSAs). In the study phase, a range of management alternatives is evaluated to determine if a WSA is suitable for wilderness designation or management under an alternate set of goals and objectives that do not include wilderness designation.

The recommendation phase consists of forwarding or reporting the suitable recommendations from the Director through the Secretary and the President to Congress in a wilderness study report. The wilderness study report is prepared after the ROD for the final CCP has been signed.

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

Appendix E summarizes the inventory phase of our wilderness review for Monomoy NWR. That draft wilderness inventory (appendix E) determined that none of the current non-wilderness portions of South Monomoy excluded from wilderness designation in 1970 yet meet the eligibility criteria for further detailed study as WSAs as defined by the Wilderness Act during the 15-year plan period.

Since the wilderness inventory (appendix E) determined no current non-wilderness portions of Monomoy NWR possess wilderness character sufficient for Wilderness Study Area designation, the wilderness study and recommendation phases of the Wilderness Review process will not be undertaken during the 15-year plan period. The refuge will again undergo another wilderness review in 15 years as part of the next planning cycle, at which time WSA designation and the wilderness study and recommendation phases will be reconsidered for the Inward Point and Powder Hole areas. We may also conduct a wilderness review prior to the next planning cycle should:

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

Issues, Concerns, and Other Opportunities

From our issues workbook, public and focus group meetings, the assessment conducted by CBI, and planning team discussions, we developed a list of issues, opportunities, and any other item requiring a management decision. Over time, some of these issues faded in importance while others surfaced or gained more importance. We concentrated on the issues raised during scoping and afterwards, as they drive our analysis and comparison of alternatives. Most of these issues are described as they were of concern in 2005, when we began again working on this CCP. In 2013, some of the issues are not as pressing, but we have included them here, as they have been considered in the development of this CCP/EIS. We will address three categories of issues in the CCP/EIS:

(1) Significant issues—these issues formed the basis for the development and comparison of different management alternatives. A range of opinions on how to resolve these significant issues and meet objectives generated the different alternatives presented in chapter 3. These issues are resolved differently among the alternatives. Significant issues are discussed in detail below.

(2) Other issues and management concerns—these issues and management concerns are also presented in chapter 3, but are not considered "significant." These issues are often resolved in a similar manner in all of the alternatives.

(3) Issues and concerns outside the scope of this analysis—the resolution of these issues falls outside the scope of this EIS or outside the jurisdiction or authority of the Service. Although we discuss them briefly in this chapter, we do not address them further in this final CCP/EIS.

Significant Issues

Addressing the significant issues below will help us achieve some of the goals described previously. Chapter 3 describes in detail how the alternatives address these significant issues, based on adaptive management of a dynamic refuge environment, and how addressing these issues will help achieve refuge goals.

Determination of Refuge Boundary and Jurisdiction—The Declaration of Taking encompasses all the land and waters from the mean low water line on the eastern shore of the refuge to an area within Nantucket Sound identified by latitude and longitude coordinates on the western site (i.e., the eastern refuge boundary is defined as mean low water and is a shifting boundary; however, the western side of the refuge boundary is fixed). Shifting boundaries due to erosion and deposition is an ongoing issue. It is important to note, that the wilderness designation extends to mean low water across the refuge.

- **Western Boundary.** Other than horseshoe crab harvesting and clamming, the Service has not regulated any of the activities occurring within the Declaration of Taking's fixed western boundary. Concern about if and how activities might be regulated by the Service within these waters has been expressed by Town of Chatham officials.

- **Eastern Boundary.** Sand shoals constantly shift, creating a complex nearshore geomorphology. As early as 2002, the connection between Nauset/South Beach and the north tip of South Monomoy Island began forming, with the intertidal connection probably occurring in 2005 and an upland connection visible by 2006. Since the boundary of the Cape Cod National Seashore extends ¼ mile beyond the land, and Nauset/South Beach has been under the jurisdiction of the Cape Cod National Seashore for many years, the two Federal boundaries technically overlap. The Service, National Park Service, and the Town of Chatham signed a memorandum of agreement in 2007/2008 that established a temporary administrative boundary for use in determining jurisdictional authorities and working together on safety and resource management issues. It also recognized the need to work together to achieve resolution of the permanent boundary issue. That MOA has subsequently expired. There is a disagreement at this time about the ownership of Nauset/South Beach and how this boundary is delineated, and concern over what activities would be allowed to continue under Service ownership.

Fishing—Fishing is a traditional use of the waters around the Monomoy Islands. Town officials and local residents, including many people who earn a living shellfishing or commercial fishing, expressed the desire that the refuge remain open for commercial and recreational fishing.

- **Shellfishing.** Residents of the town can apply for a shellfish permit to collect shellfish. People explained that residents enjoy this recreational activity but usually go to areas more easily accessed than Monomoy NWR. The species harvested in the region are softshell clams, quahog clams, mussels, scallops, and oysters, and harvest locations change annually depending upon the suitability of the habitat for these species.

- **Sport Fishing.** Recreational fishing is conducted by individual anglers and by guides and charter captains. The Morris Island portion of the refuge is open 24 hours a day for recreational fishing. Concern was expressed about continued access to the islands for fishing and 24-hour fishing access to Morris Island, as a gate had been recently installed at refuge headquarters.

- **Commercial Open Water Fishing**. The commercial fishing industry in Chatham includes open water fishing which is conducted using hook and line, trawling, fish pots (lobster, whelk, and crab) and fish weirs. There is strong interest by the Town of Chatham, the Massachusetts Division of Marine Fisheries, State legislators and local residents to allow unencumbered access and fishing in Nantucket Sound and the Southway.

Management of Resources—This includes concerns relating to both archaeological and biological management of resources. Some of these are significant issues because the objectives and/or strategies will differ among the alternatives.

- **Predator Management**. Currently, the refuge manages predators, such as coyote, greater black-backed gull, and black-crowned night-heron through a variety of lethal and non-lethal methods. Predator management elicits a strong emotional response from some individuals. Some feel that management of coyotes is ineffective and that it is a regional issue, not solely one for the refuge to resolve. Some stated it is imperative that we use existing non-lethal alternatives and actively search out new ones; additionally, when lethal management does occur, the targets are specific. Some stated that lethal predator management is never appropriate for a national wildlife refuge. Others feel policies that integrate deterrents and careful habitat modification target only offending individuals, and that actively searching for alternatives to lethal management is more appropriate. Some suggested more research was needed on alternative types of management and their effectiveness. The nesting laughing gull and tern (common, roseate) populations have increased dramatically since the predator management program was instituted in the late 1990s. The CCP will address predator management as an important management tool to minimize losses to listed waterbird and shorebird populations utilizing the refuge.

Depredation on piping plover eggs

Yianni Laskaris

- **Mosquito Control**. Currently on Monomoy NWR, the Cape Cod Mosquito Control Project controls mosquitoes. *Bacillus thuringiensis israelenis* (BTI) is a bacterium that acts specifically on mosquito larvae and prevents their development. According to the few who mentioned this issue, the application is safe and there have been no incidents with humans or animals. Many in the town do support the control of mosquitoes due to their nuisance and, more importantly, their ability to carry various diseases. Mosquito control is only an issue on Morris Island.

- **Habitat Management of Nesting Seabirds and Shorebirds.** Most interviewees noted that this is the primary natural resource of the refuge. Most interviewees consider this a valuable resource and one that the refuge does a decent to superior job in managing and protecting. Some noted the valuable relationship between Massachusetts Audubon Society and the refuge, including the tours that take place frequently in the summer. A few noted that issues have arisen in the past, from gull control to closure of various areas/islands. Overall, however, most interviewees appeared satisfied with the refuge's management of this primary resource. Nesting seabird and shorebird habitat management involves vegetation management, including the use of prescribed burning to reduce cover of grasses and woody plants in the tern colony.

- **Seals**. The seal population on Monomoy refuge has grown steadily since 2005. Some people believe that seals are impacting sport and commercial fisheries. There is also concern about the increase in the sitings of great white sharks off the Monomoy Islands and elsewhere on Cape Cod, which is attributed to the increasing seal population.

- **Dredging and Beach Nourishment**. The Town of Chatham, U.S. Army Corps of Engineers, local harbors and marinas, and private individuals want to dredge or deposit dredged material within the refuge boundary for recreational and commercial use, or to create or improve habitat for species of conservation concern in non-wilderness areas. In addition, they want to see local beach areas created and maintained outside the refuge boundary.

Public Access—Public access at Monomoy NWR consists of a number of key components.

- **Parking at Morris Island**. Stakeholders indicated that the parking lot at the refuge headquarters is often too small to accommodate visitor demand. Some local individuals feel that the refuge's open access parking attracts people to Monomoy NWR to use the beach for recreational activities and sunbathing, thereby exacerbating a parking situation on the town-owned causeway. The narrow causeway was not designed to accommodate parked cars, which can cause a safety problem. Also, some local residents are concerned that the parking at Morris Island attracts too many people and creates too much noise from buses.

- **Traffic.** Neighbors with property adjacent to the refuge have issues with the public, including vans, cars, trucks, recreational vehicles and school buses, using the right-of-way on Tisquantum Road to get to the refuge, The road is narrow and, other than snow removal, maintained primarily by the Association. Some noted that although the road is used for refuge operations, the refuge does not assist in paying for or maintaining the road. Others noted that due to poor signage, refuge traffic sometimes ends up in other neighborhoods.

- **Parking at Stage Island.** For many years we issued a very limited number of permits to allow parking in our lot on Stage Island. Non-Service parking and dinghy storage is now interfering with refuge operations, as our use of this lot has changed in the past few years.

- **Continued Access.** The general public, including anglers, expressed a desire to ensure that free, public access to the refuge continues. Shore fishermen would like to continue to access the Morris Island portion of the refuge 24 hours a day for fishing.

- **Ferry Services.** Currently, there are two ferry services that have special use permits to land on the refuge. One of the permits allows the provider to use the refuge as a base of operations. Some raised strong concern about the impacts of the current ferry service operating on refuge headquarters land. Concerns mentioned included parking on the causeway and near the headquarters, number of visitors, visitors' impacts to abutting properties, and use of ferry service as a "means to sunbathe not bird watch." Some individuals have raised concerns about the fairness of the ferry service from the refuge headquarters in that only one company has a permit that allows use of the refuge. Others noted that the ferry service provides a valuable service to visitors, ensuring that the public has direct access to North Monomoy Island and Nauset/South Beach. Some noted that this ferry service was essential to accessing the lighthouse, and that much of the use at the refuge headquarters is not ferry service customers, but general public visitors.

- **Over-sand Vehicle (OSV) Use.** There have been some problems with illegal OSV use on the refuge and in the wilderness area. This is a concern since this beach provides habitat for the federally endangered northeastern beach tiger beetles. With the February 2013 cut in Nauset/South Beach, access to South Monomoy by OSV should be significantly hampered.

Refuge Relationship with Neighbors and Local Community—The issues that may involve refuge neighbors and the local community will be addressed through coordination and partnerships. These issues could affect daily operations and visitor experience.

- **Quitnessit Neighborhood**. Some interviewees noted issues regarding the refuge's impact on abutting properties and the Quitnessit neighborhood. Of particular concern is traffic on Tisquantum Road, noise from the refuge parking lot, the use of the refuge by sunbathers, and the commercial nature of the ferry service which operates from refuge headquarters.

- **Town of Chatham**. Some interviewees noted that the Town of Chatham is the sole municipal neighbor of the refuge and, thus, this relationship should be carefully maintained and nurtured. Points mentioned are noted below.

  - Some stated that the Service does not do enough to actively keep the town informed in order to maintain an effective working relationship.

  - Some stated that the Service has not been consistent regarding its determination on public uses, nor kept promises regarding important issues with the town.

  - Among some interviewees, there is great unease about the presence and role of the Federal government in a local area that prides itself on its independence and self-sufficiency.

Public Uses—Many non-priority public uses, including those listed below, are popular on Cape Cod. Both residents and summer visitors want to engage in these uses on and around the refuge. Some of these activities are not appropriate uses of a national wildlife refuge and do not contribute to the purpose of the refuge or the mission of the refuge system, nor do they support the six priority public uses. Other activities can facilitate priority public uses. Below we provide background information on the uses we believe are most likely to be controversial. We also discuss several other non-priority uses of concern under the "Other Issues" section of this chapter.

- **Commercial Services (including guide, teaching, interpretation, leading trip (e.g., natural history tours)).** Many noted that this was a growing activity on the refuge. Commercial guides include guides for activities such as seal watching, surf fishing, surf fly-fishing, and sea duck hunting. Some expressed concern regarding commercial guide services that use the area, especially for commercial fly-fishing. Many of these guides come in from other states and may not feel the ownership of Monomoy felt by local residents and more regular users. Some felt guides "have no vested interest in preserving and maintaining Monomoy." Some interviewees said guides cross from one side of the refuge to another through the grassy nesting areas of protected birds. There was concern expressed that guides, although commercial, are not regulated. Some of the commercial guiding occurs in Morris Island and not in the designated wilderness areas. There is concern by some commercial guides that our management actions will negatively affect their activities on the refuge.

- **Dog Walking.** Currently, only Morris Island is open to dog walking (on leash). However, some people explained that dogs are not always kept on leashes and other people expressed that dogs should be banned since they disturb the birds. The Master Plan of 1988 banned pets year-round on the Monomoy Islands and during the spring and summer on the Morris Island portion of the refuge. This latter prohibition was apparently never enforced, however. In addition, the other eastern Massachusetts refuges have already eliminated dog walking.

- **Boating.** Within the refuge's Declaration of Taking boundary, there is both motorized and non-motorized boating, including standup paddleboards. A few individuals expressed concern that this boating activity has become too large, has adverse impacts for seals, and may be dangerous to those who unwisely get too close to the seals. Motorboats are normally excluded from wilderness waters but a provision in the 1970 wilderness designation allows motorized boating to continue at Monomoy refuge, with approval by the Secretary of the Interior.

- **Moorings.** The Town of Chatham issues boat moorings in Stage Harbor. Since the Stage Harbor mooring field is rapidly filling up, there will be more demand/pressure for commercial fishermen to place moorings and store their boats in the waters on the west side of North Monomoy Island. This has already happened and is anticipated to continue. Placement of these moorings within the Declaration of Taking area would be a concern to the Service, particularly in seagrass beds.

- **Kite Boarding.** The refuge staff has observed this activity disturbing beach-nesting birds as well as birds foraging in shallow waters.

- **Personal Watercrafts (wave runners and jet skis).** These vessels are small and fast. They are used in shallow areas and, as with kite boarding, disturb beach-nesting and foraging birds. Interviewees stated that the NPS ban of personal water craft in the Cape Cod National Seashore has had a positive impact at the refuge.

- **Seal Watching.** Most interviewees stated that this is an appropriate and positive activity on the refuge. Seal watching is a popular activity on the refuge and ferry services offer rides to view seals. Tourists like this activity more than whale watching because the ride is much shorter and not as rough, and seals can almost always be observed. However, some explained that it puts a burden on the refuge headquarters, adds to traffic and congestion, and presents problems regarding parking. A few expressed concerns that this activity has become too large and has adverse impacts for seals, and may be dangerous to those who unwisely get too close to the seals.

Other Issues

The following issues are narrower in scope or interest than the significant issues, but still in that range of opinions. We explain how we will address the following issues and concerns in chapter 3 under the sections Actions Common to all Alternatives and Actions Common to Alternatives B and C.

- **Beach Sports, Grilling, and Use of Shade Tents.** Interviewees noted that visitors may confuse the mission of the Cape Cod National Seashore (recreation and resource protection) with the refuge's mission of resource protection and appreciation of that resource.

- **Beach Use (sunbathing and picnicking).** Most of the interviewees stated that sunbathing should not be permitted since this is not an appropriate activity for a wildlife refuge, especially with so many other beaches in the vicinity where sunbathing can be accommodated.

- **Kayaking.** Kayakers want access from Morris Island. Use of the steep stairs at the refuge can impact other visitors using the stairs and could be unsafe. Additionally, although kayaking can support wildlife observation and photography, kayakers can also disturb seals and roosting shorebirds.

- **Law Enforcement.** Nearly everyone interviewed felt there were not enough law enforcement personnel to effectively regulate the refuge and its users, both at headquarters and out on the flats and islands. Some interviewees suggested further coordination with the National Park Service. Some noted that regular users tend to be self-policing and have informally assisted the Service in monitoring activities. Although the refuge needs more law enforcement, the level of staffing may vary among alternatives.

- **Beachcombing.** Most interviewees stated that they did not see any issues with beachcombing on the refuge. However, some noted that archaeological artifacts should be turned over to the appropriate authorities.

- **Trespass by People Engaged in Shore/Surf Fishing .** Most interviewees stated that surf-fishing is an appropriate and positive activity on the refuge. Surf fishing takes place on Monomoy NWR for striper, blue fish, and others. Some said that although they saw no problem with the activity, there could be issues of fishermen going from one side of the island to the other and cutting through the grassy areas where birds are nesting. Fishermen and other users also cut through the salt marsh. The fishermen also often put their gear behind the closed area signs on dry sandy areas in the salt marsh so they can leave their gear for the day without its getting inundated by an incoming tide. Unfortunately, these dry elevated areas are often where oystercatchers and terns are nesting.

Yianni Laskaris 2013

View from top of Monomoy Light

- **Horseshoe Crabs Harvesting for Biomedical Use.** This activity is not allowed on the refuge based on a final compatibility determination published on May 22, 2002, which found this to be incompatible with the refuge purpose. The Service was sued and the Service prepared additional information at the request of the Court. This information was accepted and the closure on horseshoe crab harvesting remains in place. Most interviewees believed that this restriction was appropriate and handled effectively. The few who mentioned the resource noted the importance of horseshoe crabs to the lifecycle of birds and other wildlife. Support for horseshoe crab harvesting was raised by one individual at the 2005 scoping meetings in Chatham.

- **Archaeology and Historic Artifacts.** A few mentioned that the refuge contains numerous historic artifacts, from shipwrecks to Native American cultural resources. Some expressed concern that the Service has not adequately catalogued what we might have and does not have the personnel to police beachcombers and others from taking such finds.

- **Low-flying Aircraft.** Low-flying aircraft continue to be a problem on the refuge, as this activity disturbs birds and creates noise in the Monomoy wilderness.

Issues Outside the Scope of this Analysis or Not Completely Within the Jurisdiction of the Service

- **Colonial Ordinance.** A number of commenters, including the Town of Chatham and members of the Massachusetts legislature, have asked about the applicability of the public trust doctrine and the Colonial Ordinances of 1641 and 1647, which bestow public access for free fishing (including shellfishing) and fowling on all lands below high tide. All rights to lands and waters within the Declaration of Taking, including those covered by the Colonial Ordinance, were eliminated as a result of the condemnation establishing the refuge. Federal law under the Supremacy Clause of the U.S. Constitution provides authority in maritime matters has been recognized by the courts, including the U.S. Supreme Court. The Colonial Ordinance does not apply at Monomoy refuge.

- **Visual impact.** A few noted that extensive activity on Nauset/South Beach could detract from the relative isolation and wilderness experience of the refuge.

Chapter 2

USFWS

Piping plover nest

Affected Environment

- Introduction
- Physical Environment
- Biological Environment
- Refuge Visitor Services Program
- Refuge Archaeological, Historical, and Cultural Resources
- Regional Socioeconomic Setting
- Refuge Administration

Introduction

This chapter describes the physical, biological, and socioeconomic settings of the project area, Monomoy National Wildlife Refuge (NWR) in Barnstable County, Massachusetts. We begin with the physical landscape description, including the cultural and historic settings and land use history, followed by current conditions, global climate change and sea level rise, air quality, and water quality.

Physical Environment

Monomoy NWR is located within the southern New England region (BCR 30 and PIF 9) off the elbow of Cape Cod in the Town of Chatham, Massachusetts (maps 1.1 and 2.1). It is one of eight refuges in the Eastern Massachusetts National Wildlife Refuge Complex. The refuge was established in 1944 and historically consisted of open water and shoals with eelgrass beds, intertidal flats, salt and freshwater marshes, dunes, freshwater ponds, and upland interdunal habitats. The 8,321-acre refuge is composed primarily of North Monomoy Island and South Monomoy, until recently a peninsula attached to the mainland via Nauset/South Beach. The refuge also includes Minimoy Island and property on Morris Island, and open waters within the Declaration of Taking. Nearly half (47 percent) of the refuge, and most (86 percent) of the land lying above mean low water is also congressionally designated wilderness. From the early 1900s to present day, resort and residential development and fishing operations, including shellfishing, have been the dominant land and water uses bordering the refuge.

The refuge's natural terrestrial habitats are dominated by intertidal sandflats, open sand, grassland-covered dunes, and salt marsh, interspersed with shrublands representative of coastal ecosystems. The majority (60 percent) of Monomoy's vegetation cover types are shaped by the dynamic tidal processes and shifting sands associated with barrier beach habitats. The remaining 40 percent is composed of upland shrubland and forest with woody shrubs and small trees. National Vegetation Cover Standards (NVCS) cover typing of the refuge has resulted in the delineation of 16 land cover types, including vegetation and water surface coverage (see appendix C).

Monomoy Refuge's beaches and salt marshes provide important spawning and nursery habitat for horseshoe crabs, and the refuge is one of the most important areas for horseshoe crabs in the State (USFWS 2002). The refuge provides habitat for large populations of gray and harbor seals and is the largest gray seal haulout site on the U.S. Atlantic seaboard. The most recent count (aerial photography conducted in March 2011) numbered 10,600 individual gray seals hauled out on the refuge (Waring 2012 personal communication). About 12 percent of the State's piping plover population nests on Monomoy NWR and Nauset/South Beach combined. The refuge has hosted one of the largest common tern colonies along the Atlantic seaboard in most years since 1999, and the largest laughing gull colony in Massachusetts in most years since 2001. Monomoy NWR also serves as an introduction site for the federally threatened northeastern beach tiger beetle. The refuge provides ideal habitat, and the project is significantly contributing to the recovery of this species (USFWS 1994, 2009b).

Morris Island/Stage Island

The Morris Island portion consists of 40 acres, connected to the mainland by a causeway, and is home to the refuge's headquarters and visitor contact station. This management unit includes beach, dunes, and salt marsh habitats that support a variety of flora and fauna, including migratory birds, horseshoe crabs, fish, mammals, reptiles, and amphibians. Four to 5 acres of intertidal salt marsh occur on the south end of the island, and American beach grass is the dominant dune vegetation. In addition, 12 upland acres are forested with woody shrubs and small trees, including northern bayberry, beach plum, pitch pine, scrub oak, and eastern red cedar.

The east side of Morris Island includes a slowly eroding coastal embankment rising close to 50 feet above a narrow beach. The narrow portion of the refuge beach extends southward until joining the more moderately sloping Morris Point, which encompasses intertidal flats, salt marsh, dunes, and beach. The Morris Island Interpretive Trail, popular with refuge visitors, follows this refuge beach corridor and loops through the different Morris Island habitats described above.

On the adjoining Stage Island, the refuge has a half-acre lot, gently sloping from the road to a sandy shoreline on Stage Harbor. This lot is used for vehicle storage and boat access. The Service holds a right-of-way on privately owned roads to access this lot, which is only accessible to the public through a refuge permit.

North Monomoy Island

North Monomoy Island is an estimated 1.3 miles long and 0.4 miles wide and consists of beach, dunes, intertidal salt marsh, and (sand and mud) flats. North Monomoy Island provides habitat for spawning horseshoe crabs, nesting habitat for salt marsh sparrows, and nesting and staging areas for shorebirds, terns, and wading birds.

South Monomoy and Nauset/South Beach

South Monomoy is roughly tear-shaped, about 6 miles long and 1.3 miles wide at the southern end and is characterized by sand and mudflats, sandy beaches, extensive dunes, salt marsh, and freshwater ponds and wetlands. Small salt marsh patches occur on the northwest and southwest sides, consisting primarily of salt marsh cordgrass, salt marsh hay, saltgrass, and black grass. The freshwater ponds and marshes, which cover more than 150 acres on South Monomoy, host cattail, pond lilies, and common reed (USFWS 1988).

As a result of ongoing, natural coastal beach migration processes typical of this area, adjacent Nauset/South Beach accreted sufficiently to connect to the northeast tip of South Monomoy (map 1.1) in 2006, creating a land bridge from the island to mainland Cape Cod. Sand is now accreting on the ocean side, widening the seaward side of the 2006 connection, while salt marsh forms on the interior side of the connection.

In early February 2013, a break in Nauset/South Beach occurred in areas that had been eroding for several years. The Nauset/South Beach “thumb” adhering to South Monomoy, while changing almost daily in size and shape, was estimated as 717 acres in June 2013. The winter storms that created the 2013 break also overwashed the majority of this residual “thumb.” That overwashing buried what had been dune and some salt marsh vegetation under sand, and lowered dunes while filling in the interdunal swales. The area is now generally lower and flatter than before the break, dominated by the bare sands of numerous overwash fans separated by patches of dune, some salt marsh vegetation abutting the intertidal flats of the old Southway channel, and approximately 3 miles of sandy beaches along the Atlantic Ocean.

Minimoy, a small island located west of the northern tip of South Monomoy, is also included in this management unit. This eroding island is currently estimated to be 0.25 miles long and 0.36 miles wide, and is also characterized by sandy beaches and dunes, as well as a growing salt marsh on the east side. This management unit provides habitat for thousands of nesting and migrating birds, including shorebirds and terns.

Cape Cod Watershed

Monomoy NWR is part of the Cape Cod watershed located in southeastern Massachusetts. Cape Cod was formed by glacial activity over 20,000 years ago. The Cape region is composed of glacial end moraines, which mark the approximate locations of the ice front, and outwash plains, formed by sediments deposited by streams of meltwater from the glaciers (Massachusetts Executive Office of Energy and Environmental Affairs [MA EOEEA] 2004). This created a series of connected, broad, sandy plains, and hilly terrain. The outwash deposits

overlay bedrock at a depth of about 300 to 400 feet in the mid-Cape area. This contiguous and permeable sandy substrate forms the matrix of the Cape Cod Aquifer. The retreating glaciers left behind depressions that filled with water and are now known as kettle hole ponds. These ponds, along with freshwater wetlands, salt marshes, and estuaries, provide habitat for a variety of fish and wildlife (MA EOEEA 2004).

The Cape Cod Glacial Aquifer is a continuous, unconfined aquifer system underlying the Cape Cod peninsula. The peninsula extends into the Atlantic Ocean and is separated from the rest of Massachusetts by the Cape Cod Canal (Martin 2008). The aquifer consists primarily of highly permeable, glacial sediments, and is the principal source of drinking water for the peninsula.

The Cape Cod watershed, as designated by the Massachusetts Office of Energy and Environmental Affairs, extends 70 miles into the Atlantic Ocean and is surrounded by the salt waters of Buzzards Bay, Cape Cod Bay, the Atlantic Ocean, and Nantucket Sound. The watershed encompasses a drainage area of approximately 440 square miles and includes 559 miles of coastline, 145 public water supply wells, 8 State areas of critical environmental concern (ACEC), 116 square miles of protected open space, and numerous rare and endangered species. Watershed priorities set forth by the State of Massachusetts for the Cape Cod watershed are:

- Reduce or eliminate nonpoint source pollution through comprehensive water resources management planning.
- Ensure drinking water quality for the future by identifying potential new water supplies and protecting existing sources.
- Support community preservation efforts within the watershed, including planning for sustainable growth and protecting Cape Cod's critical habitats.
- Improve communication, outreach, and education between citizens and watershed partners.
- Monitor and assess fresh water ponds, coastal embayments, and threatened water bodies to protect water quality, habitat, and enhance recreational uses.

Bill Thompson/USFWS

Short-billed dowitcher

You may view this information at: *http://www.mass.gov/?pageID=eoeeaterminal&L=4&L0=Home&L1=Air%2c+Water+%26+Climate+Change&L2=Preserving+Water+Resources&L3=Massachusetts+Watersheds&sid=Eoeea&b=terminalcontent&f=eea_water_capecod&csid=Eoeea* (accessed August 2011).

On a larger scale, the Monomoy Islands are included in the Cape Cod and Islands watershed (U.S. Geological Survey [USGS] HUC 01090002), which encompasses Martha's Vineyard, Nantucket (including Muskeget and Tuckernuck Islands), and other small islands south of Cape Cod (U.S. EPA, *http://cfpub.epa.gov/surf/huc.cfm?huc_code=01090002*; accessed August 2011).

Geographical Setting and Landscape Context

Biophysical Ecoregion 2-3—North Atlantic Coast

The Nature Conservancy (TNC) has divided the continental United States into 63 ecoregions—large geographic areas that share similar geologic, topographic, ecological, and climatic characteristics. These ecoregions are modified from the U.S. Forest Service's "Bailey System" (Bailey 1995). TNC has developed ecoregional conservation plans that identify conservation targets and prioritize conservation actions.

Monomoy NWR is in the North Atlantic Coast ecoregion as described by TNC (map 2.1). This ecoregion extends from Pemaquid Point in Maine south to

Delaware Bay. Flat topography, low elevations (less than 600 feet), scattered moraines, large rivers draining into estuaries and bays, and a mild, humid climate characterize this region. Rocky coasts dominate the shorelands in the north, grading into salt marsh communities to the south. The once extensive forest graded from white pine-oak-hemlock forest, to dry oak-heath forests, to mesic coastal oak forests from north to south. Wetlands, beaver meadows, pine barrens, and heathlands were embedded in this forested landscape. Hundreds of years of land clearing, agriculture, and widespread development has fragmented the landscape and eliminated large areas of forest. Still, smaller ecological systems remain, including barrier beaches and dunes, salt marshes, and freshwater wetlands (TNC 2006). Current action sites for TNC exist on Martha's Vineyard and the Cape, where land protection and management activities are already occurring.

Atlantic Flyway

Monomoy NWR is within the Atlantic flyway. Flyways have been used for many years in North America as the unit for managing waterfowl populations because they allow land managers to link efforts to conserve migratory bird species and their habitats on breeding, migration, and wintering grounds. The Atlantic Coast Joint Venture area includes the entire U.S. Atlantic coast lying completely within the Atlantic flyway. In this large area, the ACJV partners work together to assess the status, trends, and needs of bird populations and their habitats. The partners then use this information to help guide the distribution of resources to the needs and issues of highest priority.

Strategic Habitat Conservation and Landscape Conservation Cooperatives

Strategic Habitat Conservation (SHC) is the conservation approach the USFWS is using to achieve its mission in the 21st century and represents a landscape approach that is strategic, science-driven, collaborative, adaptive, and understandable. "The purpose of SHC is to coordinate and link actions that various programs and partners perform at individual sites, so that their combined effect may be capable of achieving these outcomes at the larger landscape, regional, or continental scales. In this way, conservation actions can help recover and sustain species' populations as part of whole communities and systems, together with their ecological functions and processes.

"The SHC approach is built on five main components that compel the FWS to align expertise, capability, and operations across our programs in a unified effort to achieve mutually aspired biological outcomes: (1) *biological planning*—working with partners to establish shared conservation targets and measurable biological objectives (i.e., population) for these outcomes, and identify limiting factors affecting our shared conservation targets, (2) *conservation design*—creating tools that allow us to direct conservation actions to most effectively contribute to measurable biological outcomes, (3) *conservation delivery*—working collaboratively with a broad range of partners to create and carry out conservation strategies with value at multiple spatial scales, (4) *outcome-based monitoring*—evaluating the effectiveness of conservation actions in reaching biological outcomes and to adapt future planning and delivery, and (5) *assumption-driven research*—testing assumptions made during biological planning to refine future plans and actions. Both monitoring and research help us learn from our decisions and activities and improve them over time. SHC relies on an adaptive management framework to focus on a subset of shared conservation targets, set measurable biological objectives for them, and identify the information, decisions, delivery, and monitoring needed to achieve desired biological outcomes. SHC helps the Service, and the broader conservation community, effectively organize expertise and contributions across programs and partners, so our efforts to conserve landscapes—capable of supporting self-sustaining populations of fish, wildlife, and plants—are both successful and

efficient." For more information on SHC, go to: *http://www.fws.gov/landscape-conservation/shc.html* (accessed January 2013).

In cooperation with the USGS, the Service is promoting landscape conservation through a national geographic network of landscape conservation cooperatives (LCC). "LCCs are applied conservation science partnerships with two main functions. The first is to provide the science and technical expertise needed to support conservation planning at landscape scales—beyond the reach or resources of any one organization. Through the efforts of in-house staff and science-oriented partners, LCCs are generating the tools, methods, and data managers need to design and deliver conservation using the Strategic Habitat Conservation approach (see below for more details). The second function of LCCs is to promote collaboration among their members in defining shared conservation goals. With these goals in mind, partners can identify where and how they will take action, within their own authorities and organizational priorities, to best contribute to the larger conservation effort. LCCs don't place limits on partners; rather, they help partners to see how their activities can "fit" with those of other partners to achieve a bigger and more lasting impact." For more information on LCCs, go to: *http://www.fws.gov/landscape-conservation/lcc.html* (accessed January 2013).

Monomoy NWR is located in the North Atlantic LCC, which combines BCRs 14 (Northern Atlantic Forest) and 30 (New England/Mid-Atlantic coast), and contains 12 of 13 Northeast states as well as the District of Columbia (map 2.1). It includes a diverse array of ecosystems, from high elevation spruce-fir forests to coastal islands. Near Monomoy NWR, there exist many conserved lands along Cape Cod and the associated islands (map 2.1) with which the refuge can partner.

The North Atlantic LCC, "provides a partnership in which the private, state, tribal, and federal conservation community works together to address increasing land use pressures and widespread resource threats and uncertainties amplified by a rapidly changing climate. The partners and partnerships in the cooperative address these regional threats and uncertainties by agreeing on common goals for land, water, fish, wildlife, plant, and cultural resources and jointly developing the scientific information and tools needed to prioritize and guide more effective conservation actions by partners toward those goals." For more information on the North Atlantic LCC, go to: *http://www.northatlanticlcc.org/* (accessed January 2013).

Western Hemisphere Shorebird Reserve Network

In 1995, Monomoy NWR was listed fourth among 96 sites meeting the Western Hemisphere Shorebird Reserve Network (WHSRN) shorebird staging site criteria. In March 1999, the refuge was designated as a WHSRN regional site. WHSRN is a voluntary, non-regulatory coalition of more than 160 private and public organizations in 7 countries working together to study and conserve shorebirds throughout their habitats. Membership in WHSRN provides the site with international recognition as a major host for shorebirds.

From maritime Canada to Virginia, the Western Hemisphere Shorebird Reserve Network has recognized six stopover sites that are especially important to migrating shorebirds: Bay of Fundy in New Brunswick and Nova Scotia, the Great Marsh in Massachusetts, Monomoy NWR, Edwin B. Forsythe NWR in 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

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan

Service and Partner Conservation Regions

Partners in Flight Physiographic Areas

Bird Conservation Regions

The Nature Conservency Ecoregions

USFWS Landscape Conservation Cooperatives

the site annually, particularly during southward migration (Regional Importance; WHSRN 2006). Edwin B. Forsythe Refuge supports 85,000 shorebirds annually during both migration periods combined (Harrington and Perry 1995). Maximum 1-day counts at Maryland–Virginia Barrier Islands have been over 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; Clark et al. 1993, Harrington et al. 1989).

Although no studies have estimated turnover rates and quantified the total number of shorebirds using Monomoy Refuge, at least 40 species have been documented since 1975 and thousands of migrants are estimated to use the refuge annually (International Shorebird Surveys unpublished data, Harrington and Perry 1995, Harrington et al. 1989, Koch and Paton 2009, Senner and Howe 1984, Veit and Petersen 1993). The designation of Monomoy Refuge as a WHRSN site is evidence of its value in hemispheric conservation of shorebirds. The criteria for being designated a regional site describe an area that hosts at least 20,000 shorebirds annually, or 5 percent of the species' flyway population based on peak species counts. Additional information about the WHSRN can be viewed online at: *http://www.whsrn.org/site-profile/monomoy-nwr* (accessed January 2013). More information regarding shorebird use of the refuge can be found in the Migrating Shorebirds section, under Migratory Birds.

Important Bird Area

Due to Monomoy NWR's relative importance to birds in Massachusetts, it was also designated an Important Bird Area (IBA) by the Massachusetts Audubon Society in 2000. The purpose of an IBA is to identify and protect sites that contain essential habitat for one or more species of breeding, wintering, or migrating birds. IBAs are designated as part of an international effort to protect bird habitat around the world. Information about the IBA program is available on the Massachusetts Audubon Society Web site and can be accessed at: *http://www.massaudubon.org/Birds_and_Birding/IBAs/ibaflashmapnew.php* (accessed January 2013).

Marine Protected Area

Monomoy NWR is also designated as a National Marine Protected Area (MPA) as defined under Executive Order 13158 of May 26, 2000 as, "…any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." The Monomoy NWR MPA's focus is on conserving natural and cultural heritage and sustainable production. The adjoining Cape Cod National Seashore is also a designated MPA along with the smaller, nearby Pendleton and Dixie Sword "Exempt Site" MPAs (*http://www.mpa.gov/dataanalysis/mpainventory/mpaviewer/*; accessed January 2013).

Executive Order 13547—Stewardship of the Ocean, Our Coasts, and the Great Lakes—established a national policy to, among other reasons, ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lake ecosystems and resources (*http://www.whitehouse.gov/the-press-office/executive-order-stewardship-ocean-our-coast-and-great-lakes*; accessed July 2013). The policies contained in this executive order formed the basis of the 2013 National Ocean Policy Implementation Plan. The plan was written by the National Ocean Council after extensive input from national, regional, and local stakeholders from all marine sectors; tribal, state, and local governments; the private sector; scientists; and the public (*http://www.whitehouse.gov/oceans*; accessed July 2013).

The International Convention on Biological Diversity adopted a revised and updated Strategic Plan for Biodiversity for the 2010 to 2020 period, which contains biodiversity targets, including Target 11: By 2020, at least…10 percent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative, and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes (*www.cbd.int/sp/targets*; accessed July 2013). Helping achieve this target is a global commitment on marine protected area (MPA) networks (Wenzel and Wahle 2013). Participation in the national MPA system does not constrain the management agency from changing its management of the MPA. The management agency retains the ability to add or reduce levels of protection, change the size of the MPA, or make other changes.

Geology and Topography

Geomorphic regions, or physiographic provinces, are broad-scale subdivisions based on terrain texture, rock type, and geologic structure and history. Monomoy NWR lies in the Sea Island Section of the Atlantic Coastal Plain delineated by the USGS *http://tapestry.usgs.gov/physiogr/physio.html*; accessed August 2011). Many of these islands off the Massachusetts coast mark the southern limit of the last glacial maximum (15,000 to 20,000 years ago), where terminal moraines of clay-rich, poorly sorted glacial materials were deposited. This had an influence on the subsequent development of beaches, offshore islands, and other landforms (*http://tapestry.usgs.gov/features/features.html*; accessed August 2011).

The Morris Island portion of the refuge is situated on outwash plain deposits (Oldale 1992). Ongoing erosion of the east side of the island, which rises up nearly 50 feet from a narrow beach to the refuge's headquarters site, has removed much of the beach. The southern portion of Morris Island slopes down moderately to mixed pine forest, dunes, intertidal salt marsh, and beach, and an adjoining dredge material "sand spit."

Traveling east to west on North Monomoy Island, one traverses a narrow beach, dunes, and intertidal salt marsh to reach a wide, intertidal sandflat. The northern two-thirds of South Monomoy is flanked by sandy beaches on the east and west, with north-south trending dunes between. The southern third of South Monomoy is typical of a dune-ridge island, with a high scarped dune line along the eroding eastern side and distinctive dune ridges running southwest in the direction of accretion. Although the littoral currents are the dominant force configuring the Monomoy Islands, dune vegetation, which traps sand moved by the prevailing winds, also plays an important role in dune formation and maintenance (Giese et al. 2010).

The Monomoy Islands and sand spits rest on a bed of glacial material left approximately 18,000 years ago in the wake of retreating glaciers (Oldale 1992). The islands themselves are estimated to be about 6,000 years old. The topography of the Monomoy Islands is highly dynamic and is continually being reshaped by wind and waves. Giese (1978) has traced the evolution of North and South Monomoy since the 1770s. The southern end has migrated to the south and west, while the northern end has alternately connected with and separated from the mainland of Cape Cod. Historically, the area's topography undergoes an estimated 150-year cycle, with land forms accreting, eroding, and overwashing, and islands being created and recreated to eventually form a peninsula (Giese et al. 2010). This is described in more detail in the History of Refuge Coastline Dynamics section. The future configuration of the Monomoy barrier complex largely depends on the rate of sea level rise, which is discussed under Global Climate Change and Sea Level Rise.

Coastal Geomorphology

Coastal geomorphology is the study of the processes that influence coastal landforms. These natural coastal processes include accretion and erosion, that is, the deposition and removal, of sand along shorelines. Sand eroded from one beach is transported or "down drifts," and accretes on another. These processes are influenced by many factors, including ocean currents, tides, winds, sea floor bathymetry, and human modifications. The dynamic nature of these systems means that the same beach can both accrete and erode seasonally within a given year, and fluctuate between accretion and erosion over long periods of time (MA CZM 2011). These processes provide continually changing coastlines and habitats for many species of wildlife. The dynamic Cape Cod shorelines, including the Province Lands, as well as Nauset Spit and most of Great Island, were formed by the movement and relocation of sand as part of this process; both Provincetown and Monomoy Island are still growing by about 1 acre a year with sand eroded from the outer Cape beaches (*http://www.nps.gov/caco/naturescience/upload/geomorphology.pdf*; accessed October 2011).

According to the most recent shoreline analysis, 68 percent of the Massachusetts shoreline is in a long-term erosional trend, 30 percent is in a long-term accretional trend, and 2 percent shows no net change. Overall, results indicate that the Massachusetts shore is eroding at a long-term average annual rate of 0.58 to 0.75 feet (mid-1800s to 1994). This coincides with the 75 percent of U.S. coastline that is eroding (Woods Hole Oceanographic Institute [WHOI] 2003).

Bill Thompson/USFWS

Snowy owl

For the shoreline along Chatham, the long-term average shoreline change rate over the same time period is a loss of 0.65 feet per year, but the short-term trend rates will vary by and within communities. These long-term annual averages take into account long-term erosion or accretion periods, potentially resulting in deceptively low change rates, when in fact the short-term change rates for a particular location can be much higher (WHOI 2003). South Monomoy has shifted to the south and west since the mid-1800s, with a long-term change rate of -15.6 feet per year (eroding) along the eastern edge, and +25 feet per year (accreting) on the southern tip (MORIS Shoreline Change Map; *http://maps.massgis.state.ma.us/map_ol/czm_shorelines.php*; accessed September 2011). This not only affects the overall size of the refuge, but also the available habitat for species that rely on coastal ecosystems, which are some of the major influences on the amount and quality of habitat for beach-nesting species (MA DFG 2006).

Tides and Currents
Monomoy NWR was formed by longshore, southbound, ocean currents that continuously transported sand from the Cape's eroding eastern shoreline north of the refuge. The barrier complex composing the refuge formed when the Nantucket Sound currents met these southerly flowing longshore currents and the entrained sand settled to form shoals and, eventually, islands (*http://www.capecodconnection.com/monomoy/monomoy.htm*; accessed September 2011).

Tides at Monomoy NWR are classified as semidiurnal (i.e., two high and two low tides every 24 hours). Data from the Nantucket National Water Level Observation Network (NWLON) station shows that from 1983 to 2001, the mean high water (MHW) was 6.24 feet, and mean low water was 3.20 feet (National Oceanographic and Atmospheric Administration [NOAA] 2009a)—a tidal difference of approximately 3 feet. At the refuge, the times of high and low tides are expected to coincide largely with those measured at Nantucket, although observed tides will fluctuate according to prevailing winds. Another NOAA station (buoy # 44018) located close to the refuge provides wind speed and direction, wave height, and other meteorological data. This information is available online at: *http://www.ndbc.noaa.gov/station_page.php?station=44018*; accessed June 2012.

History of Refuge Coastline Dynamics
The barrier islands and associated sand shoals at Monomoy NWR are constantly changing due to the complex nearshore geomorphology of the area, which includes storms, high winds, tide, and surf that change the terrain and shoreline. However, erosion and drift of sand from the outer beaches of Cape Cod are the foundation of the refuge's islands. The eroding sand from the north moved southward to reconnect Monomoy back to the mainland and form a peninsula for a short duration of time. A fixed boundary line (refuge Declaration of Taking) was established west of the Monomoy Islands, and the refuge's islands had room for migration and shift (U.S. District Court 1944).

In 1944, when Monomoy became a national wildlife refuge, the area was one contiguous landmass stretching from Morris Island approximately 8 miles south into Nantucket Sound. The southern end of Nauset Beach, commonly known as North Beach, which stretches from Orleans, MA to Chatham, MA, terminated just south of Morris Island, and was parallel and due east of the refuge.

At some point between 1944 and 1958, Stage Harbor was dredged for commercial fishing fleets, and sand was piled adjacent to the refuge lands at Morris Island. This new landmass is still recognizable today—the formation is a narrow finger of land heading west toward the Stage Harbor entrance. Although the channel continues to be dredged, sand is no longer deposited on this town-owned portion. During this same timeframe, a causeway was constructed between Stage and Morris Islands, and the channel separating the two islands was filled with sand. This was done to decrease the need for dredging in Stage Harbor, but also had the effect of increasing the land value of lands surrounding the refuge headquarters.

In 1958, a spring northeaster cut through the northern reaches of Monomoy, separating the island from mainland Chatham at Morris Island (figure 2.1, box 1). Monomoy Island was still accessible at low tide, and for a few years motor vehicles were able to access the island using a local ferry. Over time, however, the width of the channel between Monomoy and Morris Islands became very wide and ferrying motorized vehicles became infeasible. North Beach continued to slowly grow southward.

In 1978, a blizzard split Monomoy Island in two approximately one-third of the way down (figure 2.1, box 2); the northern island came to be known as North Monomoy, and the southern known as South Monomoy. Tidal flow through the 1978 inlet created a flood-tidal shoal near the western margin of the platform, which, due to the influence of the prevailing southwesterly wind waves, formed the islet known today as Minimoy Island (Giese et al. 2010). At the same time, the southern tip of North Beach had extended further south and was approximately due east from the mid-point of North Monomoy.

In 1987, a storm caused a break to form in front of the Chatham Lighthouse on Nauset Beach (figure 2.1, box 3); this break would continue to widen over the years. The new landmass (island) formed to the south, stretching from the Chatham Lighthouse south to North Monomoy, and became known as South Beach. Following this storm, the mainland was rip-rapped to protect the homes near the Chatham Lighthouse from scour and erosion.

In 1992, the Nauset/South Beach Island started to stretch westward and became attached to the mainland, in a landform known as a tombolo (figure 2.1, box 4).

In the winters of 1998 and 1999, a 975-foot rock revetment was installed between the Monomoy NWR beachfront and four adjacent landowners to the west on Morris Island. Following the revetment construction, beach renourishment took place with the addition of 1,300 cubic yards of sand. In 2005, the Service was approached by the Cape Cod Commission to determine if we wanted additional beach renourishment on Morris Island. With the information we had at that time, we determined that additional beach renourishment was not warranted. However, since then, the beach on the east side of Morris Island has experienced additional erosion, and we are now receptive to renourishment proposals.

From 1992 to 2006, Nauset/South Beach continued migrating southward, as sand eroded from the north and deposited on the south. These two parallel landmasses, the Monomoy Islands and Nauset/South Beach, were separated by a waterway known as the Southway. The southern tip formed a connection which could be crossed at low tide. During this time, sand from Nauset/South Beach was not transported south to re-nourish South Monomoy, but instead curled back into the Southway and moved between North and South Monomoy. The marshes on North Monomoy started to expand and the small cuts through the flats became difficult to navigate at low tide.

During this time, South Monomoy also started to erode on the east side, leaving its mid-point only 328 feet wide. The northern dunes on South Monomoy also eroded, losing half their elevation, and sand was pushed into Hospital Pond, a pond at the northern end of the island. While the intertidal connection probably occurred in 2005, a Thanksgiving Day northeaster in 2006 caused the southern tip of Nauset/South Beach to attach as dry sand to the northern tip of South Monomoy (figure 2.1, box 5). This attachment allowed a person to walk from the Chatham Lighthouse to Monomoy Point Lighthouse, something not possible since 1958.

Like South Monomoy, Nauset/South Beach has also changed in shape due to geomorphological processes, with some areas narrower than others. In February 2013, a break in Nauset/South Beach occurred through which small boats were able to pass at high tide. This break has remained as of this writing. This is discussed in greater detail in this chapter under Refuge Administration.

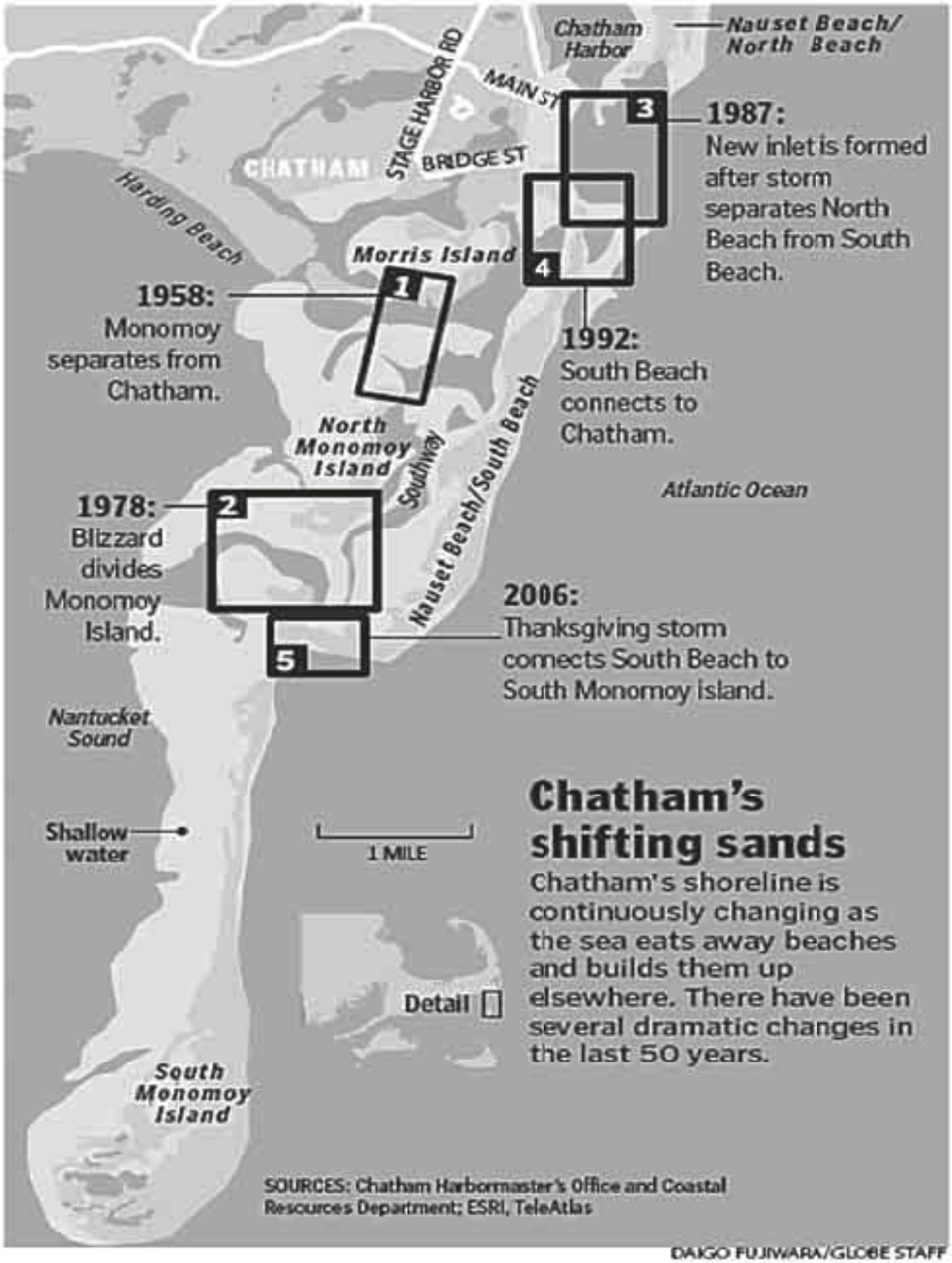


Figure 2.1. Landform Changes in Monomoy NWR and the Eastern Coastline of Cape Cod.

Major Historical Influences Shaping Landscape Vegetation

Understanding the historical distribution and composition of plant species can be useful in evaluating future management options for the Monomoy NWR (Foster et al. 2003). The Cape Cod area has undergone significant natural and anthropogenic changes, which have shaped the vegetation communities currently found on the refuge. The disturbance agents shaping the vegetation on Monomoy NWR include glaciation, other natural processes, and forms of human disturbance and land use. However, we have noted that ecologists caution against selecting one point in time, and instead recommend managing for a "historical range of variation" for each habitat type when considering the restoration of areas to native vegetation.

Understanding the history of the land, its biota, and its interactions, including the role of human beings, is the first task of restoration. For example, the study of the natural and cultural environment of coastal ecosystems increases our understanding of the ecological requirements needed to manage and conserve existing dune grasslands and maritime shrubland. A comprehensive overview of the influences on natural vegetation patterns across the Massachusetts landscape follows.

The Laurentide ice sheet covered Massachusetts and all of New England during the last glacial maximum, approximately 21,000 to 18,000 years before present (BP). The glacier reached its southernmost extent at the islands of Nantucket and Martha's Vineyard, marked by the deposition of terminal moraines on these islands. These terminal moraines are a build-up of the rock debris, or glacial till, embedded in the glacier that is sloughed off and deposited along the leading edge of the glacier. The sedimentation on these islands is consistent with this process (Motzkin and Foster 2002).

The advancing Laurentide ice sheet scoured the land and shallow-water areas, removing most plant and animal life, while retreating shorelines and exposed seabeds provided new areas for plant and invertebrate colonization (Oldale 2001). As the ice sheets retreated, sea levels gradually rose. In addition, the earth's crust slowly rebounded from the heavy weight of ice, but not as fast as sea levels were rising. By about 12,000 years BP, the coastline between the Bay of Fundy and Cape Cod was much as it is now (Pielou 1991). The indented coastline from Eastham southward to Chatham also owes its existence to the Laurentide ice sheet, and most likely represents the last remnant of an irregular coastline made up of headlands and embayments that marked the eastern limit of the glacial Cape. It also represents a western expansion of the South Channel lobe in the form of a sublobe, which, at its largest size, occupied the site of the Eastham outwash plain and limited the eastern extent of the Harwich outwash plain and the distribution of the Nauset Heights deposits (Oldale 2001).

As the ice age waned and the climate warmed, the glacier retreated, depositing till (Oldale 2001) and inundating low-lying coastal areas (Pielou 1991, Prentice et al. 1991). The exposed substrate was colonized by various plant communities, with tundra-like vegetation dominating the landscape at the southern terminus of the glacier (Jackson et al. 2000). For several thousand years, this tundra-like landscape was dominated by sedges and dwarf shrubs (Williams et al. 2004), but as the area continued to warm and trees were able to survive the shortening winters, forests became established. Initially, more cold-tolerant conifers dominated the landscape, with deciduous species reaching the area around 6,000 to 3,000 years BP (Foster et al. 2006). Most of Monomoy NWR consists of coastal wetlands and dunes; therefore, it is unlikely that extensive forest covered the local area. Dunes and intertidal areas would likely have only become an important component of the refuge area when sea levels rose to their current levels.

Contemporary Influences on Vegetation Patterns

Ecological processes and other natural disturbance regimes have also defined the current vegetation characteristics of the refuge. Of these, storms, salt spray, erosion/accretion, and fire have likely been the most important in limiting plant succession and maintaining a diversity of habitats. Through processes of erosion and accretion, winter storms and hurricanes have altered the size and position of dunes, marshes, and intertidal areas. As these areas changed in size and location, the suite of species that utilized them was altered concomitantly. For instance, expanding dune areas would have increased nesting opportunities for various seabirds. Storms might destroy some of the dune nesting sites, but would also remove or retard woody vegetation unsuitable for many nesting seabirds, allowing beneficial grasses to rapidly recolonize and dominate the newly formed dunes. Infrequent fires would also limit succession of woody shrubs and vegetation, thereby maintaining more sparsely vegetated areas for nesting. Likewise, storms and altered currents would change intertidal areas, affecting the abundance and composition of various shorebirds that use those sandflats.

Fire

There is agreement in the literature that Native Americans did use fire as a tool to clear the mainland forest understory for ease of travel and hunting, to manage game populations, and possibly to create small openings around their seasonal camps (Day 1953, Russell 1983, Patterson and Sassaman 1988, Denevan 1992, Holmes et al. 1997, Williams 2000, Motzkin and Foster 2002, DeGraaf and Yamasaki 2001). The results of these land use practices have been described as creating a shifting mosaic of localized early successional, woody-dominated habitats, but likely did not result in broad-scale alterations to the landscape (Foster and Motzkin 2003). The Wamponoag people were known to inhabit areas now within Barnstable County, including Mystic Lake, Middle Pond, and Hamblin Pond, where they cleared small forest openings prior to colonial settlement

Donna Dewhurst/USFWS

Greater scaup pair

(Caljouw 2005). At the time of European settlement, mainland Cape Cod and the islands of Martha's Vineyard and Nantucket were a mosaic of pitch pine-oak forest, scrub oak and shrub heath openings (inhabited by the now extinct heath hen, Gross 1932, Bent 1932, Simberloff 1994, Johnsgard 2008), and small grasslands, with no large-scale occurrences of grasslands or other openings (Motzkin and Foster 2002, Foster et al. 2002). The more exposed coastal fringe barrier beaches and islands lying seaward of these interior woodlands were, however, dominated by grassland vegetation interspersed with small patches of bare sand or low-growing woody shrubs and scattered trees, and bordered by tidal *Spartina* marsh in more sheltered intertidal areas, much as they are today. Salt spray and aerosols (Boyce 1954), along with mechanical "sand blasting" from blowing sands and secondarily by periodic fires on these nutrient-poor sands, "pruned" woody plants to a low shrubby stature or even eliminated them (Motzkin and Foster 2002). However, fringe coastal dunelands have been largely excluded from the substantial studies of Cape Cod uplands (Motzkin et al. 2002) and therefore the role of fire is less certain.

In the (circa) 1,000 years before European settlement, fires were more common on Cape Cod uplands than in much of New England (Patterson and Sassaman 1988, Parshall et al. 2003). Fires were particularly important in pine woodlands on outwash soils on inner Cape Cod, and were less important on hardwood-dominated moraines; outer Cape Cod apparently experienced the lowest fire occurrence (Parshall et al. 2003). In the Cape Cod region, charcoal evidence from paleoecological studies indicates that the use of fire increased concurrently with the clearing of forests in the time of European settlement. Fire, in combination with other European practices such as logging, plowing, and grazing, transformed the landscape from one dominated by forests into one in which grasslands and coppice woods were prevalent. However, the palaeoecological record is not useful in determining the prehistoric occurrence and distribution of small grasslands or heathlands, or in clarifying the importance of upland shrublands versus woodlands. Fossil pollen of characteristic oak scrub species (e.g., bear oak) cannot be distinguished from that of tree oaks and associated characteristic ericaceous species that occur commonly in woodlands, shrublands, and heathlands (Motzkin and Foster 2002).

More recently, during the 61-year period from 1951 to 2012, there were six wildfires (unplanned, human-caused ignitions) in wildland fuels documented for Monomoy NWR, ranging in size from less than 0.1 to 6 acres. No natural (lightning) ignitions are documented during that same 61-year period. Wildfire causes included two ignited by signal flares from distressed boaters, one unattended campfire, one from arson, one grassfire during cabin disposal, and one undetermined cause. During the same 61-year period, at least 9 planned ignitions (prescribed fires) in wildland fuels are documented for Monomoy NWR, ranging up to 43 acres in size. Refuge personnel experimented with prescribed fire to provide green forage for fall and spring migrating waterfowl during the early 1950s. Burning for wildlife habitat was discontinued after the 1954 burns on a belief that the potential risk from erosion outweighed the intended forage benefits to migrating waterfowl and the logistical difficulties of applying fire in such remote, inaccessible areas during the few suitable weather windows available each year. The refuge resumed using fire as a tool for disposing of unoccupied and deteriorating camps during the late 1960s; this continued through the early 1980s. Fire remained absent as a habitat management tool at Monomoy until 2002 when two small vegetation management study plots were burned within the tern colony. During the period from 2002 to 2012, four prescribed burns were executed within the South Monomoy tern colony, the largest in October 2009 and 2012 when the same 35± acres of primarily beach grass was prescribed burned to improve tern nesting habitat each of those years.

Cultural Landscape Setting and Land Use History

Pre-Contact Period

The first human inhabitants of the Cape Cod region were the Paleoindians, who reached the eastern seaboard approximately 11,500 years ago. Organized in small bands, the Paleoindians were highly mobile and used a specialized toolkit that included distinctive scrapers and fluted spear points. The environment they knew was cool and dry; the landscape was vegetated in spruce-pine forest and was populated by temperate terrestrial species, including many animals still seen in the region today. Between the Cape and the areas that now encompass the islands of Martha's Vineyard and Nantucket, the ocean floor was exposed until about 8,500 years ago. Evidence of late Paleoindian settlements has been reported in Bass River, near Chatham; however, it is likely that numerous other habitation sites existed on the exposed continental shelf, since inundated by rising sea levels in the post-glacial period (Dunford and O'Brien 1997).

Early Native American Influences

The successors to the Paleoindians were Native Americans of the Early Archaic period, approximately 9,500 to 8,000 years ago. These people knew a climate that was increasingly warm and humid and a mainland environment in which woodlands were dominated by hemlock and beech, which had replaced open conifer-dominated parkland (Shuman et al. 2004). These changes in vegetation were accompanied by shifts in animal populations in the Cape Cod region. The Native Americans modified their technologies in response, adopting new forms of notched spear points, and may have used spear-throwing devices to launch projectiles over greater distances than was possible by hand. As forests of deciduous trees closed in over the landscape, previously barren zones offered attractive resources, such as hazelnuts, hickory nuts, butternuts, and some tuberous plants (Dent 1995).

The innovative subsistence strategies practiced by the people of the Early Archaic period led them to modify their settlement system, as they used longer-term occupations and took advantage of seasonally available resources found in a wider variety of locations. Sea level rise inundated the low-lying areas along Cape Cod, separating Martha's Vineyard and Nantucket from the mainland. People seasonally occupied centrally located residential camps from which hunting and collecting parties ventured. In the warmest months of the year, communities were established near estuaries and wetlands; during the colder months, camps were occupied in the more protected interior uplands of Cape Cod, near sources of fresh water (Dunford and O'Brien 1997).

During the Middle Archaic period (8,000 to 5,000 years ago), a climatic warming trend with moist and dry sub-episodes prevailed. Hickory, chestnut, and oak became the dominant tree species (Shuman et al. 2004) and, by the end of the period, mixed deciduous forests, similar in composition to those seen in the region today, prevailed. The fruit of these trees (i.e., mast, such as acorns and nuts) was a nutritious and easily stored food source for the Native Americans (Dent 1995).

Around 6,000 years ago, the shoreline of Cape Cod took the general form that is recognizable today. The formation of barrier beaches partially closed off small bays in the glacial landscape and formed lagoons protected from the ocean. Human populations appear to have grown as the Archaic period progressed. Evidence from archaeological sites suggests that people subsisted on a mix of hunting and gathering products obtained from maritime, estuarine, and inland sources that varied according to season. The coastal environment provided a concentrated, predictable, and highly productive set of resources for Middle Archaic people (Dunford 1999). The Native Americans of this period devised a variety of contracting-stem and side-notched projectile points that were suitable for hunting and fishing, and supplemented their tool kits with grinding and

milling stones, ground-stone axes, drills, and wood-working tools such as adzes and celts.

Between 5,000 and 3,000 years ago, during the Late Archaic period, the Native American people of Cape Cod continued to hunt and gather over a large area, consuming greater volumes of shellfish. The time-honored settlement strategy continued; in the warmer months, communities lived near estuaries and wetlands, and during colder months, camps were occupied in protected inland locations (Dunford and O'Brien 1997). People burned forest underbrush to increase the productivity of certain plant species, establishing meadows and edge zones in the woodlands that attracted deer and other animals. Moister climatic conditions led to the dominance of hickory and chestnut on the mainland (Shuman et al. 2004), but the woodlands of Cape Cod were characterized by pine and oak.

By about 3,500 years ago, sea levels stabilized, and newly formed estuaries defined the coastline of Cape Cod. Currents running parallel to the shoreline carried sediment that eroded from marine scarps (i.e., sea cliffs); deposition of this sediment formed natural coastal barriers. The establishment of these barrier beaches created small, protected bays that enabled the formation of permanent estuary systems. For Native Americans, the estuaries and salt marshes that lay behind these beaches became the most productive environmental settings on Cape Cod (Dunford 1999).

Archaeologists define the Woodland period as the span of time between about 3,000 years ago and the era of initial contact with European explorers about 1500 A.D. (500 years BP). Native Americans of the Early Woodland period manufactured fired clay pottery, a development likely related to their adoption of horticultural techniques. Hunting, gathering, and fishing remained important subsistence activities, and people continued to reoccupy settlement sites that had been used during previous periods. The use of northern native plants, such as goosefoot and sunflowers, figured more centrally in subsistence during the Woodland period; however, archaeological evidence indicates a greater degree of sedentism in settlement practices, with village sites containing multiple storage pits and deep deposits suggestive of long-term habitations. The apparent definition of tribal territories was expressed through distinct decorative styles of pottery and other artifacts, such as bone combs associated with burials at village sites (Dunford 2000 personal communication).

The Late Woodland period, which began about 1,000 years ago and ended with the onset of the Contact period (circa A.D. 1500), was characterized by Native American cultivation of plants such as maize, beans, and squash, as well as Jerusalem artichokes and sunflowers. Shellfish and other marine resources supplemented this horticultural component of the diet. During the cold months, shellfish, tomcod, waterfowl, seals, and drift whales were utilized when other foods were not available. There is evidence that native people also manipulated herds of deer through the planned burning of forest underbrush and used domesticated dogs to drive deer from certain areas, such as croplands. Dogs were buried ritually in coastal shell heaps (also known as middens), and such burials occasionally were accompanied by grave goods and treated with ochre (Dincauze 2000 personal communication). In some cases, settlements were fortified in order to protect cropland. The presence of permanent villages evidently encouraged the development of complex sociopolitical structures within Native American groups and the emergence of the chiefdoms and sachemships, which the first Europeans encountered in the late sixteenth and early seventeenth centuries (Bragdon 1996). Based on the discovery of Late Woodland archaeological sites throughout Chatham, it is considered likely that the area (then called "Manomoyick")

represented a local core of Native American settlement after A.D. 1500 (Steinitz and Loparto 1987).

Although Native Americans utilized much of the upland areas and cleared forests, the impacts of their land use patterns have been largely masked by subsequent alterations at the hands of early settlers and their descendants (Parshall and Foster 2002). In the mid-seventeenth century, accelerated clearing for settlement and agriculture reduced the extent of woodlands across Cape Cod and altered the composition and structure of remaining woodlands through repeated grazing, burning, harvesting, and other activities (Motzkin et al. 2002). Although these upland areas of the Cape have changed significantly through human use, the barrier islands and spits that make up the refuge have not been dramatically affected.

Contact Period

For southern New England, the years between A.D. 1500 and 1620 mark the Contact Period, when the Native American and European societies underwent an era of encounter and trade, prior to the establishment of the permanent English settlement at Plymouth. Populations of native peoples are also believed to have decreased dramatically during this period due in large part to disease pandemics (Carlson et al. 1992, Denevan 1992). As Wampanoag populations were decimated (especially from 1616 to 1619, possibly from leptospirosis), many settlements were abandoned and lands surrounding them went fallow. During this period, the Monomoyicks, a community of the Wampanoag tribe, occupied the vicinity of Chatham or "Manomoyick." The three islands in the refuge formed a peninsula at that time, which the Native Americans called "Monomoit" (Seufert-Barr 1995).

The explorer Giovanni da Verrazano made his voyage to the Northeast in 1524. In 1602, the English explorer Bartholomew Gosnold landed on the northern tip of Cape Cod, and named the locale for the abundance of fish he was able to catch. His records indicate that his men also made inland excursions on Cape Cod to gather resources. The ship's journals note that they sailed around the southeasterly tip of the Monomoy peninsula toward Chatham, and perhaps landed and interacted with Native Americans in Hyannis. In 1605, Samuel de Champlain led an exploration into Port Fortune (i.e., Stage Harbor) in Chatham, directly west of Monomoy (Bragdon 1996). Champlain's map of Port Fortune (circa 1605) shows the Monomoy peninsula, and illustrates the approximate locations and appearances of Native American villages near Chatham during the Contact period (figure 2.2). Settlements and planting areas were surrounded by palisades and featured wigwam-style dwellings. Champlain's map does not indicate any settlement on the Monomoy peninsula, although it is likely that the Monomoyicks visited the peninsula seasonally to procure fish, shellfish, and other estuarine products.

European Influences

After the account provided by Samuel de Champlain, there are no specific European references to Monomoy prior to the establishment of Plymouth Colony in 1620. However, the New England coast was visited by other explorers after Champlain's voyage, including Hudson (in 1609), Block (in 1613), and Smith (in 1614) (Holmes et al. 1998). Governor Bradford of Plymouth described how the riptides and heavy surf of the Pollock Rip off the eastern tip of the Monomoy peninsula turned the *Mayflower* back to the harbor at Provincetown and caused the Pilgrims to settle at Plymouth, instead of south beyond the Jersey coast, which had been their intended destination (Seufert-Barr 1995). The Pilgrims,"fell amongst dangerous shoals and roaring breakers and they were so far entangled therewith, as they conceived themselves in great danger…and thought themselves happy to get out of those dangers before night overtook them."

Bradford also noted that the Native American population of Cape Cod appeared to have been reduced significantly from the levels Champlain had previously described (Bradford 1994).

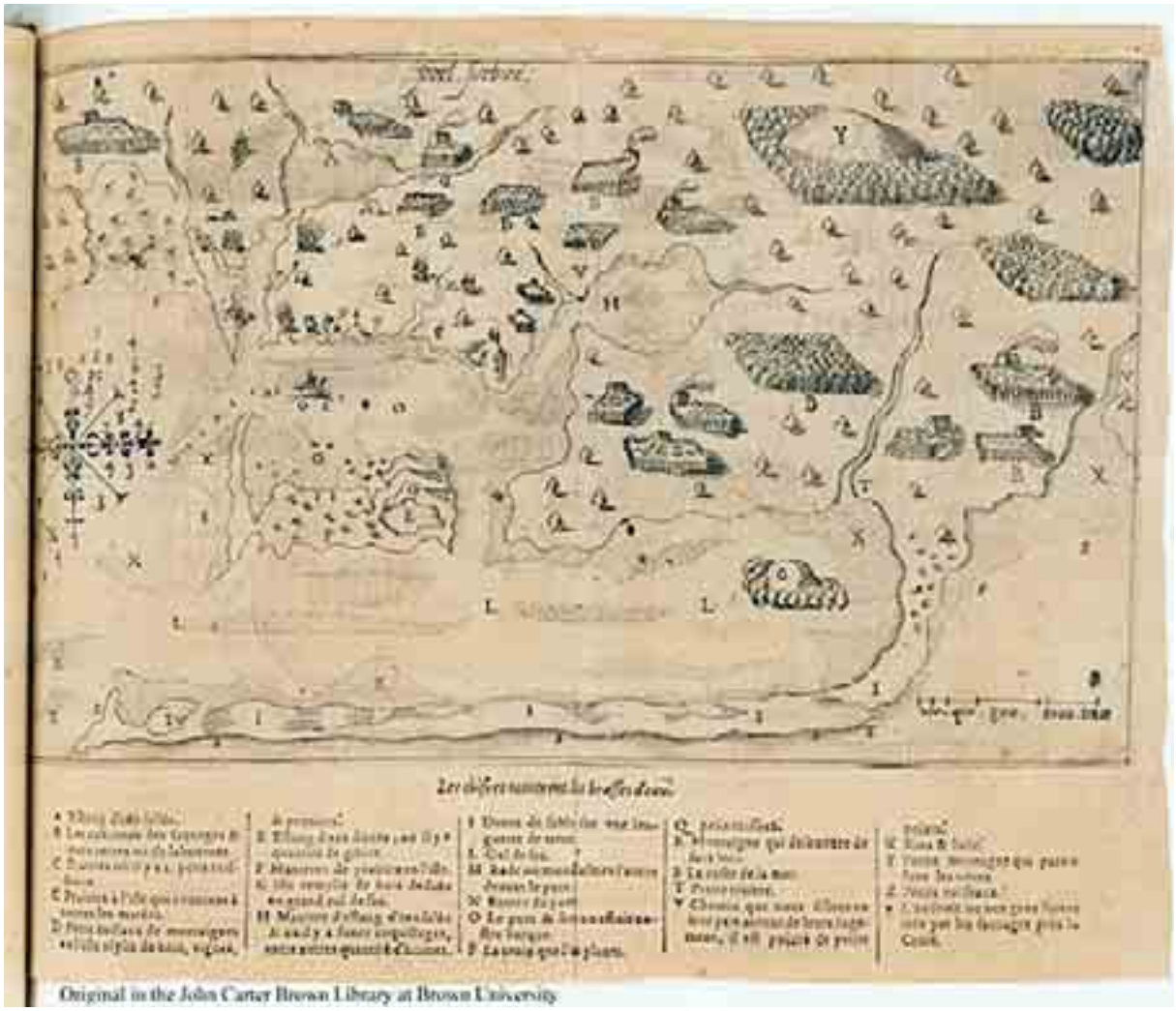


Figure 2.2. Champlain's Map of "Port Fortune" (Stage Harbor) in Chatham, Massachusetts, circa 1605 (Courtesy of the John Carter Brown Library, Brown University; also reproduced in Bragdon 1996). Note that the north arrow points to the right hand edge of the map; thus, the Monomoy peninsula is the narrow strip of land shown at the bottom of the map. *Translated legend: A. Salt water pond; B. Cabins of the savages and the fields in which they labor; C1. Meadows where there are 2 small streams; C2. Meadows covered at high tide (salt marsh); D. Little hillsides covered with woods, vines and plum trees; E. Fresh water pond, where there is much game; F. Different kinds of meadows on an island; G. Island covered with woods inside a large cul-de-sac; H. Salt water pond and where there are many shellfish, including large amounts of oysters; I. Sand dunes on a spit of land; L. Cul-de-sac; M. Roadstead where we anchored before the port; N. Port entry; O. The port and the place our bark was; P. The cross [we] planted; Q. Small streams; R. Far-away mountain; S. Sea coast; T. Small stream; V. Path we took in their country around their village, it is marked with small dots; X. Mud flats, tidal flats; Y. Small mountain seen from their territory; Z. Small streams. Place where our people were killed by the savages near the cross.* (Translated by Susan Danforth, John Carter Brown Library, Brown University).

Old World diseases introduced by the first Europeans had inflicted a mortality rate as high as 75 percent on the Native American communities of Cape Cod by circa 1616, leading to the abandonment of entire Native American villages and settlement areas (Denevan 1992). The first colonial settlements on Cape Cod occurred in Sandwich in 1638, followed by Barnstable and Yarmouth in 1639 (Holmes et al. 1998). Prior to the establishment of those communities, settlers in Plymouth had conducted trade with the surviving Native American groups of the lower Cape. They were assisted in this by Tisquantum ("Squanto"), a Native American who had befriended the Pilgrims shortly after their arrival. Tisquantum served as an interpreter and guide, providing instruction on planting and fishing techniques, and establishing relations between Plymouth and the Native American community at Monomoy (Forbes 1921). In 1641, Monomoy was mentioned in the court records of Plymouth, when Edward Holman was called to account for the removal of items from a shipwreck on the Monomoy shore (Shurtleff and Pulsifer 1856).

In 1651, the colonial settlement of Eastham, north of Monomoy, was established in lands formerly occupied by the Nauset Native American community. The Nauset population had been reduced by disease, enslavement, and emigration to Mashpee on the upper Cape, although a sachemship still existed in the Monomoy area (Holmes et al. 1998). In 1656, without the authorization of the Plymouth Colony, Captain William Nickerson entered into an agreement with Mattaquason, the sachem of the Monomoyicks, about the acquisition of lands, which included the current Monomoy, Morris, and Stage Islands; this transaction was authorized by the court in 1672 (Forbes 1921, Chatham Public Documents 2010). The missionary Daniel Gookin reported in 1674 that Manamoyick, which contained 71 members at the time, was one of three Christian Native American communities occupying lower Cape Cod (Gookin 1966). In 1686, Captain James Forster purchased Morris Island, then known as Quitnesset, located at the northern end of the Monomoy peninsula (Forbes 1921). The local colonial economy during this time was centered on farming and maritime activities. Farmers raised grain crops, but soils became depleted, leading to an increase in animal husbandry and sheep farming by 1700. Whaling supplied oil, while mackerel and cod fishing provided food, and shellfish procurement provided bait to the cod industry (Holmes et al. 1998).

The Town of Chatham was designated as the "constablewick of Monomoy" in 1696, and was incorporated with its current name in 1712 (Chatham Public Documents 2010). At that time, the Monomoy peninsula was used as pasture for sheep and cattle. The spit at the end of the peninsula was notorious for shipwrecks, and led to a new form of local industry—salvaging materials from shipwrecks. In 1711, Stewart's Tavern was opened on the south part of the Monomoy peninsula. It served passing sailors, and its presence suggests that a small fishing community (later known as Whitewash Village) had already been established on the peninsula by the early eighteenth century. In 1802, the Massachusetts Humane Society placed one of its first shelters for seafarers near the southern tip of Monomoy peninsula (i.e., Monomoy Point) to provide shelter for shipwrecked crews who managed to make it to shore (Seufert-Barr 1995).

During the early 1800s, a deep natural harbor, known as Powder Hole, attracted a sizeable settlement at Whitewash Village. As many as 50 families maintained homes there and the village featured trading stores and a pair of shipyards that served ships of the booming coastal trade. The community suffered a setback after the harbor was eroded away by a hurricane in 1860, hindering access to the fish population that had sustained the local economy. Nonetheless, settlement continued on the southern Monomoy peninsula into the early twentieth century. At its height, Whitewash Village housed about 200 residents and featured a public

school and an inn called the Monomoit House. The local economy focused on fishing for cod and mackerel, which were dried and packed for markets in Boston and New York (Seufert-Barr 1995). In the mid-twentieth century, the village featured approximately two dozen seasonal cottages and associated outbuildings.

The first Monomoy Point Lighthouse was constructed in 1823. It was the fifth lighthouse commissioned on Cape Cod and was intended to aid vessels traveling around the treacherous point at Pollock Rip. In 1849, after the elements had damaged the first lighthouse, the existing Monomoy Point Lighthouse was constructed. An important and significant example of cast-iron lighthouse construction, the tower is 40 feet high. When it was active, the light could be seen for 12 nautical miles out to sea. The lighthouse, which is accompanied by an attached keeper's house and detached oil house, was decommissioned in 1923 (Oak Point Associates 2009). The historic lighthouse, keeper's house, and oil house are the only structures that still stand on the Monomoy peninsula.

The U.S. Lifesaving Service built the Chatham Life Saving Station (USLSS 13) near Morris Island on the Monomoy peninsula in 1872. Two years later, a second lifesaving station (Monomoy, USLSS 14) was built approximately 4 miles further south on the peninsula. Finally, a third station, the Monomoy Point Lifesaving Station (USCG 44), was built in 1902 near Whitewash Village serving as the southernmost component of a series of 13 such stations between Chatham and Provincetown (Seufert-Barr 1995, *http://www.uscg.mil/history/*; accessed October 2011). At the mid-point between each of these three lifesaving stations "half-way houses" were built.

Human Influences over the Past 100 Years

By the early 1900s, the Monomoy peninsula was a popular holiday destination, where families built summer camps and duck hunters visited during the fall and winter. The elite Monomoy Brant Club brought sportsmen to the remote beach for duck hunting from 1862 to 1932. Brant were attracted each spring during northward migration to the extensive, dense eelgrass beds near the Inward Point and Romp Hole areas hunted by the club. In addition to the cottages at Whitewash Village, several seasonal dwellings were distributed throughout the Monomoy Point area and northward along the peninsula. More than two dozen cottages and outbuildings were located at Hammonds Bend in the central part of the peninsula. In 1932, the Monomoy peninsula was taken over by the U.S. military and used for aerial strafing and bombing training during World War II (Seufert-Barr 1995).

After the refuge was established in 1944, the owners of summer camps were able to obtain special use permits for seasonal use of the refuge up until 2000, when the last cabin was removed. In 1958, winter storms breached the Monomoy peninsula at its northern end, turning it into an island; storms during the winter of 1978 further divided the island, creating the geographically distinct North Monomoy Island and South Monomoy (figure 2.1, box 1 and 2, respectively).

The refuge includes an area previously known as the Monomoy Island Gunnery Range. This formerly used defense site (FUDS) was utilized for practice bombing from 1944 through 1950. In 2010, a site inspection report was completed by the U.S. Army Corps of Engineers (USACE 2010) to determine the potential for any risks to people or the environment associated with the Monomoy Island FUDS. Based on the study, only practice bombs, signals, and spotting charges were likely used. No confirmed munitions or explosives of concern (MEC) have been found historically or during the 2009 to 2010 study. Subsurface and surface soil samples were collected and presented with one or more of the following metals: aluminum, iron, zinc, antimony, copper, and nickel; however, levels did

not exceed human health risk or ecological risk and these "subsurface anomalies [are] likely attributed to cultural debris." The study's conclusions indicate there is a "low risk" to human and ecological receptors from potential MEC from remnant sources (suspected 5-pound practice bombs were discovered and blown in place by Fort Devens EOD, and there were no MEC finds during 2009 field investigation); site characteristics (limited access to the area, which is only accessible by boat); walking [more than 5 miles]; or special vehicle permit [extremely rare]). The potential for human interaction was deemed limited. During the military use of the FUDS, the center of the bombing target was located on land, but due to dynamic coastal processes, is now located offshore in the Atlantic Ocean. It is therefore assumed that "no known or suspected hazards" are present in the land portion of bombing range or air-to-ground gunnery range. Although the FUDS is open to the public during daylight hours, there are posted signs indicating closed areas where the public is not allowed.

Current Climate

Monomoy NWR is bounded by Nantucket Sound to the west and the Atlantic Ocean to the east, resulting in a maritime-influenced climate characterized by warmer temperatures in the winter and cooler temperatures in the summer compared to mainland locations. Approximately 38.9 inches of precipitation falls annually (NOAA 2002). Winter and summer temperatures are more moderate than nearby inland areas, with average temperatures of 31 degrees Fahrenheit (°F) in January and 71 °F in July (NOAA 2002). Many storms are accompanied by heavy winds and high seas that erode beaches and contribute to the dynamic coastline that surrounds the refuge.

Global Climate Change and Sea Level Rise

The global climate has been relatively stable over the last 10,000 years; however, it is now known that human activities, such as burning fossil fuels and deforesting large areas of land, are having a profound influence on the Earth's climate. Climate warming is unequivocal, as evidenced by observations of increased global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (International Panel on Climate Change [IPCC] 2007). In its 2007 assessment report on climate change, the International Panel on Climate Change stated that it had "very high confidence that the global average net effect of human activities since 1750 has been one of warming" (IPCC 2007). The U.S. Climate Change Science Program (CCSP) published findings in agreement with the IPCC report, stating that "studies to detect climate change and attribute its causes using patterns of observed temperature change in space and time show clear evidence of human influences on the climate system (due to changes in greenhouse gases, aerosols, and stratospheric ozone)" (CCSP 2008a).

Climate change is of serious concern to the Service and to our partners in the conservation community. Scientists are predicting dramatic changes in temperature, precipitation, soil moisture, sea level, frequency and magnitude of storm-surge flooding, and coastal erosion—all of which could adversely affect the function of ecological systems and modify vegetation and wildlife distributions (CCSP 2009). We expect that species' ranges will continue to shift northward or to higher elevations as temperatures rise; however, responses would likely be species-specific and vary according to local changes in precipitation and temperature. Under rapidly changing conditions, migration, not evolution, would determine which species are able to survive (USFWS 2006a). Species that cannot migrate or otherwise disperse at a sufficient rate to keep pace with shifting climate zones, such as many plants and a variety of less motile wildlife, will suffer the most.

Climate change impacts in coastal regions include a higher frequency of intense hurricanes and storms, more severe impacts of lesser intensity storms, including northeasters, warming ocean waters, and rising sea levels (Frumhoff et al. 2007). Sea level rise is one of the most potentially serious consequences of climate change for coastal ecosystems like Monomoy NWR. According to the USGS,

sea levels have been steadily rising 1 to 2 millimeters (0.04 to 0.08 inches) per year since the 19th century (*http://geochange.er.usgs.gov/poster/sealevel.html*; accessed August 2011). This is a result of a reduction of ice caps, ice fields, and mountain glaciers, in combination with the thermal expansion of ocean waters. If sea level continues to rise, this could have serious impacts on coastal barriers and islands like Monomoy and Nauset/South Beach.

USFWS

Horseshoe crab shell on the beach

Local impacts would be determined by whether the land is subsiding (lowering in elevation due to underground changes, e.g., ground water pumping) or uplifting; other determinants include topography and the presence of sea walls and other anthropogenic factors (Galbraith et al. 2002). In the Northeast, sea level rise is higher than the global average because of land subsidence, and parts of South Monomoy have been classified as areas of high vulnerability to sea level rise by the USGS. Coastal communities in Massachusetts, such as Gloucester and Marshfield, are predicted to lose more than 5 percent of their land area due to rising ocean waters by 2100 (TNC 2006). By the mid-1990s, Boston had already seen an increase in mean sea level since 1950 by 5 to 6 inches, and was predicted to see another increase of 22 inches by 2100 (TNC 2006, EPA 1997). These losses in coastal land area include intertidal, salt marsh, and drier coastal upland habitat, resulting in a decrease in feeding, resting, and breeding habitat for many coastal fish and wildlife species. Potentially impacted species include many marine and coastal bird species, lobsters and clams, and commercial fish including menhaden, alewife, and herring, among other species (Frumhoff et al. 2007).

Global mean sea level continues to rise due to thermal expansion of the oceans (IPCC 2007) and the loss of mass from glaciers, ice caps, and the Greenland and Antarctic ice sheets (Church et al. 2001, Bindoff et al. 2007). There is high confidence that the rate of sea level rise has increased between the mid-19th and the mid-20th centuries (Bindoff et al. 2007). Church et al. (2004) estimated a rate of 1.8±0.3 mm per year sea level change along the global coastline during 1950 to 2000, and Church and White (2006) determined a change of 1.7±0.3 mm per year for the twentieth century. However, satellite observations available since the early 1990s provide more accurate sea level data, with nearly global coverage. This decade-long satellite altimetry data shows that sea level has been rising at a rate of around 2 mm per year since 1993 (figure 2.2). This is significantly higher than the average during the previous half century (Bindoff et al. 2007).

In figure 2.3, the red curve shows reconstructed sea level fields since 1870 (updated from Church and White 2006), the blue curve shows coastal tide gauge measurements since 1950 (from Holgate and Woodworth 2004), and the black curve is based on satellite altimetry (Leuliette et al. 2004). The red and blue curves deviate from their averages from 1961 to 1990, and the black curve deviates from the average of the red curve for the period from 1993 to 2001. It is important to note that the change in sea level is highly non-uniform spatially; in

some regions rates are up to several times the global mean rise, while in other regions sea level is falling.

Several recent studies are predicting higher rates of sea level rise than what has been reported by IPCC (2007). The projected increase in rate of sea level rise has been attributed to a greater contribution by melting glaciers and increased ice-sheet flow. According to Meier et al. (2007), global sea level is likely to rise at rates ranging between 3.1±0.7 mm per year.

The National Water Level Observation Network, operated by the NOAA, comprises approximately 175 long-term, continuously operating stations located along the U.S. coast. There are reliable data from some of these stations going back over 150 years (NOAA 2009a). The NWLON station nearest to Monomoy NWR is located at Nantucket Island, Massachusetts (station #8449130). Based on monthly mean sea level data from 1965 to 2006, the mean sea level rise trend at this location is 2.95±0.46 mm/year (figure 2.4 equivalent to a rise of 0.97 feet in 100 years (NOAA 2009a). Within a 150-mile radius of the refuge, there are 6 NWLON stations with sea levels ranging between 1.95 and 2.7 mm/year (average 2.46 mm/year), with an average error of ±0.27 mm/year (NOAA 2009a).

The Service is addressing the potential for significant changes that will be felt by all coastal refuges due to climate change and sea level rise. In recognition of this, Monomoy NWR is one of several coastal refuges in the Northeast for which a sea level affecting marshes model (SLAMM) analysis was completed in 2009; however, for the purposes of this draft CCP/EIS, we focused our sea level rise discussion to a report specifically prepared for Monomoy NWR by Giese et al. (2010).

Giese et al. (2010) reported changes as a result of current rates of sea level rise. Their report showed that, at the current rate of sea level rise, sediment supply from Nauset Beach to Monomoy would be capable of maintaining the barrier complex, as well as supporting ongoing accretion along the southern tip of South Monomoy. Based on relative sea level rise in southern New England and global rates, Giese et al. (2010) predict the following general patterns to occur:

> Between 2010 and 2030, Nauset/South Beach overwashes would create washover fans along the inner (western) side; Nauset/South Beach sediment would move southward along the South Monomoy outer shore; and Monomoy Point would grow south/southwestward. Between 2030 and 2050, washover shoals would reach Morris Island and end Outermost Harbor navigation; a re-curved spit would develop on the southwestern side of Monomoy Point that sweeps northward. In the third quarter of the century (2050 to 2075), shoals from Nauset/South Beach would end all "inside" navigation and connect Morris Island to South Monomoy and the Monomoy Point hook would join the western shore of South Monomoy. During the final quarter (2075 to 2100), Monomoy would exist as a peninsula for a majority of the period, but eventually thins south of Morris Island; Monomoy Point would extend southwestward onto a nearby portion of Handkerchief Shoal; and an enclosed pond would form on the western shore of South Monomoy inside the re-curved spit.

Increased rates of sea level rise would dramatically alter the current configuration of the area, with increased erosion of Morris Island, the connection of Morris Island to South Monomoy, and a reduced sediment load possibly deepening Monomoy Flats (Giese et al. 2010).

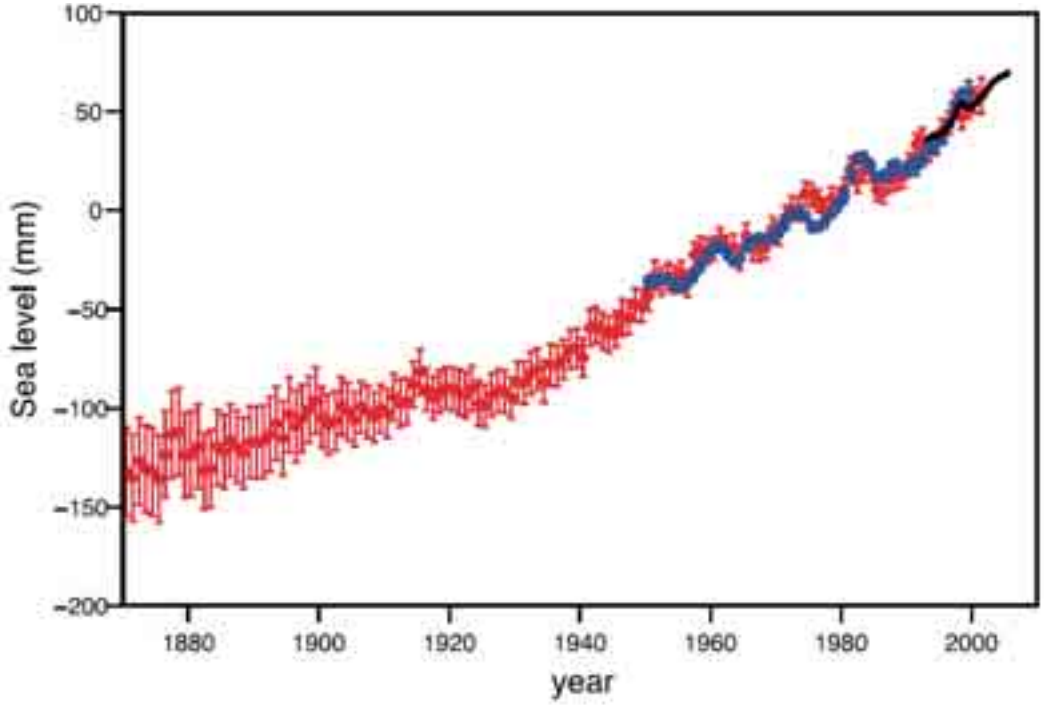


Figure 2.3. Annual Averages of the Global Mean Sea Level in Millimeters. (Error bars show 90 percent confidence intervals (Source: IPCC 2007). Dataset includes reconstructed sea level fields (red), coastal tide gauge measurements (blue), and satellite altimetry (black) data.)

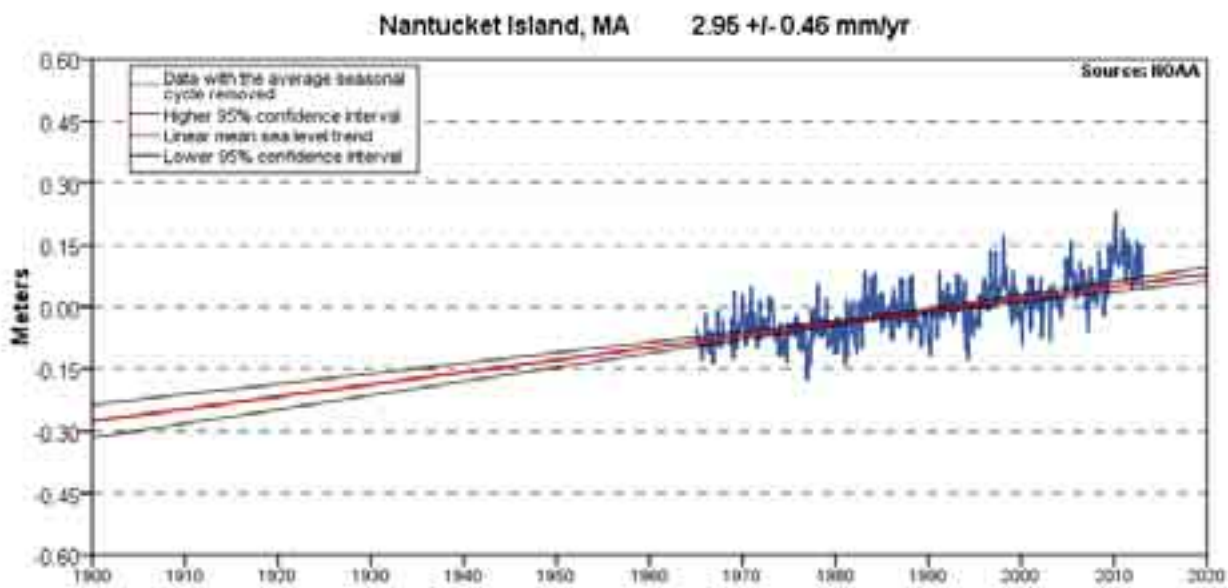


Figure 2.4. Mean Sea Level Trend at Nantucket Island, MA (Source: NOAA 2009a).

Air Quality

Under the Clean Air Act of 1990 (CAA), the Environmental Protection Agency (EPA) regulates six criteria pollutants—ozone, carbon monoxide, nitrogen dioxide, particulate matter, sulfur dioxide, and lead, and hazardous and other toxic air pollutants, including mercury, under the CAA Amendments of 1990. For each criteria pollutant, EPA has established a maximum concentration above which adverse effects on human health may occur; these threshold concentrations are called National Ambient Air Quality Standards (NAAQS). Areas of the country where air pollution levels persistently exceed the NAAQS may be designated "nonattainment." When an area does not meet the air quality standard for one of the criteria pollutants, it may be subject to the formal rule-making process to designate it as "nonattainment." The CAA further classifies nonattainment areas based on the magnitude of an area's problem. These nonattainment classifications may be used to specify what air pollution reduction measures an area must adopt, and when the area must reach attainment (40 CFR 81).

The Massachusetts Department of Environmental Protection (MA DEP) monitors levels of ozone and particle pollution from several stations in Massachusetts for attainment or exceedance of the NAAQS. These standards are reviewed every 5 years by the EPA and may be changed based on new scientific information. It is incumbent upon each state to ensure these standards are met and maintained. In the case of an exceedance of these standards, pollution control strategies are implemented, and once the standards are attained, a plan is developed to maintain that standard in such a way that incorporates future economic and emissions growth.

Over the last decade, the State has made progress in reducing the number and severity of ozone exceedances, and in January 2008 submitted a state implementation plan to the EPA that describes strategies to attain the 8-hour ozone standard by 2010 (MA DEP 2008). In 2010, Massachusetts was in attainment of the air quality standards for all pollutants except ozone. Ozone at ground level is a respiratory irritant that can reduce the overall function of the lungs, cause asthma attacks, and aggravate chronic lung diseases. It also inhibits vegetation growth, and is often found in higher concentrations far downwind from the origin of the precursors that react to form it (MA DEP 2011).

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Lichen (Ramalina *spp.*)

At one time, the NAAQS for ozone was based on the maximum 1-hour ozone concentration that occurred each day during the ozone monitoring season. In 1997, EPA set a new 8-hour ozone standard that was designed to be more representative of exposure over time, rather than just a maximum concentration. Massachusetts is designated as nonattainment of this standard. However, ozone monitors currently show that the State is meeting the 1997 0.08 ppm standard (MA DEP 2011). The 8-hour standard was revised in 2008 to 0.075 ppm. In March 2009, Massachusetts recommended to EPA that the entire state be designated as nonattainment with the 2008 standard. In January 2010, EPA proposed to revise the primary 8-hour ozone standard to a level with a range of 0.06 to 0.07 ppm. EPA postponed the new ozone standards in September 2011.

There are in total 15 continuous ozone monitoring stations across the State. Based on information collected from these sites, there were 14 days when the 8-hour ozone standard of 0.075 ppm was exceeded by at least one monitoring station in 2010. There were 36 exceedances during those 14 days (i.e., multiple monitors exceeded the standard on the same day) (MA DEP 2011). The closest two monitoring stations to the refuge are included in those that registered exceedances: Fairhaven (5 days) and Truro (4 days). Exceedances at a station averaged over 3 years can lead to a violation of NAAQS. Based on data from 2008

to 2010, both of these stations indicated violation of the 8-hour ozone standard (MA DEP 2011).

Water Quality

Water quality must be addressed for compliance with the Federal Water Pollution Control Act of 1977, also known as the Clean Water Act (CWA). The CWA provides EPA with the authority to establish water quality standards (or states to establish standards equal to or more stringent than EPA standards); control discharges into surface and subsurface waters; develop waste treatment management plans and practices; and issue permits for dredging, filling, or discharging to a water body. The CWA requires states to monitor and classify water bodies, establish water quality goals, and publish lists of monitoring and classification results; it also gives states the authority and responsibility to publish water quality standards (U.S. Code, Title 33, Chapter 26).

Summary of the General Condition of Monomoy
Monomoy NWR contains freshwater and saltwater wetland habitats including salt marsh, intertidal flats, and ponds. The only source of fresh water is from precipitation and infiltration. The EPA designated the Cape Cod Aquifer as a sole source aquifer in 1982 because it supplies at least 50 percent of the drinking water consumed in the area above it (MA EOEEA 2004). This designation provides limited Federal protection of groundwater resources that serve as drinking water supplies and means that Federal funding will not be available for any project the EPA determines poses a threat to the water quality of the aquifer through recharge. The benefit of such a designation is increased public awareness that there is only one source of drinking water for the entire community; therefore, the community may be more willing to protect it locally. Groundwater recharge is through precipitation events. Cape Cod receives an annual average of 45 inches of rainfall, almost half of which recharges the aquifer system (MA EOEEA 2004).

The refuge consists of approximately 1,970 acres of barrier beach and dune habitat. It contains very little fresh water (Station Ponds on South Monomoy), and is not affiliated with any public well fields. Monomoy is surrounded by saline water.

Long-Term Trends and Status of Water Quality for Monomoy
In Massachusetts, certain surface waters with exceptional socioeconomic, recreational, ecological, or aesthetic values are designated outstanding resource waters (ORWs) and require additional protection under State water quality regulations. The waters of Monomoy NWR, including waters in and adjacent (i.e., within 1,000 feet seaward of mean low water) to the Cape Cod National Seashore (all ORWs), are classified as marine waters Class SA[1] or freshwaters Class B[2] (MA DEP 2002).

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[1] *Class SA waters* are designated for primary and secondary contact recreational activities and as excellent fish and wildlife habitat. Class SA waters also have excellent aesthetic value. Specific Class SA waters may be designated for shellfish harvesting in 314 CMR 4.00. Any desalination plant making withdrawals from Class SA water must protect the existing and designated uses of the water. This is the most stringent coastal water classification and includes strict standards for bacteria, DO, and other characteristics to protect the designated uses of the water and human health.

[2] *Class B waters* are designated for primary and secondary contact recreational activities and for fish and wildlife habitat. Class B waters also have consistently good aesthetic value. Class B waters are suitable for compatible industrial processes, cooling, irrigation, and other agricultural uses; some Class B waters are designated as suitable for public water supply with appropriate treatment.

According to MA DEP (1993), water quality impairment in the Cape Cod watershed was due primarily to the presence of pathogens (as measured by fecal coliform bacteria) in many areas and organic enrichment/low dissolved oxygen. Sources of these contaminants, when known, included urban runoff, onsite wastewater systems, highway maintenance and runoff, and recreational activities.

Within coastal waters, the Massachusetts Office of Coastal Zone Management (CZM) states that nonpoint source pollution is the number one source of pollution problems. Contaminants include soil sediments, nutrients from fertilizers and sewage, and chemicals from pesticide use and other sources, such as fuel, cleaning chemicals, paint, and oil from marinas and boats. These pollutants are picked up as the contaminated stormwater runoff or snowmelt flows directly into a surface water body (such as the ocean) or seeps through the soil into a surface water body. The Massachusetts Office of Coastal Zone Management is working with several groups on a coastal nonpoint pollution control program to restore and protect coastal waters; additional information about this program is available online at: *http://www.mass.gov/czm/cwq.htm* (accessed October 2011).

Big and Little Station Ponds are 32-acre and 11-acre freshwater ponds, respectively, on South Monomoy, originally formed when a bay was closed off by the growth of a re-curved spit. Other small freshwater ponds and wetlands are present on South Monomoy. Most are natural, but a few lie in depressions excavated by the Service in the early 1950s in an effort to increase waterfowl habitat. Almost 25 acres of salt marsh surround the 5-acre estuarine Hospital Pond at the northern end of South Monomoy. Powder Hole, which in the mid-1800s was a deep and extensive harbor, is now a shallow estuarine water body on the southwest end of the refuge.

In 2001, the Massachusetts Department of Public Health received Federal funding to begin monitoring marine beaches throughout the State. Any public or semi-public beaches are tested daily or weekly for enterococci as an indicator organism for water quality throughout the swimming season. In the 2009 bathing season, 16 beaches in Chatham were part of the marine beaches testing program. Three of these beaches recorded single sample exceedances of the standard (MA DPH 2010).

The Massachusetts Department of Public Health analyzed water quality data from 89 sites at public beaches throughout the Cape Cod region, including Chatham. The water samples, collected between 2003 and 2012, were used to measure levels of the fecal indicator bacteria (FIB) enterococci, a group of bacterial species typically found in human and animal intestines and feces (WHOI 2012). In marine waters, the accepted level of enterococci for a single water samples is 104 colony-forming units per 100 milliliters (cfu/100 ml). The analysis found that beaches near seal haulout sites showed a decreasing trend in yearly FIB exceedance events over the last decade, while beaches away from these haulout sites demonstrated an increasing trend (WHOI 2012).

The waters immediately west of Monomoy in Nantucket Sound are designated as a no discharge area (NDA), meaning that no boats may discharge any sewage, treated or otherwise, in these waters immediately adjacent to Monomoy NWR. This designation is applied when a community or the State determines that an area is ecologically or recreationally important enough to warrant additional protection. Influxes of sewage from boats, even when treated, can discharge nutrients, chemicals, and pathogens into the water, increasing public health concerns as well as overall concern for water quality. Increased levels of nitrogen, a component of sewage, can have wide-ranging effects on water bodies, including encouraging algal blooms, decreasing dissolved oxygen content, and increasing

turbidity (poor water clarity), which all can impact the species reliant upon these coastal waters.

Water quality measures during 2011 from eight sampling sites throughout Nantucket Sound indicate a generally good condition for nitrogen (average of 0.58 uM), water clarity (using Secchi disk, 2.0 to 7.3 meters), and chlorophyll-a (0.45 to 4.32 micrograms/liter) (Costa 2012 personal communication).

State-Reported Impaired Waters
In 2010, the DEP released the 305(b)/303(d) Integrated List of Waters (report; MA DEP 2010). It combines both the 305(b) Water Quality Assessment and the 303(d) Report on Impaired Waters for each river basin. The DEP compiled those reports and submitted them to the EPA and Congress to satisfy the Federal reporting requirements under section 305(b) of the Clean Water Act.

Much of the data in this DEP report comes from a number of different third-party sources including Federal, State, and nongovernmental agencies, as well as projects with State, local, or Federal funding that submit individual watershed reports. Though the sources of data are varied, they must all have a quality assurance project plan, use of a State certified lab, QA/QC for data management, and documentation in a citable report. This ensures they are all subject to the same documentation and validation procedures.

The report on impaired waters in the State describes segments of streams, lakes, and estuaries that exhibit violations of water quality standards, and details the pollutant responsible for the violation(s) and the cause and source of the pollutant, if known. There were 102 impaired waters in the Cape Cod (USGS HUC 0109002) watershed (MA DEP 2010); of these, 84 are Category 4a, 3 are Category 4c, and 15 are Category 5 waters. Pathogens were the primary cause for impairment, but other impairments included nutrients, organic enrichment/low dissolved oxygen, other habitat alterations, turbidity, and noxious aquatic plants. Within the Cape Cod watershed, 49 pathogen-impaired segments are prioritized based on proximity to sensitive areas or designated uses that require higher quality standards, such as swimming areas, or shellfishing areas.

Noise

Surf and wind are the dominant noises on Monomoy NWR and tend to drown out many other sounds. An agreement between the Federal Aviation Administration and the Service provides a requested minimum altitude of 2,000 feet for all aircraft over the refuge, but numerous intrusions (i.e., low flying aircraft) cause disturbance to wildlife and visitors, which is a refuge violation (50 CFR 27.34). Boat motors are also audible.

Biological Environment

Soils

Most soils on the refuge are classified as beaches and sandy soils stabilized by vegetation, but deposited so recently that there is no soil development (USDA 1993). Exceptions include Ipswich mucky peat found in the estuarine marshes and Freetown muck located in freshwater potholes and depressions; both of these soil types are poorly drained soils formed in organic deposits. Ten soil types were identified for the refuge using the most recent data available according to the Web Soil Survey (table 2.1; *http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm*; accessed September 2011).

Intertidal and subtidal bottom sediments occurring within the refuge Declaration of Taking boundary are predominantly classified as lithogenous, neritic marine deposits. These deposits consist of soil and rock, especially mineral quartz (SiO_2) particles, eroded and washed from continental land masses into the shallow seas along the inner continental shelf margins, and then sorted and transported by

ocean waves currents. The Massachusetts Office of Coastal Zone Management maps show that the "generally sand" map unit predominates, with several smaller areas with finer texture mapped as "generally mud" within the Monomoy boundary (*http://maps.massgis.state.ma.us/map_ol/moris.php*; accessed March 2013).

Ocean energy, especially wave energy, repeatedly sorts and redistributes bottom sediments in shallow, nearshore areas; larger or coarser particle sizes are deposited closest to shore where the wave energy or water velocity is highest, while smaller or fine particle sizes are deposited farther from shore or shoreline areas protected from wave energy. "Sand" that typifies the Generally Sand CZM map unit has greater than 50 percent (by dry weight) of the particles falling in the 0.0625 to 2.00 mm size range using the modified Shepard ternary classification (Shepard 1954, Wentworth 1922) standard used by the USGS Sediment Lab at the Woods Hole Field Center (Poppe et al. 2000). "Mud" typifying the generally mud map unit has at least 50 percent (dry weight) of the particles falling below 0.0625 mm in size. Of 66 bottom sediment sample points in or around Monomoy included in the CZM data set, 85 percent (56) were classed as sand, 11 percent (7) as mud or clay, and 4 percent (3) as gravel deposits.

Table 2.1. Monomoy NWR Soil Types.

Soil Type	Percent Slope	Drainage Class	Parent Material	Landform
Berryland mucky loamy coarse sand	0 to 2	Very poorly drained	Loose sandy glaciofluvial deposits	Terraces
Carver coarse sand	3 to 8	Excessively drained	Sandy glaciofluvial deposits; loose sandy glaciofluvial deposits	Outwash plains
Carver coarse sand	8 to 15	Excessively drained	Sandy glaciofluvial deposits; loose sandy glaciofluvial deposits	Ice-contact slopes
Carver coarse sand	15 to 35	Excessively drained	Sandy glaciofluvial deposits; loose sandy glaciofluvial deposits	Ice-contact slopes
Freetown mucky peat	0 to 1	Very poorly drained	Highly decomposed herbaceous organic material	Bogs
Beaches			Reworked sandy and gravelly glaciofluvial deposits and/or reworked sandy and silty marine deposits	Not available
Hooksan sand, rolling		Excessively drained	Loose sandy eolian deposits	Barrier beaches
Hooksan sand, hilly		Excessively drained	Loose sandy eolian deposits	Barrier beaches
Udipsamments, smoothed		Not available	Sandy excavated or filled land	Not available
Ipswich, Pawcatuck, and Matunuck peats	0 to 1	Very poorly drained	Marine, partly-decomposed herbaceous organic material	Marshes

The sandflats of Monomoy are variably dynamic intertidal areas consisting of unconsolidated sediments primarily in the range of medium sand to fine sand with a small amount of silt and clay (Leavitt and Peters 2005). Grain sizes for sediment particles found in fine and medium sand generally falls within the range of 0.063 to 0.05 mm (Wentworth 1922). The flats are subjected to a moderate hydrodynamic flow regime, which results in a homogenous matrix of sand with minimal vertical stratigraphy (Leavitt and Peters 2005).

Refuge Vegetation

In the summer of 2010, NatureServe and the Sewall Company mapped vegetation communities on the refuge according to the National Vegetation Classification System (NVCS), which is the Federal standard. This system classifies vegetation on a national scale for the United States and is linked to the international vegetation classification. The NVCS provides a uniform name and description of vegetation communities found throughout the country and helps determine relative rarity. Based on their work in 2010, the NatureServe group generated a report summarizing a subset of the international classification standard covers of vegetation associations attributed to Monomoy NWR. Their report includes vegetation community element descriptions, element distributions along the North Atlantic coast and Northeast, and global rarity rankings of refuge communities (NatureServe 2010). Vegetation communities were described using a combination of 2010 aerial photography and ground-truthing by NatureServe, the Sewall Company, and refuge staff. Map 2.2 illustrates the distribution of different habitat cover types within the refuge and appendix C describes the type of habitats found on Monomoy NWR.

Submerged Aquatic Vegetation (SAV)

Submerged aquatic vegetation (SAV) is a critically important component of the aquatic environment in shallow coastal ecosystems, and its presence and robustness are indicators of good water quality. As far back as the 16th and 17th centuries, eelgrass was recognized for its value in sustaining waterfowl, providing habitat for fisheries and substrate for shellfish, and as a crucial component of sediment and shoreline stabilization. Humans harvested eelgrass for use as insulation, filler materials in bedding, and as compost for agriculture. Concern for the loss of these valuable services was magnified in the 1930s when a wasting disease decimated a large portion of the North Atlantic populations of eelgrass, including populations in Massachusetts (*http://www.mass.gov/dep/water/resources/eelpaper.htm;* accessed January 2013*).* Hotchkiss and Ekvall reported in 1929 that dense, extensive eelgrass beds were present north and west of Inward Point on the Common Flats, but the 1938 Griffith report described eelgrass beds in this same area as small and widely scattered.

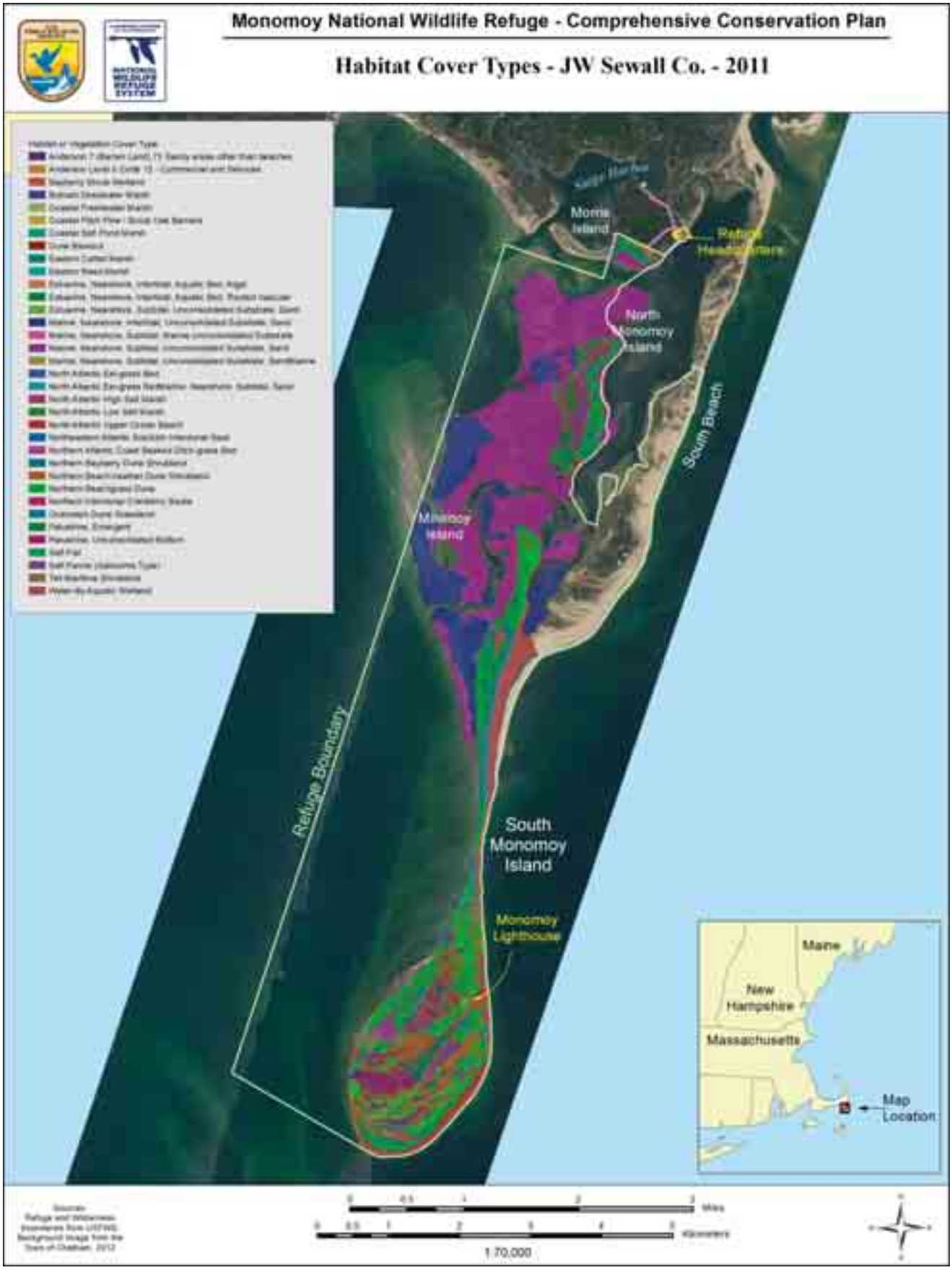
Results from Massachusetts studies and several related national and international research programs all point to the detrimental effects of nutrient enrichment and eutrophication in coastal waters, including large-scale declines of seagrass meadows. These studies suggested that seagrasses can potentially serve as sentinels of coastal environmental change associated with natural and anthropogenic disturbances. Appropriate monitoring of environmental quality and mapping the changes in seagrass distribution and abundance can provide scientists and managers with a sensitive tool for detecting and diagnosing environmental conditions responsible for the loss or gain of seagrasses.

Matt Poole/USFWS

Sandpipers

SAV can only thrive in shallow depths where light reaches the benthic zone. The rooted aquatic beds provide shelter and food for numerous aquatic invertebrates. SAV also recycles nutrients, helps to stabilize sediment, and oxygenates the water (Costello and Kenworthy 2011).

SAV composition varies with salinity. In Massachusetts, eelgrass along the coastline is the most common species. The MA DEP began a program in 1995 to track and monitor changes in existing eelgrass beds to provide an indicator of water quality. Eelgrass is an ideal species because it is sensitive to nitrogen loading and physical disturbance, and can be documented using aerial photos. Widgeon grass also forms beds in shallow sandy subtidal substrates in association with eelgrass and, like eelgrass, currently occurs less commonly than reported just prior to refuge establishment in 1944 (Hotchkiss and Ekvall 1929, Salyer 1938, Griffith 1938). The MA DEP SAV mapping effort and data set includes widgeon grass and other seagrasses detected in the “eelgrass” category.


Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Habitat Cover Types - JW Sewall Co. - 2011
Morris Island
Refuge Headquarters
North Monomoy Island
South Beach
Minimoy Island
Refuge Boundary
South Monomoy Island
Monomoy Lighthouse
Maine
New Hampshire
Massachusetts
Map Location
Miles
Kilometers
1:70,000

Morris Island and Stage Harbor embayments were two of the 46 embayments used by the MA DEP Eelgrass Mapping Project. Nantucket Sound open waters had the largest 1994 to 1996 baseline SAV area (4,201.56 of the Statewide 14,323.63 hectares) of the seven open water areas mapped. Open water seagrass beds such as those at Monomoy occur as mosaics of many small (less than 1 to 5 m^2) and large (greater than 5 to 10 m^2) patches due to their exposure to wave energy and currents, and were prone to underestimation. One of the most important services that open water SAV beds provide is a source of new propagules from their flowers and seeds. These become the new recruits critical for coastal embayment SAV bed recovery such as in Morris Island and Stage Harbor (Costello and Kenworthy 2011). Even deeper water SAV beds are vulnerable to damage from channel maintenance, beach renourishment, or fishing trawls or dredges.

Measurements were taken during three timeframes: 1994 to 1996 (Period 1), 2000 to 2002 (Period 2), and 2006 to 2007 (Period 3). It is our understanding that some areas within the Declaration of Taking and to the southway were mapped in 1995 and 2001. The Morris Island embayment site showed a net 8.8 percent decrease in SAV area, from 69.15 hectares (ha) down to 63.04, yielding a net -0.84 percent/year rate of decline over the entire analysis period. All of this decrease occurred between Periods 1 and 2, when the rate of decline was -3.02 percent/year. But this trend reversed to a +1.78 percent/year increase between Periods 2 and 3. The Stage Harbor embayment showed a 40.3 percent decrease in acreage, from 105.62 ha down to 63.10 ha, for a net -4.68 percent/year rate of decline for the entire analysis period. As with the Morris Island embayment, most the Stage Harbor embayment SAV area decline occurred during Periods 1 and 2 when the rate of decline was a sharp -8 percent/year, before slowing (improving) to -0.71 percent/year between Periods 2 and 3 (Costello and Kenworthy 2011). The median rate of decline for the South Shore Cape Cod embayments region was -3.39 percent/year (-7.73 percent/year between Periods 1 and 2, slowing to -1.21 percent/year between Periods 2 and 3), which is slightly less than the -3.7 percent/year recently reported global rate of decline for seagrasses (Waycott et al. 2009).

Conservation measures implemented for the region appear to have slowed the rate of seagrass loss, and may even be reversing an alarming regional and Statewide decline in SAV bed area for the embayments nearest to Monomoy NWR open waters, but for which SAV data are currently limited. We are stepping up our efforts to monitor seagrass loss and plan to undertake restoration projects with our partners.

Federally Listed Endangered or Threatened Species

Three federally listed species are known to breed on Monomoy NWR: piping plover (threatened), roseate tern (endangered), and northeastern beach tiger beetle (threatened). The following paragraphs describe the presence of these three species on Monomoy NWR. A total of 39 species known to use the refuge are on the Massachusetts State list of endangered and threatened wildlife. See appendix A for a complete list of State-listed and federally listed species present on the refuge.

Piping Plover

On January 10, 1986, the Service listed the piping plover as endangered (Great Lakes population) and threatened (Atlantic coast and Great Plains populations) under the ESA. Management and protection of piping plovers is one of the priority programs for the refuge. Many other avian species benefit from piping plover management, especially the least tern and the American oystercatcher.

Early documentation of piping plover on the refuge are scattered, but the species was nesting on the refuge prior to listing. A former refuge manager, Edwin Chandler, documented in his annual narratives seeing plover chicks as early as 1953, even putting a plover chick photo in his May to August 1954 narrative.

Griscom and Snyder (1955) reported 15 pairs of piping plovers on Monomoy NWR in 1955. Beginning in 1983, piping plovers were counted and monitored annually on Monomoy NWR. In February 1988, a master plan (USFWS 1988) was completed for Monomoy NWR, which stipulated that all piping plover nesting sites be closed seasonally to the public. Starting that year, these nesting sites were closed to the public from April through August to help protect the birds, their nests, and their habitat on the refuge, and that effort has continued to the present time. In recent years, the refuge has had a low of four nesting pairs of piping plover in 1993, with recorded numbers greatly expanding after the initiation of the avian diversity program in 1996 (although part of this increase may represent increased monitoring efforts). While plovers successfully nest on Monomoy NWR, current numbers (39 pairs in 2012) are generally lower than the potential capacity estimated for Monomoy NWR (94 pairs; USFWS 1996b; see map 2.3). Table 2.2 shows the number of nesting piping plover pairs and productivity tabulated over the last 16 years (1996 to 2012).

Table 2.2. Piping Plover Nesting and Productivity at Monomoy NWR (1996 to 2012).

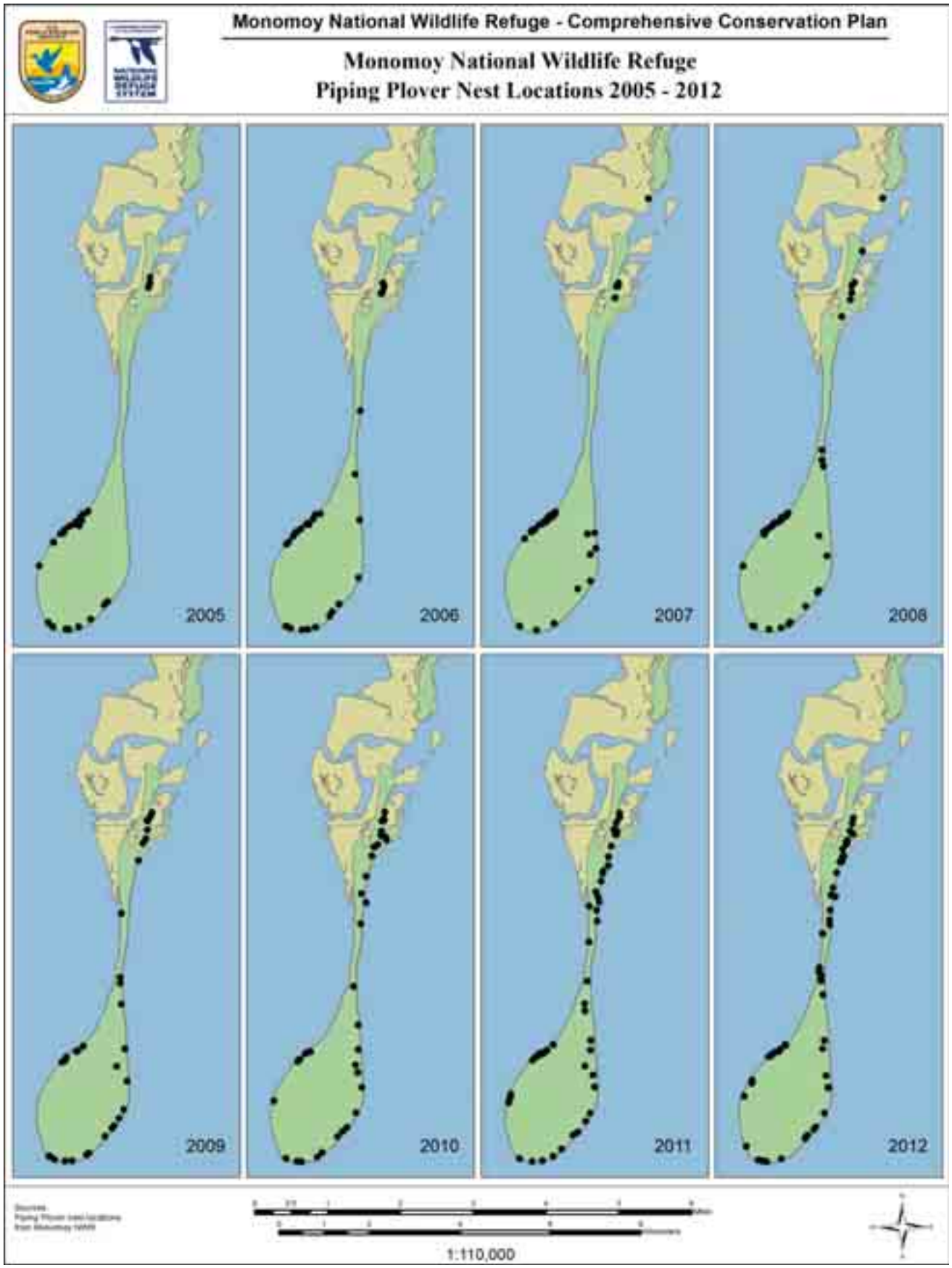
Year	Number of Nesting Pairs*; Productivity (p)**				Overall Productivity
	North Monomoy Island	South Monomoy	Minimoy Island	Total	
1996	1; p = 0.00	19; p = 2.21	N/A***	20	2.10
1997****	1	25	N/A	26	1.65
1998	1; p = 4.00	26; p = 0.69	N/A	27	0.81
1999	1; p = 0.75	26; p = 1.35	N/A	27	1.41
2000	2; p = 1.50	28; p = 1.32	N/A	31	1.33
2001	2; p = 2.00	27; p = 1.89	N/A	29	1.90
2002	2; p = 2.00	32; p = 0.94	N/A	34	1.00
2003	2; p = 2.50	31; p = 1.42	1; p = 1.00	34	1.47
2004	1; p = 3.00	24; p = 1.29	2; p = 0.00	27	1.26
2005	1; p = 0.00	18; p = 0.72	0; p = 0.00	19	0.68
2006	1; p = 4.00	24; p = 0.88	0; p = 0.00	25	1.00
2007	1; p = 3.00	19; p = 0.74	0; p = 0.00	20	0.85
2008	1; p = 0.00	26; p = 1.04	0; p = 0.00	27	1.00
2009	1; p = 0.00	31; p = 0.74	1; p = 0.00	33	0.70
2010	0; p = 0.00	33; p = 2.33	0; p = 0.00	33	2.33
2011	0; p = 0.00	41; p = 1.12	0; p = 0.00	41	1.12
2012	0; p = 0.00	39; p = 1.38	0; p = 0.00	39	1.38

**Pair numbers reflect the minimum total count for each year, and may not be the same as the index count reported to the State annually. The index count only reflects pairs present during the census window.*

***Productivity and overall productivity represent the minimum number of chicks fledged per nesting pair on the refuge.*

****The landform referred to as Minimoy Island may have existed as early as 2001 but was not surveyed until 2003 (Koch 2011 personal comment).*

*****Productivity by island is unknown for this year, but overall productivity is given as reported in Megyesi 1998.*


Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Monomoy National Wildlife Refuge
Piping Plover Nest Locations 2005 - 2012
2005
2006
2007
2008
2009
2010
2011
2012
1:110,000

Piping plover recovery efforts on the refuge have corresponded closely to management actions recommended in the Piping Plover Recovery Plan (USFWS 1996a) and revisions (USFWS 2009a). Refuge staff install symbolic fencing (sign posts with "area closed" and "beach closed" informational signs; refer to glossary) around nest sites to limit access to the area. While there are many miles of nesting habitat, the refuge is currently supporting fewer pairs of plovers than it might sustain based on habitat availability. Seasonal closures for piping plovers are based on the level of disturbance in a given area and the location of active nesting and foraging sites. Closures currently do not include all available habitat, though the refuge is moving toward increasing closures to incorporate all available high quality nesting habitat as staff time allows. If the refuge were to see an increase in public use and human disturbance, all available nesting, foraging, and staging habitat would be closed to ensure that valuable habitat was preserved. At current levels of public use, this is not a concern. The purpose of symbolic closures is to keep visitors away from nesting sites and limit disturbance to incubating adults. Predator exclosures are also placed around nests, when appropriate, to help prevent avian and mammalian predation. The staff conducts annual censuses of breeding piping plovers and monitors their productivity to determine the number of chicks fledged per pair. Reducing predation, including removal of predators, is an important action identified in the Piping Plover Recovery Plan. Predator management is an integral part of piping plover recovery efforts on the refuge and will continue into the future. Avian predators (e.g., herring and great black-backed gulls) and mammalian predators (e.g., coyote, opossum, skunk, raccoon) have been documented as responsible for nest loss.

Roseate Tern

On November 2, 1987, the Service listed the northeastern breeding population of the roseate tern as endangered. Monomoy NWR is an important nesting site for this species.

Massachusetts tern populations, including roseate and common terns, were abundant during the mid-nineteenth century, with hundreds of thousands of pairs reportedly nesting on Muskeget Island alone and several smaller colonies located on the mainland of Cape Cod that included colonies in Chatham and Wellfleet (Nisbet 1973). By the late 1800s, due to a combination of shooting and egging for food and bait, and feather collection for the millinery trade, numbers of terns nesting on Cape Cod and the islands had dramatically declined to estimates of between 5 and 10 thousand pairs. Conservation legislation in the early 1900s provided enhanced protection from human persecution and Massachusetts tern numbers rose to between 20 and 40 thousand in the State (Nisbet 1973). Beginning in the 1930s, gull populations began to expand and their populations rapidly increased in part due to the accessibility of food from open garbage dumps and discarded items from the fishing industry (MDFW 2013). Expanding gull populations soon caused tern numbers to again decrease significantly by gulls taking over nesting sites and causing intense predation on existing tern colonies. By 1977, loss of available habitat and predation brought tern numbers in Massachusetts to their lowest on record. Since 1977, cooperative efforts by Federal, State, and private conservation partners have reversed this decline for common terns, which have seen substantial population growth in recent decades. Roseate terns, however, have not had the same success. Initially, pair numbers in the State of Massachusetts increased from the 1977 low, but by 1979 began to decrease. The population experienced a series of increases and decreases over the last three decades, but is currently once again approaching the low population levels of the mid-1970s (Mostello 2012).

The first 20th century report of common and roseate terns nesting on Monomoy NWR occurred in 1961 (Nisbet 1980). The tern colony increased rapidly to 2,000 pairs by 1963, and from 1963 to 1984, Monomoy supported one of the largest tern

colonies in the Northeast. Several hundred pairs of roseate terns were found nesting on Monomoy NWR during these years. In 1978, concern heightened when tern reproductive success began to decline on the refuge. The numbers of nesting roseate terns began decreasing in the early 1980s and eventually declined to 1 nesting pair in 1988, down from 400 nesting pairs in 1980.

The roseate tern was listed as an endangered species because of the significant reduction in nesting sites: 30 major colonies were abandoned or experienced substantial declines between 1920 and 1979. By 1997, Cape Cod, Nantucket, and Martha's Vineyard had only 20 nesting pairs—significantly low numbers when compared to the 105 pairs in 1999. Due to inconsistent tern surveys and monitoring protocols prior to 1987, it is unclear whether the population is now stable or declining (USFWS 1998a). In 2002, Monomoy NWR, though considered a minor site, was one of only three sites in Massachusetts supporting nesting roseate terns. One of the recovery criteria in the Roseate Tern Recovery Plan calls for a "minimum of six large colonies (greater than or equal to 200 pairs) with high productivity (greater than or equal to within the tern's current geographic distribution) (USFWS 1989, USFWS 1998a).

The potential for a large roseate tern colony at Monomoy NWR is great, given the large common tern colony, which has similar nesting requirements. In general, common terns prefer slightly less dense vegetation, approximately 30 percent vegetation with 70 percent open sand, than do roseate terns. Roseate terns tend to prefer the opposite configuration, with about 70 percent vegetation to 30 percent open (Koch 2013 personal comment). Monomoy NWR has the potential to support a large nesting site again if we can control predation and are able to successfully provide the optimal habitat. All roseate terns in the Northeast nest in close association with large, productive common tern colonies; one of the largest of these is on the refuge (USFWS 1998a).

As a baseline for setting future population goals, the Roseate Tern Recovery Plan sets the productivity level for roseate tern at one fledged chick per nesting pair (USFWS 1998a). Roseate terns use the refuge during the breeding and post-breeding seasons. In 1998 and 1999, more than 20 pairs of roseate terns nested on South Monomoy with good to average productivity, but in 2000 nesting numbers declined dramatically. The decline in numbers observed in 2000 may have been due to predator presence; a great horned owl was present in the colony early in the season. As a result, the tern colony was abandoned every night from May 11 to June 14; for a total of 3 weeks there was full abandonment, with partial abandonment for 1 to 2 weeks thereafter. Roseate terns are generally more skittish than common terns, and may have had a hard time establishing territories due to the already existing common tern territories in this same area. Another possible explanation for the decline may be the loss of traditional nesting areas. It's possible these birds nested on Minimoy Island in 2002, but this site was not surveyed until 2003.

From 2003 to 2008, Minimoy Island hosted between 10 and 43 pairs of roseate terns. Erosion of the western side of Minimoy Island in recent years resulted in decreased habitat for roseate terns, until virtually no suitable habitat was available by 2009. Beginning in 2009, refuge staff attempted to attract roseate terns back to the main common tern nesting colony on South Monomoy by placing nesting structures, decoys, and a sound system in suitable habitat. In 2009, no roseate terns nested on the refuge, but in 2010, roseate terns returned to the nesting area on South Monomoy. Refuge staff conduct annual censuses of roseate terns, as well as productivity monitoring (to determine number of chicks fledged per nest), banding of adults and juveniles, post-breeding staging counts, and habitat enhancement (e.g., use of nesting structures). Table 2.3 shows the number of nesting pairs and productivity of roseate terns at the refuge over the last 15 years (1996 to 2012).

Predator management is an important part of the roseate and common tern restoration efforts on South Monomoy. The presence of a single mammalian predator (e.g., coyote, skunk, and raccoon) or avian predator (e.g., great horned owl, black-crowned night-heron) in a tern colony can decrease productivity or cause the terns to abandon the site entirely. Predation can limit the distribution and abundance of breeding terns and their reproductive success (Kress and Hall 2004, USFWS 2010a). Habitat management to benefit nesting seabirds and shorebirds currently includes vegetation management based on prescribed burns to remove grasses and duff.

Table 2.3. Roseate Tern Nesting and Productivity at Monomoy NWR (1996 to 2012).

	Number of Nesting Pairs; Productivity (p)						
	South Monomoy			Minimoy Island**			Refugewide Total Count
	A Count	B Count*	Total Count	A Count	B Count	Total Count	
1996	6; p = 0.00	0; p = 0.00	6	N/A	N/A	N/A	6
1997	0; p = 0.00	1; p = 0.00	1	N/A	N/A	N/A	1
1998	22; p = 0.38–0.97	17-20; p = 0.46-0.93	39-42	N/A	N/A	N/A	39-42
1999	27; p = 0.90	5-14; p = 0.57-0.29	32-41	N/A	N/A	N/A	32-41
2000	3; p = 1.00	0; p = 0.00	3	N/A	N/A	N/A	3
2001	6; p = 0.33	0; p = 0.00	6	N/A	N/A	N/A	6
2002	3; p = 1.00	0; p = 0.00	3	N/A	N/A	N/A	3
2003	3; p = 1.33	0; p = 0.00	3	10; p = 1.50	5; p = 0.40	15	18
2004	1; p = 1.00	0; p = 0.00	1	24; p = 1.13	2; p = 0.50	26	27
2005	1; p = 0	0; p = 0.00	1	22; p = 1.23	1; p = 1.00	23	24
2006	2; p = 0.50	0; p = 0.00	2	24; p = 1.00	3; p = 0.67	27	29
2007	2; p = 1.00	0; p = 0.00	2	43; = 1.00	13; p = 0.13	56	58
2008	0; p = 0.00	0; p = 0.00	0	30; p = 1.00	7; p = 0.00	37	37
2008	0; p = 0.00	0; p = 0.00	0	30; p = 1.00	7; p = 0.00	37	37
2009	0; p = 0.00	0; p = 0.00	0	0; p = 0.00	0; p = 0.00	0	0
2010	7; p = 1.14	0; p = 0.00	7	1; p = 2.00	0; p = 0.00	1	9
2011	7; p = 0.29	0; p = 0.00	7	3; p = 1.67	2; p = 0.00	5	12
2012	1; p = 2.00	1; p = 0.00	2	6; p = 0.50	0; p = 0.00	6	8

**Pairs identified during the B Count may have nested during the A Count at other sites. Since not all roseate terns are banded, we can never be certain that B nests are new pairs.*

***The landform referred to as Minimoy Island may have existed as early as 2001 but was not surveyed until 2003 (Koch 2011 personal comment).*

Northeastern Beach Tiger Beetle

In August of 1990, the Service listed the northeastern beach tiger beetle as threatened. This 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. In 1994, only two small populations remained on the Atlantic coast.

Currently northeastern beach tiger beetles can be found at two sites north of the Chesapeake Bay in Massachusetts: one on the south shore of Martha's

Vineyard and one on South Monomoy and Nauset/South Beach in Chatham, MA. The successful establishment of a northeastern beach tiger beetle population is believed to require a long stretch of relatively wide beach with no ORVs and relatively light recreational impacts. It is difficult to find these characteristics along the Massachusetts coast.

On beaches where they occur, adult northeastern beach tiger beetles are most active on warm, sunny days along the water's edge, where they are commonly seen feeding, mating, or basking (thermoregulation). The number of adult beetles active on rainy or cool, cloudy days is very low, probably because the beetles need to maintain high body temperatures for maximal predatory activity. Adults tend to be concentrated in wider sections of beach, and occur in smaller numbers or may even be absent from nearby areas of narrow beach (USFWS 1994).

Larvae occur in a relatively narrow band of the upper intertidal to high drift zone, but may relocate their burrows throughout their development to adapt to environmental and seasonal changes in the beach ecosystem (USFWS 1994). The larval stage of this beetle lasts approximately 2 years and each population consists of two cohorts: adults that emerge in odd years and adults that emerge in even years. Given that there are two distinct cohorts at each site, it is common that the population size varies from year to year, as does the exact location of spawning adult beetles. Cohort success may also depend on annual variation in weather and the ability of the larvae to survive winter storms and other natural and tidal fluctuations.

Searches on Monomoy NWR in the 1980s failed to locate the northeastern beach tiger beetle, but the structure of the habitat seemed favorable. Federal ownership, the occurrence of historic collection records labeled "Chatham" (the town in which the refuge is located), and the desire of State wildlife officials to retain Massachusetts beetles within the State all combined to make Monomoy the leading candidate as an introduction site. Meetings held in the winter of 1997 discussed translocation of beetles, though, for a variety of reasons, this was not feasible in 1998. Translocations were attempted in 1999, but weather was not favorable and larvae could not be found at the donor site (Nothnagle 2000). The first larval beetle transplant occurred in May 2000, when 23 third instar tiger beetle larvae were moved from Martha's Vineyard to the refuge. Adult beetles generally emerge from their sandy burrows in July and August, and that year, five adult tiger beetles emerged and were found on the refuge. Introduction continued to occur from 2001 through 2003 with 34, 33, and 23 larvae transplanted, respectively. In 2001, approximately 24 adults were found; in 2002, 27 adults were found; and in 2003, 19 adults were found. Table 2.4 shows the number of northeastern beach tiger beetle larvae translocated and the number of adults captured and marked on the refuge between 2000 and 2012.

Since 2004, tiger beetle larvae have not been transferred to Monomoy NWR due to logistical challenges and habitat loss on the source beach at Martha's Vineyard. However, through continued adult tiger beetle monitoring, the annual presence of tiger beetles has been documented on the refuge. Annual monitoring confirms successful survival and production of tiger beetles through all stages of life, and gives a firm indication of a new self-sustaining population at Monomoy NWR. In addition to monitoring of adult tiger beetles, tiger beetle distribution has been mapped and larval habitat surveys have been conducted from 2008 through 2012 (map 2.4). The November 2006 land bridge joining Nauset/South Beach and Monomoy NWR developed at the center of the northeastern beach tiger beetle habitat. Currently, adults and larvae occupy an area that spans several miles on the refuge and Nauset/South Beach. The Town of Chatham has been supportive of the refuge staff's work concerning the beetles.

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Northeastern Beach Tiger Beetle Distribution
Morris Island
Refuge Headquarters
North Monomoy Island
South Beach
Monomoy Island
Refuge Boundary
South Monomoy Island
Monomoy Lighthouse
2000 Larval Reintroduction
2012 Outliers
2011 Outliers
Tiger Beetle Main Habitat
1:70,000

Table 2.4. Northeastern Beach Tiger Beetle Translocated and Marked at Monomoy NWR (2000 to 2012).

Year	Number of Larvae (Translocated)	Number of Beetles Marked	High Count
2000	23	6	6
2001	34	24	24
2002	33	27	27
2003	23	19	19
2004	0	26	26
2005	0	16	16
2006	0	65	75
2007	0	19	19
2008	0	179	180
2009	0	102	102
2010*	0	90	571**
2011*	0	100	375**
2012*	0	40	1228**

**Tiger beetle populations on the refuge became too large to capture all adults for marking and instead a subset was marked to approximate the population and high counts were taken on most survey days.*

***Population estimate is approximately 30 to 40 percent of the highest or peak count in a given year. This was determined using program Mark (Kapitulik 2011 personal comment).*

Birds

This section describes migratory bird species, including waterfowl, shorebirds, seabirds, other colonial nesting waterbirds, raptors, and other birds of conservation concern that are found on the refuge.

Migratory Birds

Refer to appendix A for a complete list of birds present on the refuge.

Red Knot

The red knot is a candidate for Federal protection under the Endangered Species Act. These birds undertake one of the longest migrations known, traveling from their furthest wintering ground at the tip of South America to their Arctic breeding grounds and back again each year, an estimated 16,000-mile round trip. Their migration also includes some of the longest non-stop 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). Delaware Bay, arguably the most important stopover in the Western Hemisphere, supporting thousands of red knots especially during the northward migration, has been the focus of much research in the last two decades.

Southeastern Massachusetts, and Monomoy Refuge in particular, are likely to provide one of the most important sites for adult and juvenile red knots during their southward migration (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). In 2009, refuge staff began partnering with the Conserve Wildlife Foundation of New Jersey and others to cannon-net shorebirds on Monomoy Refuge during southward migration. Refuge staff were interested in capturing shorebirds to test for avian influenza (see the shorebird section for more details), but through the partnership were also able to start deploying geolocators on red knots to learn more about migration, stopover, and wintering sites. Geolocators are global location sensors that record changes in ambient light levels. This information can then be used to estimate sunrise and sunset, allowing for an estimated calculation of latitude and longitude (Nisbet et al. 2011). In 2009 and 2010, more than 50 data loggers were deployed on adult and sub-adult red knots passing through Monomoy Refuge and surrounding beaches. During this time, geolocators were also deployed at Delaware Bay and other sites. Preliminary results from geolocators retrieved from North American wintering red knots (recovered at Monomoy refuge and other participating sites) have confirmed the importance of Monomoy Refuge as a stopover site; North American wintering red knots spent 58 to 75 days here before migrating south in November. This work has also confirmed the importance of Florida as a wintering site, and has raised the awareness of occupied sites in North and South Carolina, Haiti, Columbia, and Cuba (Burger et al. 2012).

While we are beginning to learn more about migration, stopover, and wintering sites of adults, currently there is little information on migration routes, and no information on wintering sites of juvenile red knots. Survival of juveniles during their first winter could be a key factor in population dynamics. Knowledge of migration and wintering sites would allow researchers to assess habitat condition, work toward minimizing disturbance and other limiting factors, and better understand first-year survival. As a result, we have continued working with partners and began placing geolocators on juvenile red knots (54) migrating through Chatham in 2011. We continued this work in 2012, but very few juveniles were observed in the area in 2012 (likely due to a poor breeding season) and only 11 juvenile red knots were captured and outfitted with geolocators.

While only a subset of captured red knots at Monomoy Refuge are outfitted with geolocators, all red knots receive a unique 3-digit alpha-numeric lime green flag, which can be read from a distance by researchers, bird watchers, and the general public. Resightings of banded birds are incorporated into a collaborative resighting database, (available online at: *http://www.bandedbirds.org*), which allows all partners to benefit from this information. The compilation of banding and resighting data in one central place, collected from participants throughout the flyway, increases the power of these data and allows for a greater understanding of this species' migration paths and habitat use. Refuge staff have supported and participated in intensive resighting surveys of red knots in the Chatham area since 2009 (resighting surveys were also occurring in previous years without USWFS support). From 2009 to 2012, more than 8,500 red knots with unique alpha-numeric flags, or flag and color band combinations, have been observed for inclusion in the *www.bandedbirds.org* database.

Waterfowl and Waterbirds

Established for the protection and perpetuation of migratory waterfowl (Bureau of Biological Survey 1938), Monomoy NWR is one of the sites in Massachusetts with the largest diversity of breeding waterfowl species. Brood surveys done sporadically over the years have found the following waterfowl species breeding on the refuge: mallard, Canada goose, American black duck, gadwall, green-winged teal, American wigeon, northern pintail, northern shoveler, blue-winged teal, and ruddy duck (USFWS unpublished data). Many of these species nest in

other locations in Massachusetts; however, South Monomoy's freshwater ponds and marshes provide important migratory stopover and wintering habitat for waterfowl. Redhead, bufflehead, common goldeneye, hooded merganser, lesser scaup, greater scaup, ring-necked duck, canvasback, pied-billed grebe, and American coot have also been found to use Monomoy's freshwater ponds and marshes as migratory stopovers (Nikula 2011 personal communication).

The shellfish-rich waters around Monomoy NWR attract thousands of migrating and wintering scoter, common eider, long-tailed duck, and red-breasted merganser. Extensive eelgrass and sea lettuce beds in the nearshore waters of Monomoy Refuge provide winter food for wintering and migrating Atlantic brant. Midwinter waterfowl surveys are conducted annually coast-wide and include waters surrounding Monomoy Refuge. Table 2.5 below includes counts of waterfowl (except mute swans) from 2005 to 2012 for waters surrounding Monomoy NWR, as well as all of coastal Massachusetts and offshore islands (in parentheses).

Table 2.5. Midwinter Waterfowl Surveys (January) for Waters Surrounding Monomoy NWR and Coastwide (in parentheses) (2005 to 2012).*

Year	American Black Duck	Atlantic Brant	Bufflehead	Canada Goose	Common Eider	Goldeneye	Long-tailed Duck	Mallard	Merganser	Scaup	Scoter
2005	414	0	52	78	1033	1	31	0	8	0	19
2006	683	52	64	293	1746	67	67	2	40	0	0
2007	497 (20280)	0 (1417)	133 (7663)	120 (11144)	25859 (37831)	0 (1585)	0 (168)	0 (5324)	61 (8125)	0 (1161)	623 (8707)
2008	795 (18346)	0 (2272)	18 (6116)	433 (10316)	578 (78856)	16 (4659)	0 (273)	0 (4629)	51 (3676)	0 (3741)	8 (21654)
2009	103 (18877)	32 (1908)	28 (9312)	32 (11105)	6584 (65676)	0 (1037)	21 (1437)	0 (3288)	52 (4316)	18 (3524)	1 (12337)
2010	522 (18599)	0 (1572)	70 (5790)	126 (8229)	108 (46097)	0 (1092)	0 (239)	2 (2452)	14 (8940)	0 (4273)	2 (5450)
2011	245 (16589)	0 (1213)	2 (2032)	211 (11299)	25014 (46198)	0 (835)	0 (148)	0 (1808)	4 (4643)	0 (2382)	26 (4817)
2012	906 (30591)	40 (1550)	0 (3860)	580 (16579)	603 (41076)	5 (5587)	5 (698)	0 (3153)	51 (15025)	0 (4534)	333 (7111)

Source: Klimstra 2012

* *Species that were not recorded at Monomoy NWR during any year from 2005 to 2012, but were recorded elsewhere in Massachusetts, are not included in this table. Data obtained from midwinter waterfowl survey records, USFWS. Information about these surveys can be found at: https://migbirdapps.fws.gov/mbdc/databases/mwi/aboutmwi_allflyways.htm*; accessed January 2013.

Migrating Shorebirds

A 1984 report of the International Shorebird Survey cites Monomoy NWR among the five most important of 454 autumn shorebird stopover areas studied east of the Rocky Mountains (Harrington 1984 as cited in USFWS 1988). In March 1999, the refuge was designated as a WHSRN regional site based on a maximum one-day count of approximately 21,000 shorebirds (WHSRN 2006; see

USFWS

Service employee holding a tern

WHSRN section for details). In particular, the refuge provides habitat for significant numbers of species that are listed as highly imperiled or high concern by the U.S. Shorebird Conservation Plan (Brown et al. 2001), as highest or high priority within Bird Conservation Region 30 (ACJV 2005; *http://www.acjv.org/bird_conservation_regions.htm*; accessed January 2013), New England/Mid Atlantic coast, and as birds of conservation concern in Region 5 (Maine to Virginia; USFWS 2008a) by the U.S. Fish and Wildlife Service.

Monomoy NWR is a favored stopover site for southward migrating shorebirds because of its location in the landscape and critical foraging habitats (Koch and Paton 2009). During northward migration, many shorebirds traveling north along the east coast of the United States stop at Delaware Bay and then migrate nonstop to sites in Canada, thus bypassing New England completely. However, during southward migration, many shorebirds use more easterly migratory routes back to their non-breeding areas, thus traveling through more northerly areas of the Atlantic coast (Morrison 1984, Myers et al. 1987). The Cape Cod region of Massachusetts protrudes into the Atlantic Ocean, attracting southbound shorebirds following a more easterly path. Habitats at Monomoy Refuge 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 provides foraging and roosting habitats (Koch and Paton 2009).

Most migratory shorebirds that use the refuge as a stopover site forage during low tides on the expansive flats and salt marsh habitat surrounding the islands, and move to other areas such as Nauset/South Beach to roost at high tides. Shorebirds that remain on the refuge during high tides in recent years have roosted in the higher elevations of salt marsh and beach berm/dunes on the northeast and south sides of Minimoy Island, the western side of North Monomoy Island, and on and around the land connection between Nauset/South Beach and South Monomoy (Koch and Paton, in prep). Most salt marsh habitat on the refuge is closed to public access from April through at least July, and sometimes through August, to protect nesting shorebirds and waterbirds. The majority of flats where shorebirds forage and beach areas where shorebirds roost are mostly open to public access. However, because most of the habitats used by shorebirds are not easily reached without a boat, human disturbance is relatively low compared to other sites in Massachusetts (Koch and Paton 2009).

Standardized shorebird surveys were conducted on one-hectare (1-ha) plots throughout the majority of the intertidal habitat on Monomoy NWR from April to October (2006) and November (2007) to characterize seasonal species diversity and abundance. Table 2.6 summarizes relative abundance of all documented shorebird species during 2006 and 2007, using shorebird-use-days; one shorebird-use-day equals one individual shorebird detected within a 1-ha plot during a survey. We detected 22 shorebird species during surveys (21 in 2006 and 20 in 2007) and eight additional species outside of our surveys. Semipalmated

sandpipers, sanderlings, black-bellied plovers, dunlin, and short-billed dowitchers combined accounted for more than 75 percent of all shorebirds counted. Nine species had a combined 2-year total of 1,000 shorebird-use-days or more (Koch and Paton 2009).

Table 2.6. Conservation Priority and Abundance of all Shorebird Species Observed in Survey Plots at Monomoy NWR in 2006 and 2007.

Species	Conservation priority[a]	Total shorebird-use-days[b]	High count ha^{-1} [c]	Mean (SE) shorebird-use-days ha^{-1} [c]
Black-bellied plover	H, M	10,798	146	2.7 (0.1)
American golden-plover	H	2	1	< 0.1 (0.0)
Semipalmated plover	M	6,369	200	1.6 (0.1)
Piping plover	HH	90	13	< 0.1 (0.0)
American oystercatcher	HH, BCC	354	15	0.1 (0.0)
Greater yellowlegs	H	661	70	0.2 (0.0)
Lesser yellowlegs	BCC	209	37	0.1 (0.0)
Willet	H	696	9	0.2 (0.0)
Whimbrel	HH, BCC, M	15	4	< 0.1 (0.0)
Hudsonian godwit	BCC, H	141	16	< 0.1 (0.0)
Marbled godwit	BCC, H	10	4	< 0.1 (0.0)
Ruddy turnstone	HH, M	1,392	122	0.3 (0.0)
Red knot	HH, BCC, M	3,164	137	0.8 (0.1)
Sanderling	HH, M	14,896	450	3.7 (0.2)
Semipalmated sandpiper	H, BCC, M	19,365	512	4.9 (0.4)
Western sandpiper		6	3	< 0.1 (0.0)
Least sandpiper		2,684	97	0.7 (0.1)
White-rumped sandpiper	H, M	424	61	0.1 (0.0)
Pectoral sandpiper		12	7	< 0.1 (0.0)
Dunlin	H, M	8,106	138	2.0 (0.2)
Short-billed dowitcher	H, BCC, M	7,499	277	1.9 (0.1)
Long-billed dowitcher		8	2	< 0.1
TOTAL		**76,901**	**579**	**19.3 (0.7)**

[a] *Additional shorebird species detected outside of plots include: killdeer, solitary sandpiper, spotted sandpiper, upland sandpiper, curlew sandpiper, stilt sandpiper, buff-breasted sandpiper, and red-necked phalarope.*

[b] *Species prioritized as Highest Priority (HH) and High Priority (H) for BCR 30 (ACJV 2005), species listed as a Bird of Conservation Concern (BCC) for U.S. Fish and Wildlife Service Region 5 (Maine to Virginia; USFWS 2008) or species that occur in high concentrations on the northern Atlantic U.S. Coast and for which this area has been identified as extremely important during migration (M) relative to other areas by the U.S. Shorebird Conservation Plan (Brown et al. 2001).*

[c] *Cumulative total of birds counted; does not account for individual birds that may have been counted on multiple days. Both years combined.*

Figure 2.5 shows migration chronology of shorebirds on Monomoy NWR. Seasonal variation in species-richness was similar between years and was higher during southward migration (especially during 15 July to 31 August) compared to northward migration, and was lowest during June in both years (Koch and Paton 2009).

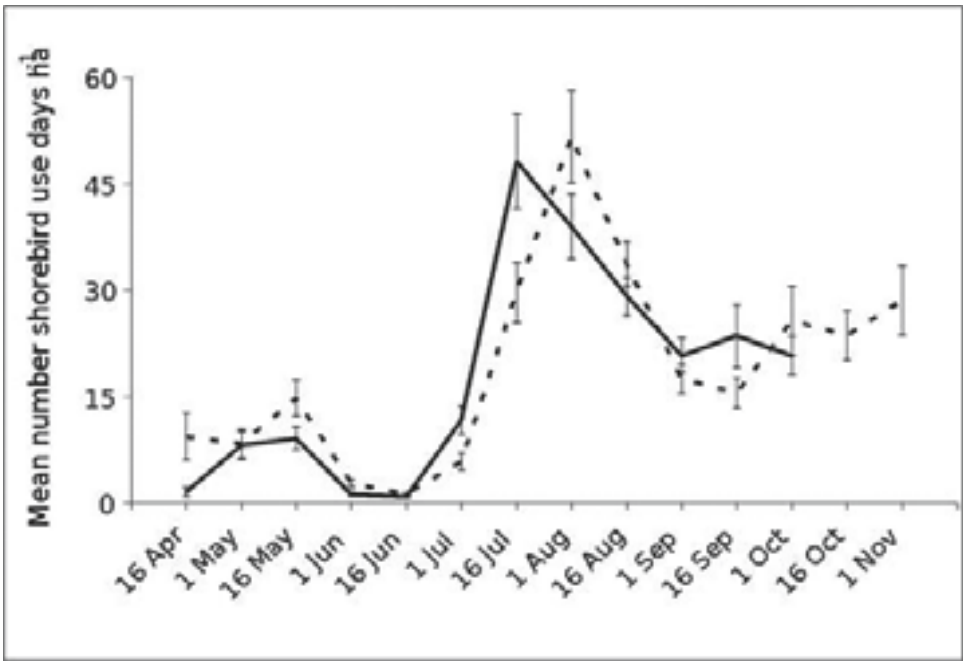


Figure 2.5. Seasonal Variation in Mean (+ or – 1SE) Shorebird-use-days for all Shorebirds Based on Semi-monthly Time Intervals at Monomoy NWR. Solid line represents 2006 and dashed line represents 2007.

All species, except ruddy turnstone, were more common during southward migration compared to northward migration (figure 2.6). Of the eight species that were more common during southward migration, we observed two different patterns of migration. During southward migration, semipalmated plover, semipalmated sandpiper, least sandpiper, and short-billed dowitcher exhibited rather short, distinct windows of migration and little annual variation in migration chronology (except for semipalmated sandpiper). These species were also completely absent or rare during northward migration. In contrast, black-bellied plover, red knot, sanderling, and dunlin had a more protracted southward migration, and these species (except for red knot) were also present in substantial numbers during northward migration. The observed increase in shorebird-use-days during southward migration may be partially attributed to an influx of juveniles, but is more likely explained by differences in species-specific northward and southward migration pathways. Many species of New World shorebirds exhibit an elliptical migration, travelling along more easterly pathways during southward migration (Morrison 1984, Myers et al. 1987, Gratto-Trevor and Dickson 1994). For example, Myers et al. (1990) found sanderlings primarily used central and Pacific migration corridors during northward migration through North America, but shifted to the Atlantic coast during southward migration, especially using Monomoy NWR and sites along some Atlantic states. Lower shorebird abundance on the northeast Atlantic coast during the northward migration may be partly a result of climate and lower food availability (Morrison 1984).

In 2009, refuge staff began partnering with the Conserve Wildlife Foundation of New Jersey and others to cannon-net shorebirds on Monomoy Refuge during

southward migration. Refuge staff were interested in capturing shorebirds to test for highly pathogenic avian influenza (HPAI).

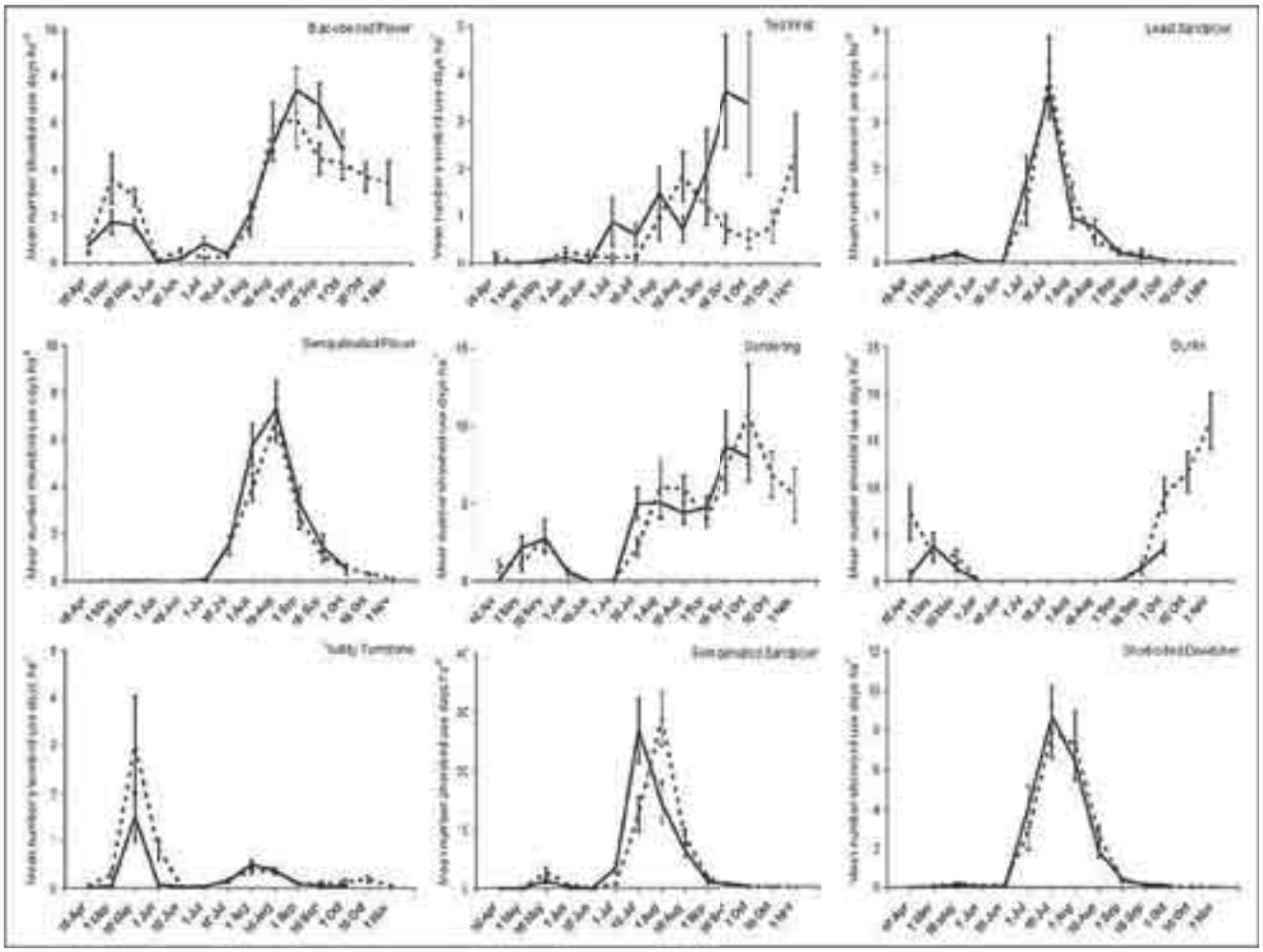


Figure 2.6. Seasonal Variation in Mean (+ or – 1SE) Shorebird-use-days for Nine Shorebird Species Based on Semi-monthly Time Intervals at Monomoy NWR. Solid lines represent 2006 and dashed lines represent 2007.

Tens of thousands of shorebirds, representing more than 20 species, rely on the refuge during spring and fall migration. Many of these species have been identified as high priority for live bird sampling in the Atlantic flyway (Atlantic Flyway Migratory Bird Technical Section 2006). Because of the abundance and diversity of birds present on the refuge during spring, summer, and fall, Monomoy NWR is of particular interest with respect to HPAI surveillance. In 2009, staff collected cloacal and pharyngeal swabs from 1 semipalmated plover, 16 black-bellied plovers, 30 sanderlings, and 103 red knots. Staff continued monitoring for HPAI in 2010 collecting swabs from 2 semipalmated sandpipers, 3 black-bellied plovers, 11 sanderlings, and 90 red knots. All swabs from 2009 and 2010 tested negative for HPAI.

Through this partnership and cannon-netting effort, we have also been placing metal Bird Band Laboratory-issued bands on all shorebirds, and unique 3-digit alpha-numeric lime green flags that can be read from a distance by researchers, bird watchers, and the general public on red knots (see the Red Knot section for details on this species), short-billed dowitchers, and sanderlings. Resightings of banded birds are incorporated into a collaborative resighting database,

bandedbirds.org, which allows all partners to benefit from this information. The compilation into one database of banding and resighting data collected from participants flyway-wide increases the power of these data and allows for a greater understanding of migration paths and habitat use of this species.

Nesting Shorebirds

In addition to hosting tens of thousands of shorebirds during migration, the refuge's specialized habitat supports nesting shorebirds of conservation concern, including piping plovers, American oystercatchers, and willets. Piping plovers' nesting history on Monomoy NWR is described above. American oystercatchers and willets have expanded their breeding ranges to include coastal Massachusetts and have established themselves as nesters on Monomoy Refuge within the last 30 years. Numbers of nesting American oystercatchers in the past 16 years is included in table 2.7, but pair numbers prior to 2002 are likely underestimates due to the low level of monitoring done in these years. Good estimates of productivity are difficult to obtain because of the secretive nature of American oystercatcher chicks, but annual productivity is generally between 0.25 and 0.50 chicks/pair. Willet nests are only counted opportunistically, but it is likely that 25 to 50 pairs of willets nest on the refuge each year. Predation of eggs and chicks by coyotes and gulls and nest overwash continue to limit reproductive success of this species. Monomoy NWR remains one of the most important nesting sites in Massachusetts for American oystercatchers, and in some years has been one of the more important staging sites for oystercatchers prior to the onset of migration. Very little is currently known about staging site selection for this species, 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 (Koch 2011 personal communication).

Table 2.7. American Oystercatcher Nesting and Productivity at Monomoy NWR (1996 to 2012).

Year	Number of Nesting Pairs; Productivity (p)			
	North Monomoy Island	South Monomoy	Minimoy Island	Refugewide
1996*	N/A	8 nests found	N/A	8 nests found
1997*	N/A	6 pairs	N/A	6 pairs
1998*	8 pairs	6 pairs	N/A	14 pairs
1999*	7 pairs	10 pairs	N/A	17 pairs
2000*	3 pairs	12 pairs	N/A	15 pairs
2001*	5 pairs	14-15 pairs	N/A	19-20 pairs
2002	9; p = 0.33	17; p = 0.65	N/A	26; p = 0.54
2003	12; p = 0.08	17; p = 0.35	4; p = 1.25	33; p = 0.36
2004	10; p = 0.30	15; p = 0.27	9; p = 0.78	34; p = 0.41
2005	11; p = 0.00	11; p = 0.09	7; p = 0.00	29; p = 0.03
2006	8; p = 0.63	13; p = 0.38	8; p = 0.63	29; p = 0.52
2007	13; p = 0.62	13; p = 0.62	8; p = 0.13	34; p = 0.50
2008	14; p = 0.57	11; p = 0.09	6; p = 0.17	31; p = 0.32
2009	8; p = 0.00	8; p = 0.38	6; p = 0.17	22; p = 0.18
2010	10; p = 0.20	8; p = 0.88	6; p = 1.67	24; p = 0.79
2011	8; p = 0.50	9; p = 0.00	6; p = 0.67	23; p = 0.35
2012	9; p = 0.00	11; p = 0.27	6; p = 0.33	26; p = 0.19

**Oystercatcher productivity was not quantified in these years.*

Seabirds
The following is a description of tern and gull species that occur on the refuge.

Common Terns
For most of the late 19th century and first half of the 20th century, Monomoy was a continuation of either Nauset Beach or Morris Island and was not particularly remote or inaccessible. During the 1920s and 1930s, terns established large colonies at nearby Tern Island and North Beach, but apparently not on Monomoy. A few least terns and arctic terns reportedly nested on Monomoy as early as 1921 and at other times through the 1950s (Erwin 1979a).

In 1958, a storm separated Monomoy from the mainland, and the first 20th century report of common terns and roseate terns nesting on Monomoy was recorded in 1961 (Nisbet 1980). The colony increased rapidly to at least 2,000 pairs by 1963. The rapid growth was probably due to recruitment from the nearby colonies at Tern Island and North Beach, and possibly Muskeget Island. During most of the 1960s, tern colonies were located at both the north and south ends of the refuge, but in 1971, the expanding herring gull colony usurped the tern sites at the south end, and the terns formed a single large colony on what is now North Monomoy Island (USFWS 1988). From 1963 to 1984, Monomoy NWR supported one of the largest tern colonies in the Northeast. Until 1979, nesting populations ranged from 2,000 to 4,000 pairs. Most of these were common terns, but several hundred pairs of roseate terns were also present. Arctic terns on the southern edge of their range never numbered more than three or four dozen pairs on Monomoy.

By the late 1970s, common, roseate, and arctic terns were restricted to the north end of North Monomoy Island, with a laughing gull colony nearby. Concern heightened in 1978 when tern reproductive success began to decline. In addition to pressure from the gulls to the south, the tern and laughing gull colonies were becoming constricted from the north due to erosion of the island. After a February 1978 storm, the erosion rate accelerated and in the summer of 1979 was estimated to be 16 to 33 feet per month (USFWS 1988).

Common and roseate tern numbers declined steadily throughout the 1980s and 1990s. In 1996, an avian diversity project was initiated by the Service to create more nesting space for terns. Despite the public opposition, this first year of gull control was extremely successful and tern numbers increased dramatically at the restoration site; numbers continued to increase annually through 2003, reached a plateau for a few years, and then started to decline slightly in 2007, reaching an ultimate recent low in 2009 (figure 2.7).

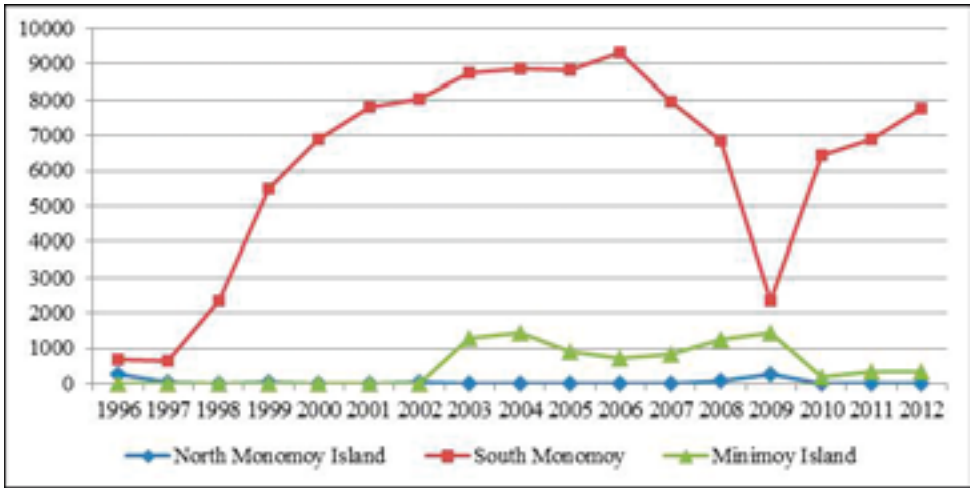


Figure 2.7. Nesting Common Terns on Monomoy NWR (1996 to 2012).

At its height, Monomoy NWR boasted the largest common tern colony in Massachusetts—approximately 43 percent of the population in the State, and it has been the largest tern colony on the Atlantic seaboard. Reproductive success was generally great to excellent in most years for the first 10 years following restoration, but in more recent years, productivity has often been reduced by heavy predation from gulls, coyotes, and black-crowned night-herons, storms and inclement weather, and a combination of marginal habitat and disease outbreaks (table 2.8). Additionally, the number of nesting common terns on Monomoy NWR is inversely related to the number of nesting common terns at Plymouth Beach in Plymouth, MA, and the quality of that nesting site. The increase of nesting common terns in the first few years following the start of the project was concomitant with a decline in the nesting common terns at Plymouth Beach. Birds nesting at Plymouth Beach had been subject to predator pressures prior to abandoning that site and moving to Monomoy Refuge. Similarly, in recent years when nesting numbers at Monomoy refuge have declined, numbers at Plymouth Beach have increased. Band resighting data confirmed that birds from Plymouth Beach were disproportionately represented and much more likely to be at Monomoy NWR than birds from warm-water sites in Buzzards Bay.

Table 2.8. Common Tern Productivity (1996 to 2012).

Year	Common Tern Productivity (SMNY A-period)
1996	1.50
1997	1.70
1998	1.83
1999	1.61
2000	1.85
2001	1.2
2002	0.70
2003	1.26
2004	1.59
2005	1.41
2006	0.96
2007	0.70
2008	1.12
2009	0.35
2010	1.25
2011	1.28
2012	1.26

To maintain tern populations, refuge staff have employed a variety of techniques to improve nesting habitat and increase tern productivity. Techniques such as vegetation manipulation, including application of herbicide and controlled burning, as well as the use of artificial nesting structures have been employed. The two main objectives for controlling vegetation, primarily American beach grass on South Monomoy, have been to reestablish suitable nesting habitat for roseate and common terns in historic nesting areas, and to decrease optimal nesting habitat for an encroaching population of laughing gulls. In 2001, one 30×30 meter control plot and two 15×30 meter adjacent experimental plots

were established on the east side of the north tip to test different vegetation manipulation techniques. In one experimental plot the vegetation was pulled out by hand, and in the other experimental plot the vegetation was weed-whacked and then covered with landscape cloth. Four additional 30×30 meter experimental plots were added between the fall of 2001 and the spring of 2002 and subjected to (1) herbicide application and raking, (2) herbicide application and burning, (3) raking only, and (4) burning only. Through both seasons of testing, productivity of terns and predator activity within the plots was closely monitored with the results from vegetation manipulation. Experimental vegetation manipulation during 2001 to 2002 showed that of the six treatments used, burning and a combination of herbicide and burning produced a habitat type that most deterred nesting laughing gulls and enticed nesting common terns (USFWS 2007b). Although the combination of herbicide and raking produced the most significant alterations in vegetation structure, burning alone was the only type of management that actually resulted in a decline in the number of nesting laughing gulls that persisted for 2 years.

Since the vegetation work in 2001 to 2002, three controlled burns have been conducted on the refuge to improve nesting habitat for terns. On April 8, 2004, two 60×60 meter plots were burned on the southwestern edge of the colony. This area was one of the main areas of encroachment by laughing gulls. Baseline vegetation data was collected prior to the prescribed burn and changes in vegetation cover (dead and alive), open sand, and the amount of duff were measured after the burn, and after the nesting season that immediately followed the burn. Overall, the burn was successful in reducing the number of laughing gulls nesting in these plots while increasing the number of terns. Despite the success of the burn in 2004, however, nesting laughing gulls were again reaching high numbers and another burn was conducted on October 15, 2009. Refuge staff and Region 5 fire personnel burned the entire tern nesting area (36 acres on the north tip of South Monomoy). Refuge staff collected pre-burn vegetation data and post-burn vegetation data to compare percentages of woody species, green vegetation and thatch, and areas of open sand impacted by the burn. Vegetation data collection was continued annually after the burn in 2009 was completed, and it was determined in fall of 2011 that vegetation levels were reaching that of the pre-burn data, indicating the need to burn again. A burn was conducted in October 2012 over the majority of the northern tip of South Monomoy, excluding a small roseate tern nesting area where habitat was already desirable. Post-burn vegetation data has not yet been collected.

Prescribed fire has been used as a tool to thin out areas of vegetation that are considered too thick for tern nesting, and artificial nesting structures have been used to provide additional cover in areas that are too sparsely vegetated for terns. Several areas within the main tern nesting area on South Monomoy are completely void of vegetation. Beginning in 1997, approximately 100 tern boxes (Series 500, modeled after J. Spendelow, USGS/BRD, Patuxent Wildlife Research Center, Laurel, MD) have been placed throughout the colony in areas with little vegetation on South Monomoy. Although this type of box was designed specifically to attract nesting adult roseate terns and provide shelter for large mobile roseate tern chicks (USFWS 1999b), common tern chicks frequently use these boxes for shelter from predators and exposure to inclement weather on South Monomoy.

Large seabird colonies are often a breeding ground for avian disease. Since the documentation of salmonellosis outbreaks beginning in 2004, and the 2005 paralytic shellfish poisoning mortality on South Monomoy, disease monitoring has become a vital component of our biological monitoring program. The tern colony is monitored regularly for adult tern mortality and fledglings

demonstrating symptoms of salmonellosis. The salmonella bacterium is often naturally present at low levels in seabirds and outbreaks commonly manifest in large colonies of nesting terns and gulls. Symptoms of salmonellosis include ruffled feathers, diarrhea, and severe lethargy. Shortly before death, birds may appear unsteady, may shiver, and breathe more rapidly than normal (USGS 1999). Spasms, paralysis, and discolored excretions around the vent are additional signs of salmonellosis. The salmonella bacteria can cause large-scale losses of colonial nesting birds, and once symptoms become readily apparent, death usually occurs within 12 hours. The source of the 2004 salmonellosis infection at Monomoy NWR has not been identified despite efforts to determine its origin.

The colony is also monitored for large mortality events and unusual behavior that could be associated with highly pathogenic avian influenza (HPAI H5N1). The HPAI H5N1 virus has not yet been detected in the United States in either wild migratory waterfowl or domestic birds (USFWS 2006c). Mortality surveys were conducted from 2008 to 2010 in areas with concentrations of sensitive species (terns, gulls, and shorebirds), looking for groups of sick and dead birds. As part of a regional monitoring effort, refuge staff collected cloacal and pharyngeal swabs from 50 live adult common terns during the nesting season from 2008 to 2010. All samples collected and submitted to the National Wildlife Health Center in Madison, WI, tested negative for HPAI.

Least Terns

Least terns generally show high colony site tenacity (Burger 1984) and site fidelity (Atwood and Massey 1988), though their use of Monomoy NWR has varied widely from year to year. Large areas of least tern habitat are available on the refuge, though predator presence is a problem and may be the reason least terns have only nested in small numbers in most years. In 1970, there were three least tern colonies totaling 200 pairs on Monomoy Refuge. Two least tern colonies produced young in 1979, and between 1980 and 1983, least terns were occasionally seen at the beginning of the breeding season. Unsuccessful least tern nest attempts occurred in 1984 and 1985, and the highest count (300 pairs) was recorded in 1987 (USFWS 1988). Monitoring least tern nest attempts may have been inconsistent in past years, but during the last 16 years, all suitable least tern nesting sites have been carefully surveyed during peak nesting times. Survey numbers are included in table 2.9. Most of the nesting least terns on the refuge have been utilizing South Monomoy (south tip, southwest, southeast, and northeast sides), but several pairs have attempted to nest on Minimoy Island when habitat was available. Obtaining accurate productivity estimates is difficult and can cause additional disturbance to nesting birds, but in most years, productivity has been qualitatively defined as poor. Predators (primarily gulls and coyotes) and overwash are often to blame for loss of eggs and chicks.

Table 2.9. Least Terns Nesting on Monomoy NWR (1996 to 2012).*

Year	South Monomoy	Minimoy Island**	Refugewide
1996	103	N/A	103
1997	6 (138)	N/A	6 (138)
1998	246	N/A	246
1999	103	N/A	103
2000	119	N/A	119
2001	16	N/A	16
2002	6 (50)	N/A	6 (50)
2003	62 (143)	0 (6)	62 (149)
2004	1 (229)	0 (1)	1 (230)

Year	South Monomoy	Minimoy Island**	Refugewide
2005	93 (39)	0	93 (39)
2006	57	0	57
2007	32 (51)	0 (7)	32 (58)
2008	144 (6)	0 (5)	144 (11)
2009	5 (7)	3	8 (7)
2010	39 (11)	0	39 (11)
2011	104***	0	104***
2012	52 (152)	0	52 (152)

**The first number listed represents the A-period total and the number in parentheses represents the B-period total nest count.*

***Minimoy was not monitored until 2003.*

****A ground nest count was not completed during the census window in 2011; only an adult count was done during the window. All other counts in this table are based on peak nest counts completed during the census window June 5 to 20.*

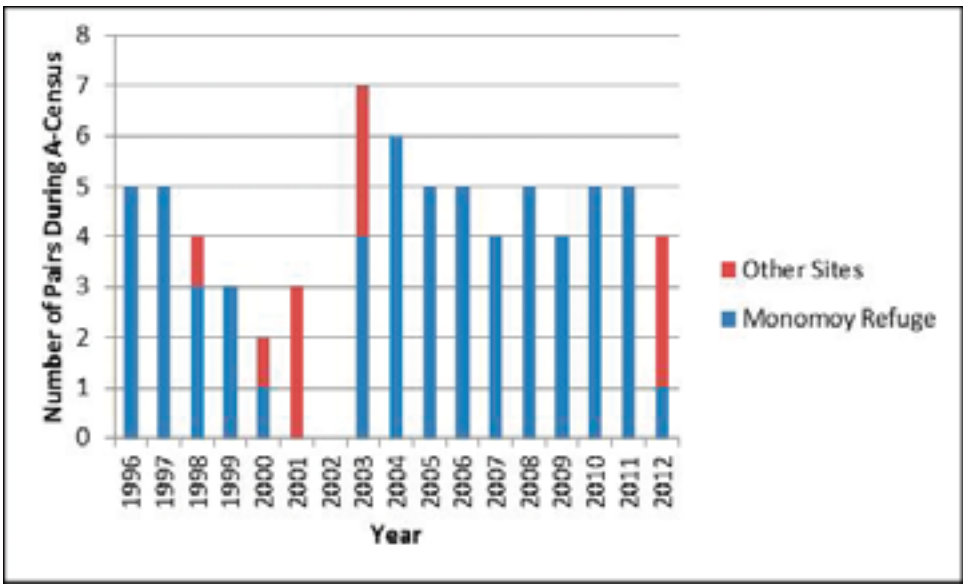
Staging Terns
Monomoy NWR hosts thousands of staging terns during the post-breeding season. Common and roseate terns are found in the highest numbers; there are smaller numbers of black terns, Forster's terns, arctic terns, and least terns. Occasionally sandwich and royal terns have been sighted on the refuge.

In late July, roseate terns begin moving to staging areas on Cape Cod, including areas of Monomoy NWR. Anecdotal evidence suggests that potentially 100 percent of the roseate tern population uses Cape Cod for a portion of the post-breeding period. The concentration of these birds implies that this period of their life cycle is largely important to their survival. Of the 13.24 km^2 identified as important during the post-breeding period, 6.18 km^2 occur on Federal land (Cape Cod National Seashore and Monomoy National Wildlife Refuge) (Jedrey 2010 personal communication).

Beginning in 1998, staging tern counts were conducted opportunistically by refuge staff and generally limited to the flats on the north tip of South Monomoy. A high staging count of 10,890 terns was recorded on August 4, 1999. Beginning in 2007, staff from the Coastal Waterbird Program and USGS conducted staging counts on many different sites throughout Cape Cod, including the refuge, as part of their roseate tern monitoring program, resulting in much more consistent and intense coverage at the refuge. Results from their study have not been finalized. In 2010, refuge staff also began expanding the geographic area of the counts to include the connection of Nauset/South Beach and South Monomoy and areas further north on Nauset/South Beach.

Black Skimmers
Monomoy NWR lies on the northern edge of the black skimmer's breeding range. Over the last three decades, single pairs sporadically nested on the refuge, generally in association with common terns. The nesting population of black skimmers at the refuge climbed to three pairs in 1986 and then declined to zero pairs in the 1990s until 1996 and 1997, when five pairs were recorded (figure 2.8). Since that time, a few black skimmers have continued to nest on the refuge in most years; in many years the refuge has been the only nesting site in Massachusetts. Productivity for these nesting birds has been sporadic with some good years and poor years.

Figure 2.8. Black Skimmers Nesting at Monomoy NWR Compared to Other Sites in Massachusetts (1996 to 2012).



Gulls

Laughing Gulls

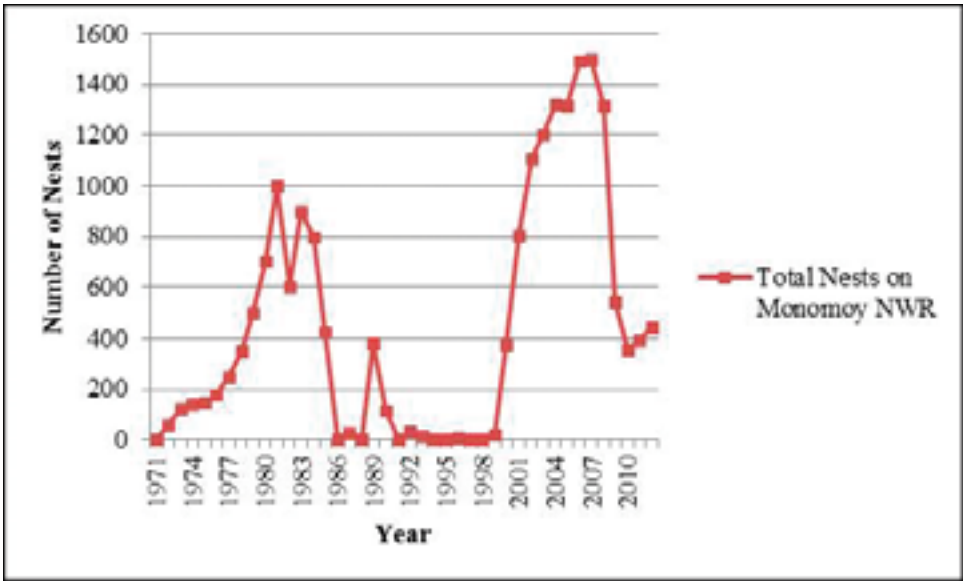
Laughing gulls, perhaps displaced from Muskeget Island, first colonized Monomoy NWR in 1971 and succeeded in establishing a colony adjacent to and within the tern colony at the northernmost tip of the refuge. Laughing gull numbers rose steadily during the 1970s to a peak of 1,000 pairs in 1981 (USFWS 1988), but then declined steadily; laughing gulls eventually stopped nesting by the mid-1990s (USFWS 1996b), which was most likely the result of continued expansion of the herring and great black-backed gull populations that encroached on tern and laughing gull nesting areas (USFWS 1996b, USFWS unpublished reports 1985 to 1994). Both laughing gulls and terns benefited from the lethal removal of herring and great black-backed gulls that began in 1996, and by 2002 the population of nesting laughing gulls had increased to 1,106 pairs (USFWS 2003a) and the numbers of pairs continued to increase through 2007 (figure 2.9; USFWS 2009e).

As the laughing gull population increased, their rapid population growth put them in direct competition with roseate and common terns. Each year laughing gulls are counted in conjunction with the annual tern census. See figure 2.9 for trends of nesting laughing gulls on Monomoy NWR.

Black crowned night heron

Gary M. Stolz/USFWS

Figure 2.9. Number of Nesting Laughing Gulls Counted on South Monomoy (A-Census). (The counts for 1972 to 1984 are estimates).



Habitat manipulation and nest destruction are tools that have been used to keep the laughing gull population low and decrease their competition with nesting terns. Refer to appendix J for more information on management techniques used to control the laughing gull population.

Great Black-backed and Herring Gulls

Although it has been reported that several herring gulls nested on Monomoy Island in 1924 (Forbush 1925), the recent history of herring gull nesting on Monomoy NWR started with five pairs in 1963 (Kadlec and Drury 1968). The colony growth in successive years was spectacular with 75 pairs in 1964; 420 pairs in 1965; 1,000 pairs in 1966; 8,000 pairs in 1969; and more than 15,000 pairs in 1980; but in 1995, only 5,200 pairs of herring gulls were found on the refuge. This drop in herring gull numbers may be correlated to the closing of landfills and poor census methods used during the census in 1995. Great black-backed gulls moved onto Monomoy soon after the herring gulls did; there were 75 to 80 pairs in 1965 and 1966 and about 175 pairs in 1972. By 1980, the great black-backed population had reached 3,300 pairs, and in 1995 had reached a total of 7,350 pairs, for a combined count of more than 13,000 pairs of the two large gull species (USFWS 1996b).

These counts (through the mid-1990s) are estimates, however, and uncertainty and inconsistency in methodology over years reduces their reliability. In recent years, complete counts of nesting gulls have been conducted on North Monomoy Island in 2000 and 2007 (refer to table 2.10). In 2000, South Monomoy was surveyed using aerial photography; in 2007, it was surveyed using a stratified random-sample transect method. In 2000, 1,018 great black-backed gulls and 1,609 herring gull nests were counted on North Monomoy Island, but the aerial photography for South Monomoy was never fully analyzed. In 2007, 1,245 herring gull nests and 683 great black-backed gull nests were counted on North Monomoy Island. An additional 1,088 herring gull nests and 2,490 great black-backed gull nests were estimated on South Monomoy, for a total refugewide count of 2,333 herring gull nests and 3,173 great black-backed gull nests.

Table 2.10. Great Black-backed Gull and Herring Gull Nests Counted in Areas A and B During May Gull Censuses in 1996 to 2007* on South Monomoy.

Year	Great Black-backed Gull		Herring Gull		Empty		Total		
	Area A	Area B	Area A	Area B	Area A	Area B	Area A	Area B	Total
1996	307	652	544	178	859	322	1710	1152	2862
1997	78	356	26	51	262	147	366	554	920
1998	7	259	0	10	6	99	13	368	381
1999	2	195	0	35	1	98	3	328	331
2000	0	139	0	33	0	86	0	258	258
2001	3	115	0	28	3	55	6	198*	204*
2002	3	114	0	56	0	47	3	217	220
2003	1	79	0	32	0	47	1	158	159
2004	4	59	0	14	0	104	4	177	181
2005	0	39	0	18	0	61	0	118	118
2006	0	12	0	3	0	43	0	58	58
2007	0	13	0	5	0	17	0	35	35

**No gull census took place in 2008 through 2012.*

Gull Control Efforts (1979 to 2008)

During the 1970s, tern populations on Monomoy NWR became restricted in area and declined in numbers, while nesting herring and great black-backed gull populations increased to very high levels and expanded to occupy extensive areas of the refuge, including former tern colony locations (USFWS 1988). Various efforts between 1979 and 1995 were unsuccessful at controlling the gull population on the refuge. In accordance with tasks outlined in the Piping Plover Recovery Plan, Roseate Tern Recovery Plan, Endangered Species Act of 1973, and the goals of the National Wildlife Refuge System in 1996, which direct national wildlife refuge units to "preserve, restore, and enhance in their natural ecosystem (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered," the Service proposed to strengthen ongoing efforts to manage habitat for nesting species on Monomoy NWR. The Avian Diversity Project began in 1996, and a contiguous 169.5-acre area (67.7 ha) was chosen on the north end of South Monomoy (designated Areas A and B) to provide gull-free nesting habitat. The Service has used a variety of techniques to control nesting gulls and maintain habitat for terns. Details of these efforts are described in appendix J.

Other Colonial Nesting Waterbirds

Monomoy is one of a few remaining nesting sites in the State of Massachusetts for colonial nesting wading birds. The number of nesting black-crowned night-herons on Monomoy NWR increased from 12 pairs in 1980 to 200 pairs in 1987, and this colony size has maintained over the years. Black-crowned night-herons nested each year on South Monomoy until recently, when they began transitioning to nesting sites on North Monomoy Island (figure 2.10). All wading birds nested on North Monomoy Island in 2008 through 2011, with the exception of one black-crowned night-heron nest on South Monomoy in 2009. Black-crowned night-herons nest primarily in rugosa rose, but also utilize bayberry, poison ivy bushes, and beach plum (especially on North Monomoy Island). Dissections performed at the refuge and papers from other heronries in New England

confirm that black-crowned night-herons at Monomoy feed primarily on sand lance, mummichog, assorted other small fish, Fowler toads, meadow voles, immature gulls, and tern eggs and chicks (USFWS unpublished data, Hall and Kress 2008).

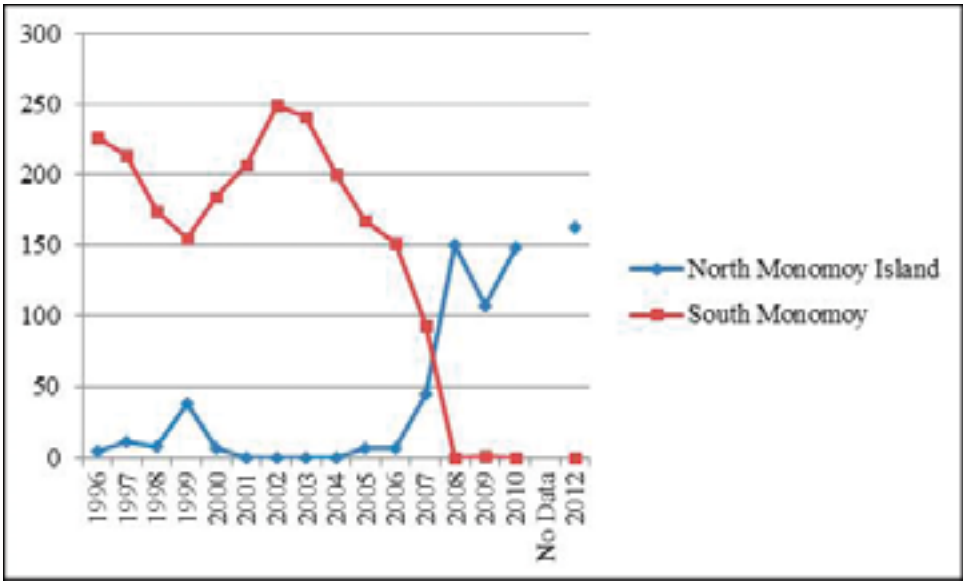


Figure 2.10. Nesting Black-crowned Night-herons on Monomoy NWR (1996 to 2012).

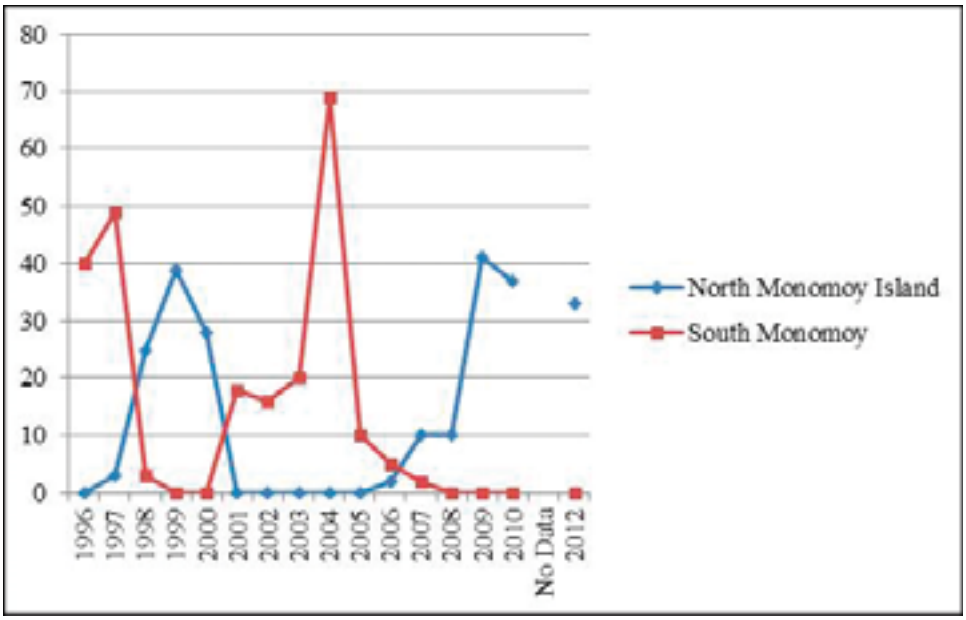
Black-crowned night-herons have been significant predators of tern eggs in past years. Black-crowned night-herons are deemed predatory only when disturbed terns are heard and then observed mobbing a heron walking through the colony in search of nests, or when herons are observed inside the tern colony actively eating tern eggs. Black-crowned night-herons observed flying over the colony or walking near the tern colony and not disturbing terns are not considered predatory and are not removed (Megyesi 1997). Refer to appendix J for more information about control of black-crowned night-herons on the refuge.

Monomoy's snowy egrets first became established on the refuge in 1981 and nest in association with black-crowned night-herons. Feeding habitat within a 5-mile radius of the snowy egret rookery provides ample food, primarily sand lance, mummichogs, and striped killifish (USFWS unpublished data). The nesting population peaked in 1987 with 90 pairs (USFWS 1988) and has fluctuated over the years. The refuge has averaged about 40 pairs in years when snowy egrets were present. In recent years, snowy egrets nested primarily on North Monomoy. In 2009, there were 41 nesting pairs of snowy egrets on North Monomoy Island (USFWS 2012) and in 2010, 37 nesting pairs (USFWS unpublished data), although numbers may be higher than recorded (figure 2.11).

Glossy ibis were recorded nesting in past years on the refuge. In 1999 one pair of glossy ibis nested on North Monomoy Island (USFWS 2000), and in both 2002 and 2004 one pair of glossy ibis nested on South Monomoy Island (USFWS 2003a, 2007b). There have been no glossy ibis nests documented on the refuge since 2004.

Great egrets also periodically nested on the refuge, with nests documented in 1996, 1997, 2005, 2008, 2010, and 2012.

Figure 2.11. Snowy Egrets on Monomoy NWR (1996 to 2012).



Raptors

Short-eared owls and great horned owls are seen on the refuge during the spring and summer months. Bald eagles and peregrine falcons are observed at Monomoy NWR during spring and fall migration and in winter. Other raptors seen on or around Monomoy NWR during migration include sharp-shinned hawks and Cooper's hawks, both State species of special concern. American kestrels, merlin, red-tailed hawks, northern harriers, and snowy owls are seen occasionally on the refuge during the winter months. Data from hawk watch surveys conducted on Morris Island by volunteer Don Manchester from 2001 to 2010 are summarized in table 2.11.

Table 2.11. Hawk Watch Total Hours Observed and Species Counted by Year.

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
American kestrel	10	8	6	10	8	0	10	5	1	6
Bald eagle	1	1	0	0	0	1	0	0	0	0
Broad-winged hawk	1	0	1	0	0	5	0	0	0	1
Cooper's hawk	124	123	95	118	129	119	153	137	93	56
Merlin	36	34	43	45	30	0	28	45	21	24
Northern goshawk	2	0	0	7	3	1	4	2	1	1
Northern harrier	9	42	29	23	16	18	18	14	11	6
Osprey	8	11	13	24	10	26	24	19	27	31
Peregrine falcon	104	39	44	113	83	90	67	95	82	36
Rough-legged hawk	0	1	0	0	0	0	0	0	0	0
Red-shouldered hawk	2	0	0	0	1	0	3	1	2	2
Red-tailed hawk	2	e	7	45	42	90	59	49	48	32
Sharp-shinned hawk	1062	754	406	692	549	1442	802	939	575	291

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Turkey vulture	12	19	21	30	29	26	30	53	30	29
Unidentified Accipiter	25	11	12	10	3	5	10	6	5	5
Unidentified Buteo	0	0	0	0	0	0	1	0	0	0
Unidentified Falcon	2	0	1	1	0	1	0	0	0	0
Unidentified Raptor	4	4	3	4	1	7	1	2	4	1
Total Hours Surveyed	207	214.5	248	254	136	249	214.5	213.5	145	112

Historically, short-eared owls, a State endangered species, nested on Monomoy NWR; however, no nesting has been recorded in recent years. In 1984, four pairs nested in the refuge, five pairs nested in 1985 and 1986, and two pairs nested in 1987 (USFWS 1988).

Great horned owls have nested in recent years on Monomoy NWR, but no official counts have been conducted (Iaquinto 2011 personal communication). Great horned owls have been active predators on the refuge in past years. Evidence of owl predation, including sightings of owls and pellets collected from the tern colony, has been documented in most years since 2004. For more information on predator management techniques refer to appendix J.

Northern harriers, a State threatened species, also nest on the refuge. Four northern harrier nests were found in the refuge in 1997, three nests in 1998, at least one nest in 1999, and three nests in 2000. The islands were not searched in their entirety during these and in subsequent years, and these numbers are likely an underestimate. In recent years, staff has been limited and the island has not been searched for nesting owls or harriers, though northern harriers are seen frequently on all portions of the refuge. Northern harriers are not controlled on the island or discouraged from hunting in the common tern colony.

Other Birds of Conservation Concern

Breeding songbird surveys were conducted on South Monomoy from 1996 to 2006. Earlier surveys (1996 to 2001) were conducted using a transect protocol and were limited to the northern half of South Monomoy. In 2001, we switched to using a protocol that was developed by the USFWS and was standardized for all refuges in Region 5 to allow comparisons across refuges. This protocol consisted of 32 fixed points on South Monomoy that were surveyed annually from 2001 to 2006. During the 6 years, 62 species and 2,620 individual birds were recorded; however, many were flyovers of non-songbirds. Of the breeding songbirds, the most commonly recorded were red-winged blackbirds (379 recorded), common yellowthroat (292 recorded), song sparrow (290 recorded), savannah sparrow (247 recorded), and common grackle (116 recorded). Other songbirds recorded on surveys include tree swallow, horned lark, barn swallow, eastern kingbird, yellow warbler, gray catbird, salt marsh sparrow, American goldfinch, willow flycatcher, brown-headed cowbird, bank swallow, and cliff swallow (USFWS unpublished data). Refer to appendix A for a complete list of documented breeding songbirds on the refuge.

Point counts to detect salt marsh sparrows and other salt marsh species have been conducted on the refuge to collect baseline data for these habitats. Salt marsh sparrows breed actively in salt marsh habitats on the refuge. Though no surveys have been done to measure productivity, it has been confirmed that this species has bred on the refuge in each year surveys were conducted. Counts were conducted at one point on Morris Island three times annually between 2001 and 2005 and at six points on North Monomoy Island two to three times

annually between 2005 and 2010 (no surveys were conducted in 2008). At least 5 years of survey data was collected for each point. In 2011 through 2013, as part of the Salt marsh Habitat and Avian Research Project (SHARP), point counts were conducted by seasonal staff associated with the University of Maine under the supervision of PhD student Maureen Correll. These surveys conducted by the SHARP project will be used to investigate changes in tidal marsh bird populations on the refuge and in eastern Massachusetts over the past 20 years by comparing current data collection to over 20 years of historical data. In addition to point counts, rapid assessment vegetation surveys were completed as part of the study following protocols of the USGS Salt marsh Integrity Project.

Two separate special use permits have been issued for additional research pertaining to salt marsh sparrows on the refuge in recent years. In 2011, Oksana Lane from the BioDiversity Research Institute (BRI) in Maine, collected blood samples from salt marsh sparrows on North Monomoy Island. Objectives of the research were to measure mercury exposure in adult and hatch year salt marsh sparrows by sampling blood and feathers. BRI took blood samples from 22 individuals and found that only four of these individuals had slightly elevated mercury levels (above 0.7 μg/g) (unpublished data, 2011 Special Use Permit #53514-11016 Annual Report) but were below the estimated reproductive success effect level of 1.2 μg/g in songbird blood (Jackson et al. 2011).

In 2013, as part of the SHARP project, PhD student Jen Walsh, from the University of New Hampshire, collected blood samples from salt marsh sparrows on North Monomoy Island with an objective of confirming that the refuge was outside the zone of hybridization with Nelson's sparrows. The results of this work have not yet been reported to the refuge.

In 2011, volunteer James Junda founded the Monomoy Refuge Banding Station (MRBS) with cooperation of the refuge staff. It was operated in 2011 and 2012 by both volunteers and highly trained professional banders. Operations were based upon the protocols of other constant- effort banding stations in the United States and Canada, with an emphasis on standardized research protocols (Junda 2013). Fall migration monitoring provides the basis for long-term trend analysis of migrating birds using the refuge. The protocol used on the refuge is designed to be comparable with the methodology of other fall migration banding stations. The protocol includes regular monitoring, standardized census, banding, and incidental observations taken each day staff was present at the station. The fall migration season extends from August 15 to November 15. In 2011, the banding station was open on 14 days; during 2012, the effort was increased to a total of 36 days, though coverage was intermittent due to weather unsuitable for banding. A total of 934 birds and one bat comprising 73 different species were captured and banded in 2011; during 2012, 1,787 individual birds of 79 species were captured. In total, 91 species have been banded at the MRBS between the 2011 and 2012 fall migration seasons. In addition to daily banding performed at the MRBS, banders attempted to trap saw-whet owls three nights in early November using playback calls. Ultimately they captured and banded two owls. A separate banding effort was also conducted by MRBS staff to sample salt marsh sparrows on North Monomoy Island. In total, 18 salt marsh sparrows were mist netted and banded during two days of netting.

USFWS

Northern gannet

The most commonly captured birds in the 2 years were myrtle warblers, tree swallows, red-breasted nuthatch, and savannah sparrows. The top 10 most common species captured over the 2 years can be seen in table 2.12. A number of species rare to the refuge were captured, including bay-breasted warbler, black-throated grey warbler, blue grosbeak, bobolink, clay-colored sparrow, lark sparrow, pine siskin, rusty blackbird, Townsend's solitaire, white-winged crossbill, and yellow-throated warbler.

Discussion about the possibility of erecting a wind turbine to provide power to the Monomoy Point light keeper's house prompted preconstruction surveys during 2010 and 2011 to determine bird use of the area during migration and the nesting season. Surveys were performed from mid-August through October in 2010 and from mid-April through September in 2011. While these surveys were designed to evaluate potential impact to birds resulting from a wind turbine (variables such as height of flight were recorded), they provide useful baseline data about frequency and abundance of bird use in this area.

Table 2.12. Most Common Species Captured at MRBS 2011 to 2012 (includes recaptures).

Species	2011	2012
Myrtle warbler	274	360
Tree swallow	157	286
Red-breasted nuthatch	0	162
Savannah sparrow	63	83
Golden-crowned kinglet	17	72
Slate-colored junco	12	75
Song sparrow	26	51
Pine siskin	0	49
Common yellowthroat	26	47
Palm warbler	12	46

Data are still being analyzed, but a preliminary summary is presented here. In 2010, staff recorded 1,107 observations comprising 3,938 birds within the proposed wind turbine survey area. Of the 2,582 identifiable birds, 53 species were recorded. The 2011 surveys resulted in 1,816 observations of 13,067 birds. From the 11,825 birds identified, 64 species were recorded. The most common species observed in the survey area in 2010 included tree swallow (1,790), house sparrow (136), yellow-rumped warbler (60), double-crested cormorant (59), and bank swallow (56). The most common species observed in 2011 included tree swallow (9,779), red-winged blackbird (285), common tern (273), common grackle (257), and double-crested cormorant (198).

Mammals

Marine Mammals

Gray seal, a Massachusetts species of special concern, and harbor seal are found on the refuge and in the surrounding waters. Gray seals use the refuge for hauling out and pupping. In fact, Monomoy NWR is the largest haulout site for gray seals on the U.S. Atlantic seaboard, and one of only two consistent sites in Massachusetts where gray seals pup. Gray seals use the refuge lands and waters all year. Gray seal pupping is limited but may be increasing, though there have never been high levels of pupping on the refuge. Many more gray seals pup on Muskeget, an island off of Nantucket. Gray seals start to group up in late autumn and pupping generally occurs from mid-December to early February. Pups are nursed for three weeks until they molt their white coat. Once the pups molt, they disperse and may be seen at distances relatively far from where they were born. Males will breed with females immediately following pupping.

Official counts of gray seal adults have not been conducted since the late nineties, so an exact population estimate is not known. Since the population is always changing and is relatively plastic, it is difficult to narrow down how many individuals use the refuge lands and waters, but it is certainly in the thousands.

In 1999, Margaret E. Barlas completed a study on the distribution and abundance of gray and harbor seals that included aerial surveys. In her study, the high count for gray seals on Monomoy was a May 1999 count of 3,322 individuals. No harbor seals were counted at that time, but the number has certainly increased in recent years.

Harbor seals are winter, not year-round, residents on the refuge. They generally start arriving in refuge waters in early September and remain until late March. Numbers of these seals increase slowly through this time period and then quickly drop off in March. Though harbor seals are still present, their numbers are not as high as in the past. Gray seals seem to be displacing harbor seals to some extent, but the two species will haul out together, with gray seals occupying the upper beach and harbor seals staying closer to the water. Peak pupping for harbor seals is in June and occurs elsewhere, mainly on the coasts of Maine and maritime Canada (Waring 2010 personal communication).

Terrestrial Mammals

Monomoy NWR's small terrestrial mammals, which include the masked shrew, northern short-tailed shrew, white-footed mouse, common muskrat, meadow jumping mouse, and meadow vole, serve as prey for the refuge's raptors. Of these, the meadow vole is the most abundant small mammal. Although none are known residents, the big brown bat, red bat, and hoary bat have also been recorded on Monomoy Refuge (USFWS 1988). In 2010 and 2011, ultrasonic recordings were made to survey bats flying over the area surrounding the Monomoy Point Lighthouse, but data are still being analyzed. No other formal terrestrial mammal surveys have been conducted on the refuge since 1988.

When the island first became isolated from the mainland, the Service removed red fox. Mammal sightings were rare through the 1980s (long-tailed weasel (1983), Norway rats (1985), raccoon (1986)). Since 1995, mammals including red fox, raccoon, striped skunk, and Virginia opossum have been periodically noted on the refuge. In 2000, one striped skunk was seen; in 2001, a striped skunk was shot and removed from the refuge; and in 2011 skunk tracks were seen near the lighthouse. In 2007 a raccoon carcass was found near the lighthouse, and raccoon tracks were seen several times in 2010 through 2012. Tracks and a raccoon carcass were observed on Nauset/South Beach near the South Monomoy connection in 2012. No live raccoon were seen on the islands or South Monomoy since 2005. Virginia opossum were seen or confirmed as present most years between 2006 and 2012, though they were only a problem for nesting birds in 2008. River otter were sighted in the fresh water ponds in 2007, 2011, and 2012. For more information on small mammal predation on the refuge refer to appendix J.

Evidence of coyote on Monomoy NWR was first recorded in 1996 (USFWS 1997), and evidence of coyote denning has been observed in most years since 1998. Beginning in 1998, lethal coyote removal has been conducted to minimize depredation on nesting birds. The refuge has employed a variety of techniques that are outlined in appendix J.

It is possible that the presence of potential mammalian predators (i.e., coyote, red fox, domestic dog, fisher, mink, weasel, striped skunk, river otter, raccoon, opossum, and muskrat) will increase. Access to the island became easier for land based mammalian predators with the connection to Nauset/South Beach in November 2006, and an increase was seen in mammal activity on South Monomoy. It appears that the February 2013 break in Nauset/South Beach could be contributing to a decline in the number of coyotes seen in the spring and summer of 2013 on the refuge.

Between 1960 and 1980, the white-tailed deer population on Monomoy remained fairly constant at 15 to 25 individuals. A high count of 30 deer was made in 1984, but during March and April of 1985, 11 winter and storm-killed deer were found; necropsies revealed the deer had been in poor health. An aerial survey conducted in January 1986 tallied 15 deer on the refuge, and the deer population has likely remained around 15 to 25 since that time (USFWS 1988), although no formal deer surveys have been conducted since 1986. More recent information on deer using South Monomoy is anecdotal and has come in large part from staff spending the summer working near the lighthouse.

Amphibians and Reptiles

No formal studies have been conducted to inventory amphibians or reptiles on Monomoy NWR; however, Fowler's toad, American toad, eastern ribbon snake, and common garter snake are present on the refuge. Eastern hognose snakes have been confirmed on the refuge, though they are rare and have not been documented every year.

Sea Turtles

Five sea turtle species--green, hawksbill (rare visitor), Kemp's ridley, leatherback, and loggerhead--can be found in the waters surrounding the refuge and are all protected under the U.S. Endangered Species Act (see appendix A for species status). The National Marine Fisheries Service (NOAA-NMFS) is the lead agency for pelagic sea turtle recovery. The Massachusetts Audubon Society's Wellfleet Bay Sanctuary operates and maintains a sea turtle sighting hotline for southern New England boaters (*http://www.seaturtlesightings.org*; accessed July 2013). The sighting hotline site provides maps of sightings by turtle species, year, and month. The hotline maps and data points do not represent a systematic survey, nor an accurate count of sea turtles, but are helpful for characterizing sea turtle status and use near Monomoy.

The nearshore open waters of northeastern Nantucket Sound, including those west of Monomoy, are a primary June through September feeding location for adult leatherbacks turtles, the most commonly sighted species (*http://seaturtlesightings.org/monthmap.html*; accessed July 2013, Prescott 2013 personal communication) when jellyfish become abundant. July and August are the peak months for sea turtle sightings around Monomoy. Loggerhead turtles were also sighted almost annually since 2003, and Kemp's ridley turtles are sighted somewhat less often in the Nantucket Sound waters west of Monomoy. As water temperatures warm in the spring, sea turtles migrate north from tropical and subtropical waters to inhabit their northern foraging grounds. Juveniles and, to a lesser extent, adults are found along the New England coast from May through November, when water tempeartures are favorable, and return south before the onset of winter (NOAA 2013).

Threats to sea turtles in the marine envrionment include bycatch in commercial and recreational fisheries, vessel collisions, and marine debris entanglement and ingestion (NOAA 2013). Several species have been recovered or entangled in refuge waters in recent years. Since 1996, there have been nine documented sea turtle entanglements (six leatherbacks and three loggerheads) with fixed fishing gear (pots and wiers) on or near the refuge (map 2.5) (Landry 2013 personal communication). In 2008, a dead Kemp's ridley sea turtle was recovered within the refuge Declaration of Taking boundary. When dead or stranded sea turtles are discovered on the refuge they are reported to Mass Audubon, who manages immediate response for stranded sea turtles on Cape Cod, and to the NOAA Fisheries Service Northeast marine mammal and sea turtle stranding hotline. Given the potential that seasonal use of refuge waters within the Declaration of Taking boundary may be increasing, gear entanglement and vessel strike

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Sea Turtle Entanglements from Fixed Fishing Gear
Morris Island
North Monomoy Island
South Beach
Refuge Boundary
South Monomoy Island
Monomoy Lighthouse
Leatherback caught in lobster gear
Leatherback caught in fishing weir
Loggerhead caught in fishing weir
1:70,000

incidence for sea turtles may correspondingly increase during the 15-year plan period to a point where additional management actions may be required.

Fish

Aquatic species on Monomoy NWR are found in both freshwater and saltwater ponds and marshes. Freshwater ponds and marshes on South Monomoy cover more than 140 acres (USFWS 1988). There are no freshwater ponds or marshes on North Monomoy, Minimoy, or Morris Islands. The main freshwater ponds on South Monomoy are Big and Little Station Ponds; other small freshwater ponds and wetlands dot the island. The two main salt ponds on South Monomoy are Hospital Pond and Powder Hole. Almost 25 acres of salt marsh surround the 5-acre estuarine Hospital Pond at the northern end of South Monomoy. Powder Hole, which in the mid-1800s was a deep and extensive harbor, is now a shallow estuarine waterbody on the southwest end of the refuge.

Freshwater Fish

Big Station Pond, approximately 32 acres, and Little Station Pond, approximately 11 acres, naturally formed on South Monomoy as deep saltwater lagoons, which subsequently became cut off from the ocean and are now freshwater ponds. Big Station Pond may occasionally get an influx of salt water from high storms (Iaquinto 2011 personal communication). Both are considered warm water ponds. Very little formal information about the fisheries and ponds on Monomoy is available; however, it is likely the ponds on the refuge have American eel, as well as mosquitofish and other small fish (Camisa 2011 personal communication). In 1951 and 1952, the Service stocked largemouth bass in these ponds and bass were abundant for a few years.

Saltwater Fish

A large number of fish species are found in Nantucket Sound and the Atlantic side of South Monomoy. These fish species are listed in appendix A, as compiled from the State of Massachusetts Division of Marine Fisheries (MDMF) trawl surveys. The rich diversity of marine life is a result of the unique geographic location of Nantucket Sound. It is located along the confluence of the cold Labrador Current and the warmer Gulf Stream, creating an ecological transitional zone where the ranges of southern and northern species overlap (Center for Coastal Studies 2003).

The sand eel or American sand lance, a small fish abundant in the ocean waters around Monomoy, is an important food species for many larger fish and for colonial waterbirds nesting on the refuge (USFWS 1988). Striped bass and bluefish are commonly found in the nearshore waters in Nantucket Sound off South Monomoy.

The Magnuson-Stevenson Fishery Conservation Act (MSFCMA) of 1976 established eight regional councils tasked with managing various fishery resources within Federal waters. The New England Fishery Management Council (NEFMC) and the Mid-Atlantic Fishery Management Council (MAFMC) are responsible for developing fishery management plans for species inhabiting Nantucket Sound. The Sustainable Fisheries Act (1996) amendment to MSFCMA requires NOAA National Marine Fisheries Service and the management councils to identify and describe essential fish habitat (EFH) for federally managed species, and specify actions to conserve and enhance EFH. Congress defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 U.S.C. § 1802(10)). Additionally, management councils designate habitat of particular concern (HAPC) to areas within EFH that are ecologically important, sensitive to disturbances, or rare (50 CFR 600.815(8)). Designating HAPC is intended to specify high priority areas within EFH where managers should focus conservation efforts.

Essential fish habitat designations occur in portions of open water within the Declaration of Taking boundary for 13 federally managed species of fish, including Atlantic cod, pollock, windowpane flounder, winter flounder, yellowtail flounder, white hake, silver hake, little skate, winter skate, ocean pout, Atlantic wolfish, smooth dogfish, and Atlantic bluefin tuna (table 2.13; NOAA 2009b, NEFMC 2012). Waters in the Declaration of Taking boundary have also been identified as habitat of particular concern for juvenile Atlantic cod (NEFMC 2012).

Table 2.13. Essential Fish Habitat at Monomoy NWR.

Common Name	Scientific Name	Life History Stages			
		Egg	Larval	Juvenile	Adult
Major Gadids					
Atlantic cod	*Gadus morhua*	X	X	X	
Pollock	*Pollachius virens*			X	
Flat Fish					
Windowpane flounder	*Scophthalmus aquosus*			X	X
Winter flounder	*Pseudopleuronectes americanus*		X		X
Yellowtail flounder	*Limanda ferruginea*			X	X
Hakes					
White hake	*Urophycis tenuis*		X	X	
Silver hake	*Merluccius bilinearis*	X	X	X	
Skates					
Little skate	*Raja erinacea*			X	X
Winter skate	*Leucoraja ocellata*			X	
Other Species					
Ocean pout	*Zoarces americanus*	X			X
Atlantic wolffish	*Anarhichas lupus*	X	X	X	X
Highly Migratory Species					
Atlantic bluefin tuna	*Thunnus thynnus*			X	X
Smooth dogfish	*Mustelus canis*	X	X	X	X

Source: Data assembled from the New England Fishery Management Council Essential Fish Habitat and Habitat Area of Particular Concern Designation Alternatives Draft 2012; and NOAA Fisheries Division of Highly Migratory Species Amendment 1 to the consolidated Highly Migratory Species Fishery Management Plan, June 2009.

Invertebrates

Countless species of marine invertebrates, including insects, shellfish, horseshoe crabs, and marine worms, amphipods, and other crustaceans inhabit the refuge's terrestrial and intertidal habitats. Many of these are a vital food source for shorebirds and seabirds (USFWS 1988). Although no formal, standardized surveys have been done to document abundance and diversity of invertebrate species, Leavitt and Peters (2005) compiled a table of benthic species that are likely to occur on the sandflats of Monomoy NWR. As stated in Leavitt and Peters (2005), the list, "was generated based on reported presence of the organisms in local sandflats coupled with further investigation into their life history details, primarily using Weiss (1995)." The table of likely species can be found in appendix A.

In 2007, refuge staff collected sediment core samples to quantify invertebrate species available for foraging shorebirds. A 10-cm diameter corer was used to a depth of 5 cm (sample volume of 393 cm^3), with samples collected during two sampling periods (July 7 to July 22 and August 23 to September 8), which coincided with peak migration periods of the most abundant shorebird species on the refuge (Koch and Paton 2009). A total of 375 samples was collected during each sampling period. All macrofauna (greater than 1 mm) were counted and classified into six categories: (1) amethyst gem clams; (2) mollusks (Phylum Mollusca, except *G. gemma*); (3) annelids (Phylum Annelida); (4) horseshoe crab eggs, membranes, or larvae; (5) arachnids/insects (Classes Arachnida and Insecta); and (6) crustaceans (Class Crustacea). A mean estimate of abundance/core of each macrofauna category was calculated for each sampling period and is in table 2.14 below. The mean abundance for each category was statistically different between time periods (Koch 2010).

Table 2.14. Macrofauna Abundance in Sediment Cores.

Prey category	(SE) $core^{-1}$	
	Period 1	Period 2
Gemma gemma	118.1 (5.50)	164.1 (10.18)
Phylum Mollusca	17.1 (1.33)	40.3 (2.82)
Phylum Annelida	2.7 (0.28)	3.9 (0.40)
Horseshoe crab eggs	0.9 (0.15)	0.4 (0.08)
Classes Arachnida and Insecta	0.5 (0.11)	0.7 (0.19)
Class Crustacea	3.4 (0.26)	4.9 (0.48)

Intertidal marine flats and nearshore marine waters are an important source of softshell clams, northern quahogs, blue mussels, bay scallops, sea scallops, and surf clams. Shorebirds and gulls feed on shellfish in intertidal flats and mussel beds in Nantucket Sound, while sea ducks utilize subtidal shellfish.

Horseshoe Crab

The intertidal habitat at Monomoy NWR hosts one of the largest spawning sites for horseshoe crabs in Massachusetts (USFWS 2002). Horseshoe crabs are an important component of the Northeast coastal ecosystem and their eggs are an integral part of the coastal food web. Horseshoe crab eggs provide an important food source for birds, including gulls (Botton and Loveland 1993, Shuster Jr. 1982, Penn and Brockman 1994, Burger and Wagner 1995 as cited in Burger 1996) and migrating shorebirds. In addition, horseshoe crab eggs and larvae are often eaten by minnows and juveniles of larger fish, (Harrington and Shuster Jr. 1999, Mugford 1975, USFWS 1988, Finley 2011 personal communication) including killifish species (Finley 2011 personal communication), such as striped killifish, eel species such as American eel, (Warwell 1897, deSylva et al. 1962), weakfish, northern kingfish, Atlantic silverside, summer flounder, winter flounder (deSylva et al 1962, Penn and Brockman 1994), striped bass (Martin 1974), and white perch (Shuster Jr. 1982). Other fauna observed 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, MA (Shuster Jr. 1958 as in Shuster Jr. 1982), devil ray, (Teale 1945 as cited in Shuster Jr. 1982), puffers (Shuster Jr. 1958 as cited in Shuster Jr. 1982), sharks, and loggerhead sea turtles (Atlantic States Marine Fisheries Commission [ASMFC] 1998b and 1999a).

There is no known recreational fishery for the horseshoe crab, but they are commercially harvested for use as bait for American eel and conch or whelk fisheries. Horseshoe crab blood is also important to biomedical research and pharmaceutical testing (refer to chapter 3 for more details). Concern over the growing exploitation of horseshoe crabs has been expressed by State and Federal fishery resource agencies, conservation organizations, and fishery interests. Harvest closures in states south of Massachusetts in the early 2000s motivated harvesters to move their operations north. The increased harvesting pressure on Monomoy NWR caused refuge staff to review the position on horseshoe crab harvesting. At that time, one biomedical harvester was issued a special use permit by the refuge to collect horseshoe crabs from refuge water by special use permit. Commercial harvesting for bait was never officially permitted, and beginning in 2000, refuge staff enforced a prohibition on all harvesting activity and denied further special use permits for biomedical harvesting. A local horseshoe crab harvester filed a lawsuit against the USFWS and the neighboring National Park Service as a result. The USFWS completed a comprehensive compatibility determination released to the public on May 22, 2002, and resurveyed the refuge boundary. The final decision to prohibit all horseshoe crab harvesting on the refuge is still enforced today.

Refuge staff conduct spawning counts in some years to provide a long-term index of the local population size; they also tag and re-sight tagged horseshoe crabs to learn more about local movement patterns and contribute to rangewide studies of harvest activities. Conducting spawning counts in concert with other sites in Massachusetts is important because of the role the refuge plays in overall recovery. The refuge also serves as a control site when evaluating the impacts of harvest at other sites on population, sex ratios, and mean size. Spawning surveys were first conducted on the refuge in 2000, when the ban on harvesting began. Between 2000 and 2002 a study was conducted that compared spawning and sex ratios on four sites on Cape Cod including Monomoy Refuge. Monomoy NWR and Nauset Estuary consistently had the lowest sex-ratios of the four sites (Monomoy NWR 1:1.9, Nauset Estuary 1:1.6). In 2000, Monomoy NWR had significantly lower ratios (more females to males) than either Pleasant Bay or Cape Cod Bay. There was both a lower frequency of females and a higher frequency of males at the non-refuge sites (James-Pirri 2012). Spawning indices at Monomoy were 1 to 1.9 in the original survey period between 2000 and 2002, and were 1 to 1.8 between 2008 and 2009 (James-Pirri et al. 2005).

Tagging has been conducted in cooperation with the Maryland Fisheries Resource Office every year since 2001 (see table 2.15 for total number of crabs tagged). Data are used to track changes in populations over time, document movement between embayments, and document impacts of harvest activity.

Table 2.15. Total Number of Horseshoe Crabs Tagged on Monomoy NWR (2001 to 2012).

Year	Number of Males	Number of Females	Total crabs Tagged	Total Number of Resights Reported*
2001	510	328	838	19
2002	398	150	548	43
2003	332	104	436	14
2004	291	118	409	20
2005	288	303	593	19
2006	266	134	400	14

Year	Number of Males	Number of Females	Total crabs Tagged	Total Number of Resights Reported*
2007	299	147	446	19
2008	394	48	442	13
2009	347	139	486	28
2010	377	85	462	34
2011	438	156	598	54
2012	612	191	803	55

**The number of re-sights includes crabs from one cohort that have been re-sighted in multiple years.*

Since tagging began in 2001, 332 crabs have been re-sighted and reported. Between 2001 and 2007, tags were reported to a hotline at the refuge office, but reports were often incomplete. In 2008, the refuge began using disc tags issued by the Maryland Fisheries Resource Office, which included a tag re-sight phone number at that office. With Monomoy NWR's formally joining this project, resightings can be much more efficiently collected by volunteers at one location and, therefore, information on resightings since 2008 is likely more complete (Iaquinto 2013 personal comment). Approximately half of the crabs reported as being alive when resighted since 2008 (73 in total) were reported by beachcombers. Crabs are also reported by a variety of other observers, including refuge or Nauset/South Beach staff, sport or commercial fishermen, and biomedical companies. Though harvest is not allowed on the refuge, some crabs are likely captured for bait or bleeding outside the refuge boundary, and reported. Most of the 73 crabs reported alive were released, though 5 were kept for bait, 3 were bought or sold, and 1 was reported as "other." One hundred four of the crabs resighted were reported as being found dead; the majority of these were reported by beachcombers. Only seven crabs were reported with an unknown status (USFWS unpublished data). Seventy-six percent of the crabs resighted since 2008 were found in the Chatham area. Forty-four crabs were found in different towns, though the majority of them were on Cape Cod, the islands of Martha's Vineyard and Nantucket, or immediately adjacent towns surrounding Buzzard's Bay. One crab was found in Fenwick, DE, and must have been transported by artificial means.

Insects

Portions of South Monomoy were surveyed as part of the Virginia Tech piping plover study mentioned in the Federally Listed Endangered or Threatened Species section of this document. Researchers collected invertebrates on South Monomoy. The invertebrates found in largest numbers were flies (Order Diptera), beetles (Order Coleoptera), and crustaceans (Order Crustacea) (Keane 2002).

Informal surveys of dragonflies (Order Odonata) were completed on several trips to South Monomoy by Blair Nikula, Jackie Sones, and Jeremiah Trimble in the 1990s. The species present during these surveys have been listed in appendix A, though it is likely that additional species occur on the refuge as occasional visitors from the mainland or vagrants from farther afield. (Nikula 2013 personal communication).

Hairy-necked tiger beetle, bronzed tiger beetle, and margined tiger beetle, also commonly listed as salt marsh tiger beetle, are also present on the refuge, along with one species of robber-fly (family Asilidae) (Kapitulik 2011 personal communication).

Invasive Species

No formal inventory has been done of invasive species on the refuge, although *Phragmites* and rugosa rose are known to exist on Monomoy NWR. Rugosa rose is used by herons, egrets, and gulls as nesting habitat and has not been controlled on the refuge. *Phragmites* occurs in both shallow, freshwater marshes and intertidal habitats (Gucker 2008). This species is a persistent and hearty perennial plant that can reach heights up to 20 feet tall and out-compete native plant species (Gucker 2008). *Phragmites* often forms single-species stands with thick mats of roots and rhizomes.

In July 2003, refuge staff collected *Phragmites* samples from 12 different stands (map 2.6) on South Monomoy and submitted them to Cornell University to determine if they are the native or introduced genotypes. All samples (included the two stands discussed below) were diagnosed by Dr. Bernd Blossey as the introduced genotypes.

In 2011, efforts were made to control the spread of *Phragmites* in the main tern colony on South Monomoy. A small stand occurs in a low-lying, centrally located area within the South Monomoy common tern colony. This particular stand provides protection and cover for predators such as coyotes. A second stand occurs south of the primary nesting area, providing an additional space to conceal predators. *Phragmites* control work was not continued in 2012 due to time constraints and poor weather during the months of September and October.

Mute swans are an exotic species of waterfowl introduced from Europe sometime in the late 1800s. This species of swan is very aggressive during nesting season and has been documented killing the young of other nesting waterfowl nearby. In 1996, 12 adult mute swans were observed in the refuge, although no formal surveys were conducted. Mute swans are lethally removed by refuge staff in order to prevent the establishment of a mute swan population on the refuge.

Refuge Visitor Services Program

The Improvement Act designated six priority public uses on national wildlife refuges: hunting, fishing, wildlife observation, photography, environmental education, and interpretation. As detailed in the Service's "General Guidelines for Wildlife-Dependent Recreation," (605 FW 1), we will strive to meet the criteria for a quality wildlife-dependent recreation program.

All of the six priority public uses are currently occurring on the refuge, although the refuge has never officially been open for waterfowl hunting. Based on staff observations and refuge-led programming, opportunities for the remaining five priority uses are being provided in varying degrees, and are in demand by visitors and residents of Chatham and the surrounding area. All of these activities are sufficiently provided elsewhere on Cape Cod, including on adjacent Town of Chatham land and the Cape Cod National Seashore. As such, refuge land restrictions do not eliminate the opportunity for those public uses elsewhere in the Chatham area.

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 maladies in our Nation's youth (Louv 2005). We strive to promote the concept of connecting children and families with nature in all of our compatible wildlife-dependent recreational opportunities. We look to our partners such as the Friends of Monomoy, Mass Audubon, the National Park Service, the Town of Chatham, and others to help us develop and assist with both formal environmental education and informal programming to utilize the outdoors as a classroom.

When developing plans for recreational uses, the refuge staff first evaluates the potential for negative impacts to wildlife, and completes a compatibility

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Non-native Phragmites Locations
Morris Island
North Monomoy Island
South Beach
Monomoy Island
Refuge Boundary
South Monomoy Island
Monomoy Lighthouse
1:70,000

determination to ensure that the use does not materially interfere with purposes of the refuge or the mission of the Refuge System. The refuge seeks locations and creates designs that would provide high quality wildlife experiences for visitors, while also taking into account the ability to maintain programs and facilities over time with existing resources and funding. Refuge efforts are increased by assistance from our Friends group, volunteers, and other partners, without whose help we would be unable to develop or deliver current and proposed recreational programs.

The U.S. Geological Survey, in collaboration with the USFWS, conducted visitor surveys for selected refuges nationwide; Monomoy NWR was among those chosen. During the summers of 2010 and 2011, with help from volunteers, the refuge requested contact information from visitors. The USGS used this information to contact and interview participants. The information collected was presented in a report, National Wildlife Refuge Visitor Survey Results: 2010/2011 (Sexton et al. 2011), made available to the public. The individual results for Monomoy NWR provide a summary of trip characteristics and experiences of a sample of visitors. These data can be used to inform decision-making efforts related to the refuge, such as visitor services management, transportation planning and management, and during the planning of this draft CCP/EIS. This effort will allow for a better understanding of visitors' recreational, educational, and informational experiences, and will measure satisfaction with current services, access, and facilities.

In the survey results report, we learned that 70 percent of visitors were aware of the role of the U.S. Fish and Wildlife Service in managing national wildlife refuges, and 84 percent aware that the Refuge System has the mission of conserving, managing, and restoring fish, wildlife, plants, and their habitat. While most visitors are not aware of the day-to-day refuge operations that occur, they realize the refuge replays an important role in conservation. Of those who responded, approximately 75 percent travelled beyond 50 miles to visit the refuge; within that 75 percent of travelers, 50 percent of them stated that visiting the refuge was one of many equally important reasons for their trip.

The visitor characteristics showed that nearly all (93 percent) surveyed visitors to Monomoy NWR indicated that they were citizens or permanent residents of the United States. Only those visitors 18 years or older were sampled. Visitors were a mix of 53 percent male with an average age of 59 years and 47 percent female with an average age of 54 years. Visitors, on average, reported they had 17 years of formal education (graduate or professional school). The median level of income was $75,000 to $99,000. Visitors to the refuge were predominantly Caucasian (96 percent).

Based on visitation estimates, approximately 68 percent of visitors are participating in wildlife-dependent recreational uses. In the USGS survey, 94 percent of respondents stated they were satisfied with the recreational activities and opportunities available. Although each visitor may have individual reasons to visit the refuge and stay for varying lengths of time, it became clear through conducting this survey that those visiting are individual families (as opposed to large groups), with 84 percent of visitors using private vehicles to access Morris Island. This statistic points to the parking congestion we have been facing at the refuge for many years, which has resulted in decreased access to potential visitors as they cannot locate an available authorized parking spot. Respondents stated they were likely to use a boat that goes to different points on refuge waterways; an offsite parking lot that provides trail access; a bus/tram that provides a guided tour; and a bike share program. We intend to address these access needs in the implementation of the transportation study through the strategies identified in chapter 3 (available online at: *http://www.fws.gov/northeast/monomoy/*).

Some uses, such as sport fishing or birdwatching, require wildlife and are considered priority public uses. By law, we are to facilitate all priority public uses that are compatible on the refuge. Others, such as swimming, sunbathing, or dog walking, do not require wildlife. These latter uses are not priority public uses and do not need to be offered by the refuge. In this section, we describe the priority, non-priority, and unauthorized uses that have been occurring on the refuge in recent years.

People come to the refuge for a variety of reasons. Table 2.16 describes refuge visitation in 2012.

Table 2.16. Number of Visitors by Activity in 2012.

Activity	Visitors
Visitor center	14,500
Other non-priority public uses	12,000
Wildlife observation	5,000
Special events	3,600
Fishing	1,650
Nature photography	500
Interpretive programs onsite	75
Environmental education programs onsite	25
Total	37,350

Priority Wildlife-Dependent Public Uses

Described below are the current opportunities the refuge provides for engaging in priority public uses as defined by the National Wildlife Refuge System Improvement Act of 1997. Portions of the refuge are closed seasonally to protect wildlife, as shown in maps 2.7 and 2.8. Visitors may drive, walk, or bicycle to the visitor contact station, beach, and trails on Morris Island. Parking is somewhat limited at this site. North Monomoy Island and South Monomoy are accessible by boat or, in season, by commercial ferry, which offers opportunities for wildlife viewing and fishing. The refuge is open from ½-hour before sunrise to ½-hour after sunset, except for surf fishing on Morris Island, which is allowed 24 hours a day.

Wildlife Observation and Photography

A ¾-mile trail, the Morris Island Trail located on Morris Island, winds through a variety of coastal habitats and offers a unique opportunity to access two viewing locations. Overlooks along the trail provide views of the refuge's North Monomoy Island and South Monomoy. There is a small trail on North Monomoy Island; there are no formal trails on South Monomoy. Historically, a boat was needed to access both North Monomoy Island and South Monomoy, but with the connection of South Monomoy to Nauset/South Beach in 2006, visitors could walk 5 miles to the refuge from Chatham's Lighthouse Beach. The February 2013 breach made this impossible. Visitors reach the islands by private boats or, in season, by commercial ferries that operate on the refuge under a special use permit. These remote locations provide superior landscape and seasonal wildlife viewing opportunities in a nationally designated wilderness area.

Fishing

The Monomoy NWR offers superb recreational fin fishing opportunities late spring through fall, as well as softshell clam harvesting. Anglers are allowed to surf fish in any of the areas open to public access, as well as 24-hour fishing on

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Public Use - North and South Monomoy Islands
Legend
Boat Landings
2012 Closed Areas: April 1 - Sept 30
Closed areas and closure dates may vary from year to year based on wildlife use and changes in habitat.
Morris Island
North Monomoy Island
South Beach
South Beach was not managed by the refuge in 2012 or 2013.
Refuge Boundary
South Monomoy Island
Monomoy Lighthouse
1:70,000

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Public Use - North Monomoy Island
North Monomoy Island
Boat Landing
Trail
Areas inside the yellow line are seasonally closed to public access to protect wildlife.
1:10,000

Morris Island. Striped bass, bluefish, bonito, and false albacore are among some of the species commonly fished from shore or boat. All State regulations apply, and anglers are required to have a State saltwater fishing license. Recreational shellfishing areas are more restrictive and visitors must possess a Town of Chatham shellfishing permit. The only shellfishing to date that has been found compatible and is, therefore, authorized on the refuge is softshell clam harvesting using traditional hand tools. We know that other types of shellfish, lobster, conch, and whelk harvesting has occurred in refuge waters, but the refuge has never officially been opened to these uses.

Commercial fishing guides facilitate recreational fishing on the refuge. Captains are required by the Massachusetts Division of Marine Fisheries to obtain a for-hire fishing permit to operate in State waters. We know that commercial guides work on the refuge, but special use permits have not been issued to any guides on the refuge. Because commercial fishing guides have, for the most part, not interacted with refuge staff, we have little information about the number of guides that are operating on the refuge, the number of recreational anglers that are being commercially guided, or where and when they fish.

Hunting

Monomoy NWR has never been officially opened to waterfowl hunting, although we know that there is a long history of waterfowl hunting in the open waters off Monomoy Island. The Monomoy Branting Club of Boston was established near Shooter's Island and Inward Point in 1862 as steam powered the industrial revolution and leisure time increased (Roscoe 1995, Phillips 1932). Warren Hapgood of Boston, one-time president of the Massachusetts Fish and Game Association, was an original founding member sportsman, along with Chatham locals including George Bearse, Alonzo Nye, David Nye, and Washington Bearse, who assumed the roles of member-guides and caretakers. The club was established near the Common Flats where the Bearse and Nye families found success earning part of their annual livelihoods market gunning for shorebirds and waterfowl during the pre-Civil War decades. Several of the original buildings remained standing at the site until salvaged by the Service in 1953 (figure 2.12; USFWS 1953 unpublished) as their destruction by the encroaching sea became imminent.

Figure 2.12. Monomoy Branting Club of Boston buildings, storm-battered just prior to demolition in 1953, built near Shooter's Island and Inward Point after the club was established in 1862 (USFWS 1953 unpublished).

Atlantic brant was the principle game sought by club members in sink boxes (Deane 1885) each spring from 1863 to 1909, when spring brant hunting was abolished (Bent 1925, Phillips 1932). Fall sport hunting continued, but was generally less successful than spring hunting due to differing seasonal migration patterns (Bent 1925, Phillips 1932). The log of brant hunting effort and harvest kept by club members (Phillips 1932, Roscoe 1995) and popular articles of the day (Deane 1885) give some insight into the conditions and methods of that era.

The club log (Phillips 1932) records 12,091 brant harvested during spring hunts spanning 2,127 days (about six brant per day) from 1863 to 1909 (figure 2.13). Peak harvests such as the 1867 all-time high of 715, occurred at 3-year to 5-year intervals, apparently coinciding with good nesting success; more than half the brant harvested were juveniles. Conversely, poor harvest years such as the 1895 all-time low of 29 brant, also occurred at 3-year to 5-year intervals, and generally coincided with years of poor juvenile recruitment when young birds were less than 15 percent of the total harvest. Weather and climatic conditions were noted most often as affecting club hunting success during the early years. By 1875, notations in the log indicate user conflicts were beginning on the Common Flats with small boats (especially scallopers), fish weirs, other hunters, and shipwreck/salvage; these continue through the remainder of the record. In 1885 to 1888, geomorphology changes to the protective Nauset Beach were noted as altering brant flight patterns and adversely affecting hunting success.

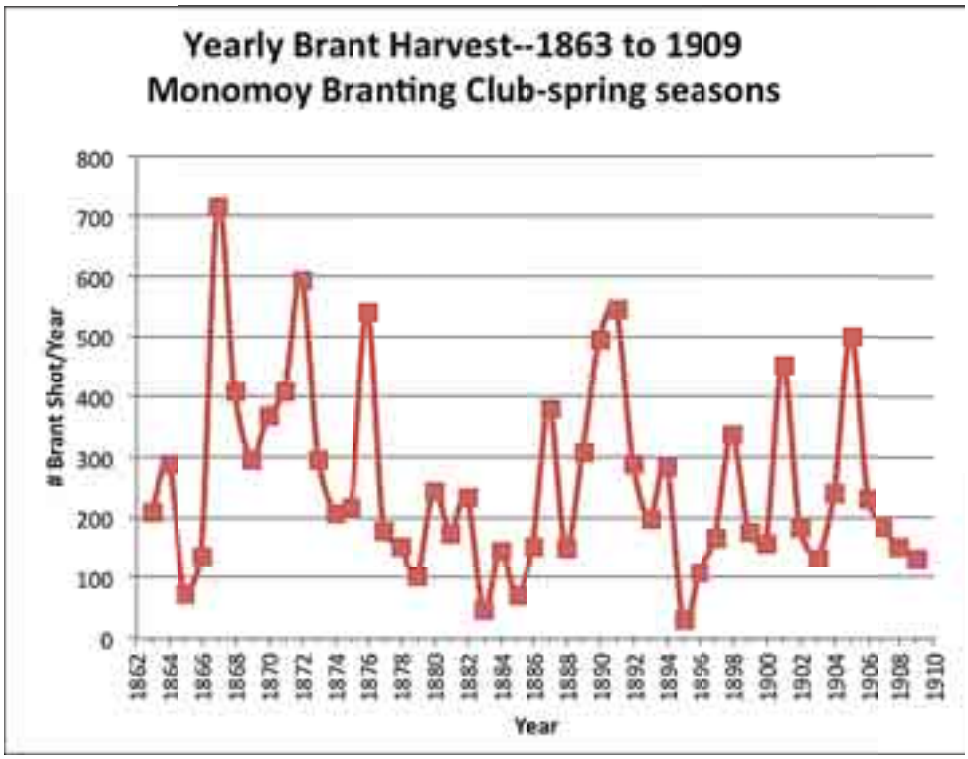


Figure 2.13. Monomoy Branting Club's Annual Brant Harvest.

Sport hunting for waterfowl on and around Monomoy continued increasing in popularity through the late 1800s, spawning rival clubs and entrepreneurs catering to growing numbers of sportsmen such as the Monomoy Shooting Club, of which William "Billy" Bloomer became the proprietor in 1898, assisted by Josiah Hunt (Roscoe 1995). But as concerns over continental waterfowl and shorebird population declines grew into the early 1890s, so did opposition to sport

hunting (Bent 1925), including opposition to the 1923 efforts by the Monomoy Branting Club to gain title to Shooter's Island (Roscoe 1995). Indications of a major decline in the previously abundant eelgrass the brant depended upon for food had become evident by 1931 to 1932 (Phillips 1932), as Monomoy began to come under consideration for establishing a new migratory bird refuge.

Today, waterfowl hunting occurs in the Chatham area and commercial guides market waterfowl hunts around Monomoy, but none have requested a refuge permit to operate within the refuge. It is likely these commercial guides are not aware the refuge has never been opened for waterfowl or any other form of hunting. The actual numbers of commercial guides operating within the refuge, the number of waterfowl hunters that are being commercially guided, where or when they hunt, or what they harvest is unknown.

Interpretation

The refuge headquarters and visitor contact station are located on Morris Island and contain wildlife-themed exhibits and informative brochures. There is also a "Junior Ranger" children's discovery area inside the contact station where young visitors can learn through hands-on activities about the refuge's resources. These activities include scavenger hunts and a "Let's Go Outside" backpack that visitors can take out onto the refuge. The refuge has one official trail at this time, called the Morris Island trail, which is ¾ mile long. The Morris Island Trail has interpretive panels that assist in informing visitors about the refuge's purposes and resources. There are additional trails available for walking that extend beyond the Morris Island Trail. Refuge staff, volunteers, and interns offer guided walks and programming throughout the summer months.

Visitors who utilize ferry services also have the opportunity to learn about the refuge while en route to the ferry drop-off sites on North Monomoy Island and South Monomoy. Two ferry services have been issued special use permits to bring anglers and birders to the refuge. One of these also brings seal watchers to the refuge. However, there are other charter boats bringing seal watchers to the waters around the refuge. These operators do not have a permit from the Service to conduct their business on the refuge, and we have been made aware of incidents of seal harassment from some of these boat operators. Refuge staff have no information on the numbers of passengers that come to the refuge for seal watching, nor do we have any information available about the number of charter boats that are operating on and near the refuge.

Environmental Education

Currently, the refuge does not develop and implement formal environmental educational programming. Occasionally, refuge staff conduct educational programming upon request to local schools, colleges, and universities, and we may work with partners to provide environmental education on the refuge. Any areas open to the public are suitable for organized environmental education to occur.

Other Refuge Public Use Activities—Current or Potential

In general, for a public activity to be allowed on a national wildlife refuge, it must first be found appropriate and compatible, in compliance with Service policies (see chapter 1). Activities that were found compatible for Monomoy NWR in 1994 are: beachcombing, hiking/backpacking, jogging/walking, birding, natural and cultural history tours, photography, picnicking, commercial ferry service, snowshoeing, research, sunbathing/swimming, and wildlife observation. We reviewed the 1994 findings during this CCP planning process. Some of our findings have changed. All of our findings are documented in appendix D.

The following lists and describes other public use activities that occur or are likely to occur within the intertidal zone of the refuge and in the adjacent subtidal, benthic zones, and water column, which can impact refuge management and wildlife using the refuge. We previously have not managed some of these

uses, but look at all of them in this document to determine the benefits or impacts of these uses. Activities that occur within the submerged waters within the Declaration of Taking are also described below.

Kite boarding: This is a new use that has been observed adjacent to the refuge and within the Declaration of Taking boundary. Individuals use a large kite to help them move through shallow water areas rapidly. Although it occurs on the surface of the water, it disturbs nesting and staging birds on refuge islands and surrounding flats. This sport is popular around Hardings Beach and Stage Harbor Beach (*http://voices.yahoo.com/cape-cod-kiteboarding-windsurfing-hardings-beach-2189909.html*; accessed April 2013). Kite boarding appears to be replacing "windsurfing" or "sailboarding" in popularity as recreational equipment technology has evolved over the past few decades.

Personal watercraft: Personal watercraft, such as wave runners and jet skis, are not allowed within the Cape Cod National Seashore boundary, within Pleasant Bay, or within the Southway Channel. However, wave runners are allowed within Nantucket Sound and frequently are within the Declaration of Taking refuge boundary on the west side.

Kayaking and Paddleboards: Kayakers and, to a lesser extent, stand-up paddleboarders are often observed using the waters in and around the refuge or pulled up on refuge shorelines during the warmer months. Most of these day trips originate from and return to mainland sites, especially the Morris Island Road causeway that affords vehicle parking and carry-in access to both Outermost Harbor and Stage Harbor; these are a relatively short and sheltered paddle to North Monomoy Island, Nauset/South Beach, and the connection to South Monomoy. Signs indicating that the carry-in/out of kayaks or canoes from refuge parking on Morris Island is prohibited are posted near the stairways providing beach access.

Shellfish Harvesting: The Massachusetts Division of Marine Fisheries established 17 designated shellfish growing areas in the Town of Chatham, MA, which encompass 101,763 acres. Three are located in or adjacent to Monomoy NWR, with Monomoy Island (SC47) being the largest designated area at 37,831 acres. Nearly 80 percent of the harvestable intertidal shellfish flats in the Town of Chatham are located in SC47. Not all of these intertidal flats are within the refuge's Declaration of Taking. Shellfish harvesting is permitted with town and State permits. The State permit requires shellfishermen to file an annual harvest report with the State and to identify the specific areas harvested. This does not tell us, however, how much of the harvest occurred on the refuge.

Clamming: For over 150 years, the Monomoy area has been known as one of the most productive clamming areas in Massachusetts. Traditionally harvested species are softshell clams, quahogs (hard-shelled clams), and surf clams. Softshell clam harvesting became a lucrative fishery after the 1978 break and subsequent shifting of sands and creation of sandflats. In the past, shellfishing has been concentrated on the point of Morris Island, the Common Flats, and the Powder Hole area. The majority of shellfish harvesting in recent years on the refuge has occurred in intertidal habitat (and in very shallow subtidal areas adjacent to intertidal habitat), primarily on the western side of North Monomoy Island (especially the southern end) and South Monomoy (especially the northern end), the eastern side of Minomoy Island, the area between Morris Island and North Monomoy Island, the area between North Monomoy Island and South Monomoy, and the area between the refuge and Nauset/South Beach (the Southway). Many of the intertidal shellfish harvest areas listed above lie within the Monomoy wilderness boundary. Refer to map 2.9 for locations. Softshell clam harvest using pumps takes place in several designated locations within Chatham, and occurred occasionally within Powder Hole on South Monomoy as recently as 2011, after which the town's shellfishing regulations were formally amended

on February 21, 2012, by Board of Selectmen action following a public hearing on the rule change to exclude the practice in Powder Hole (Town of Chatham, Board of Selectmen Meeting Minutes for February 21, 2012 available online at: *http://www.mytowngovernment.org/02633*; accessed May 2013). The principal reason for excluding Powder Hole from the designated site in Chatham was that harvesting using hydraulic pumping could not be conducted in the manner required by the town as little to no area remained in the Powder Hole basin that met the water depth requirement at low tide.

Softshell clam harvesters in coastal New England typically use short hand-rakes, 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). Shellfishers at the refuge usually land their boats adjacent to harvest areas, arriving around the midpoint of the falling tide. The boat is anchored and often grounds as the tide continues falling. Harvesters spend most of their time harvesting shellfish in localized patches. Harvesters can turn over approximately 40 m^2 of sediment in a low tide event (Leavitt and Fraser 2004).

Quahogs are hard-shelled clams that are often harvested using pumps that suspend the sediment and make the quahog float to the surface, where they are collected. Quahog harvesting using pumps does take place within open waters in the southwestern corner of the refuge. Quahogs are also harvested using bull rakes, often from shallow drafting boats in water, but in some intertidal areas of Monomoy NWR, quahog populations have established and can be harvested when the intertidal areas are exposed. The physical act is much like harvesting softshell clams, but the individual is usually standing upright and scrapes the sediment surface with a longer hand-held rake. Bull raking has become a common occurrence on the refuge (particularly near Minimoy Island) and has also occurred within Powder Hole in the past.

USFWS

Shell on the beach at Monomoy National Wildlife Refuge

Surf clam harvesting: Surf clam harvesting is not currently occurring on the refuge, although surf clams are present in the shallow water within the Declaration of Taking boundary along South Monomoy (map 2.9).

Mussel harvesting: The Town of Chatham allows mussel harvesting year-round, but the refuge has never been open to mussel harvesting. Small vessels drag dredges (no larger than 36 inches in width) through shallow areas at high tide to extract mussels from the sediment. These mussel beds are often vital for wintering waterfowl, especially common eider. Additionally, mussels are an important food for staging and migrating American oystercatchers and migrating red knots; staff have documented declines in both of these species in areas where mussel harvesting has occurred in recent years. Mussel harvesting has occurred in the open waters north of North Monomoy Island. We have no information on how often this has occurred, when it occurred, and how many people harvest mussels in this area. Mussel dragging occurred in shallow waters along the northwestern and the eastern flats of North Monomoy Island from 2008 to 2011 (map 2.9). Harvesters redirected their efforts from these areas in 2012 to take advantage of more productive flats located in Chatham Harbor. Mussel harvesting still occurs around North Monomoy Island, however, it is limited in scope compared with prior years (Gagne 2013 personal communication).

Bay scallop dragging: Scallop harvesting is conducted on and around the refuge from November through March. The refuge has never been open to scallop harvesting. Small dredges are dragged through dormant eelgrass beds where scallops reside. The Town of Chatham requires that all scallop dredge frames measure 36 inches or less in width. The use of rakes on dredge frames is prohibited to minimize disturbance to bottom substrate and eelgrass beds. Scallops are currently harvested from subtidal eelgrass beds located along the western side of North Monomoy Island, the Morris Island Channel, and the

Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Monomoy NWR Shellfish Resources
Monomoy Island
Refuge Headquarters
North Monomoy Island
South Beach
Monomoy Island
Refuge Boundary
South Monomoy Island
Monomoy Lighthouse
Shellfish Resources
Resource
Mussels
Quahogs
Quahogs (long rake)
Scallops
Softshell Clams
Surf Clams
Historic Softshell Flats
Miles
Kilometers
1:70,000

northern end of the old Southway Channel (between North Monomoy Island and Nauset/South Beach; see map 2.9). Prior to the 1978 break, scallop dragging of subtidal areas occurred throughout the western boundary of the refuge; the shallow waters and sea grass beds were a highly productive area for bay scallops. It was theorized that, with the Southway closed off, the flats would slowly subside, eventually changing the western boundary back into a scallop fishery. However, if the 2013 break in Nauset/South Beach persists, the future direction of the fishery will remain uncertain.

Whelk (Conch) harvesting: Channeled whelk and knobbed whelk are harvested on and around the refuge from mid-April to mid-December (MDMF 2013a). The refuge has never been open for conch harvesting. Pots baited primarily with horseshoe crabs are used to catch whelk. The total reportable landings for whelk in SC 47 from 2007 through 2011 were estimated at approximately 144,622 pounds (table F.21; Massachusetts Division of Marine Fisheries; Dealer Reports, May 2010 and January 2013). During this period, whelk landings in SC47 have increased from a low of 18,611 pounds in 2007 to 42,982 pounds in 2011 (table F.21).

Razor clam harvesting: To the best of our knowledge, razor clam harvesting is not currently occurring on the refuge, but is occurring nearby. Also, razor clams have historically been harvested on the refuge and may be again in the future, as regional conditions change. There has been a robust razor clam fishery in Chatham in 2012 and 2013. Razor clams were harvested using salt injection in Wellfleet, Truro, and Eastham in 2005 and 2006. In this process, a salt solution is injected into the sandflats, and when razor clams expel themselves, a harvester collects the clams on the surface.

Oyster harvesting: We are not aware of any oyster harvesting occurring on the refuge; however, it is occurring in areas adjacent to the refuge as noted below under "Aquaculture." We do not address oyster harvesting further in this plan.

Aquaculture: The Town of Chatham propagates and distributes, or seeds, shellfish spat adjacent to the Morris Island portion of the refuge. Young shellfish (quahogs, scallops, and oysters) are reared and moved from nursery sites and placed in subtidal areas, including sites adjoining the Morris Island unit of the refuge and in the Southway. The Town has not seeded any flats adjoining other portions of the refuge or within the Monomoy Wilderness for many years and has no such intentions, since shellfish populations continue to sustain themselves naturally in these areas (Moore 2011 personal communication). The Town of Chatham has not undertaken any softshell clam propagation or seeding to date.

Commercial Fisheries: Nantucket Sound supports a diversity of commercially harvested fish and invertebrate species such as flounder, sea bass, scup, mackerel, striped bass, bluefish, lobster, and squid. The marine fishery resources of Nantucket Sound are monitored and managed by the National Marine Fisheries Service—a branch of the National Oceanic and Atmospheric Association, the NEFMC and the MAFMC (established by the Magnuson-Stevenson Fishery Conservation Act), and the Massachusetts Division of Marine Fisheries. The ASMFC coordinates interstate management activities for wide-ranging species, including lobster, striped bass, bluefish, black sea bass and others) (ASMFC 2013).

Nantucket Sound, which encompasses waters within the refuge's Declaration of Taking boundary, is designated as NOAA Fisheries Statistical Sampling Area 538 and Massachusetts Division of Marine Fisheries (MDMF) Statistical Reporting Area 10 (SRA 10). MDMF monitors State-permitted commercial fishing activity for certain fisheries and gear types in State waters within 3 miles from the coast. NOAA Fisheries has jurisdiction over federally permitted commercial fishing activities in all Federal waters between 3 and 200 miles

offshore. The 1983 Magnuson-Stevens Act was amended by Congress to give the Commonwealth of Massachusetts exclusive regulatory jurisdiction and authority throughout Nantucket Sound. NOAA Fisheries and MDMF collect independent and overlapping commercial fishing data. Federal permit holders are required by NOAA Fisheries to submit vessel trip reports that include information on fishing location, gear type, and species caught during each fishing trip (NOAA 2012). MDMF collects commercial harvest data through seafood dealer reports (Standard Atlantic Fishery Information System) and, until recently, annual catch reports identifying species caught and effort. Under the catch reporting system, fishermen were not required to report fishing locations for fin fish harvest, with the exception of certain gear types. Beginning in 2010, MDMF implemented a new comprehensive trip-level reporting system that collects harvest information from all State permit holders for all species. This change will help fill gaps in datasets, standardize data collection across State and Federal agencies, and facilitate data pooling between organizations (MDMF 2013b).

Some commercial fishing occurs in refuge waters, particularly in the southwest corner of the Declaration of Taking boundary; however, we currently have very little information on the extent. Commercial fishing is regulated by the Massachusetts Division of Marine Fisheries and the National Marine Fisheries Service. The waters of the refuge constitute less than 1 percent of MDMF SRA 10 (Nantucket Sound) and consequently the amount of commercial activity in this area is proportionately small. Commercial landings data for SRA 10 do not exist on a small enough spatial scale to accurately depict fishing activity specifically within the refuge Declaration of Taking boundary; nevertheless, landings data from SRA 10 are helpful for characterizing the commercial fishing industry in Nantucket Sound.

MDMF commercial fin fish landings from SRA 10 are reported for 2010 and 2011 to help characterize the commercial fin fish resource in Nantucket Sound. The data includes landings from Massachusetts permit holders as well as from NMFS vessel trip reports for individuals holding both State and Federal permits. The short timeframe of the dataset available under the State's new reporting system limits the ability to make inferences about long-term population trends. Despite this, these data establish a useful baseline for future use. The commercial fin fish landings reported by MDMF for SRA 10 for 2010 and 2011 averaged 963,195 lbs (436,897 kg). Fin fish catches during this time period were heavily composed of summer flounder, bluefish, scup, black seabass, striped bass, haddock, spiny dogfish, butterfish, cod, menhaden, and skate (table 2.17). These species represent approximately 93 percent of commercial fin fish landings reported by MDMF from SRA 10 in 2010 and 99 percent of the landings in 2011.

Table 2.17. Massachusetts Commercial Fin Fish Harvest (live pounds) in Nantucket Sound (SRA 10).

Species	2010	2011
Bluefish	89,437	190,577
Bonito, Atlantic	*	*
Butterfish	24,521	6,388
Cod, Atlantic	20,601	26,270
Cunner		*
Cusk	*	*
Dogfish, smooth	*	
Dogfish, spiny	27,503	113,957
Flounder, plaice, American (dab)	1,490	362
Flounder, sand dab (windowpane)	*	

Species	2010	2011
Flounder, summer (fluke)	238,061	287,087
Flounder, winter	16,602	1,558
Flounder, witch (gray sole)	4,838	1,102
Flounder, yellowtail	2,083	5,185
Goosefish	9,533	1,262
Haddock	33,482	12,001
Hake, Atlantic, red	*	
Hake, Atlantic, white	4,749	*
Hake, silver (whiting)	*	*
Herring, Atlantic, sea	*	
King whiting	*	
Mackerel, Atlantic	336	1,093
Menhaden	21,141	1,471
Perch, ocean (redfish)	*	*
Pollock, Atlantic	5,003	3,587
Puffer, northern		*
Scup	203,126	182,145
Sea bass, black	89,984	94,507
Sea robins		*
Skate, little	*	
Skate, winter	*	*
Skates	10,075	15,685
Striped bass	82,721	85,119
Tautog	2,170	5,377
Triggerfishes	*	
Tuna, albacore		*
Tuna, bluefin	2,377	1,825
Tuna, yellowfin		*

Source: DMF Trip-level and NMFS Vessel Trip Reports.

** Confidential*

The commercial lobster fishery is managed from New Jersey to Maine by the ASMFC. The commission's interstate Fishery Management Plan divides Massachusetts into seven lobster conservation management areas that the Massachusetts Division of Marine Fisheries regulates (Dean 2010). Monomoy NWR is located within the Outer Cape Lobster Conservation Management Area (MDMF 2013a).

The lobster fishery in Nantucket Sound does not appear to be a major fishery. According to the Massachusetts lobster fishery statistic for 2006, more than 82 percent of the lobster harvest in territorial waters came from areas north of Cape Cod (Statistical Reporting Areas 1-7) (Dean 2010). Of the total commercial lobster harvest reported for Massachusetts coastal waters in 2006 (8,854,669 pounds), only 0.2 percent came from SRA 10.

The total State-reportable lobster landings for SRA 10 (Nantucket Sound) from 2001 through 2011 were estimated at approximately 265,779 pounds (table 2.18). During this period, lobster landings averaged 24,162 pounds, with a high of 41,741 pounds in 2002 and a low of 9,244 pounds in 2009 (table 2.18). It is not known how many lobsters are harvested commercially from within the refuge's Declaration of Taking boundary.

Table 2.18. Massachusetts Commercial Lobster Landings for SRA 10.

Year	SRA	Lobster Pounds
2001	10	23,828
2002	10	41,741
2003	10	23,862
2004	10	27,796
2005	10	30,200
2006	10	21,699
2007	10	18,037
2008	10	17,725
2009	10	9,244
2010	10	22,668
2011	10	28,979

Source: DMF Annual and Trip-Level Catch Reports

Commercial fisheries utilize a variety of gear types in Nantucket Sound. These are described below in table 2.19. The Cape Cod Commercial Fishermen's Alliance website provides a good overview of the region's commercial fishery and gear types employed (*http://www.capecodfishermen/the-fishermen*; accessed December 2013).

Table 2.19. Massachusetts Commercial Fin Fish Harvest Proportion by Gear Type in Nantucket Sound (SRA 10).

Gear Category	2010	2011
Gillnet	6.2%	13.9%
Hook	24.8%	32.0%
Other	1.4%	0.2%
Trap	8.1%	8.1%
Trawl	53.5%	40.5%
Weir	6.1%	5.3%

Fixed gear—Fish Weirs: Although historically used throughout Cape Cod, Chatham is one of the few Massachusetts towns to permit fish weirs, one of which continues to operate most years within the refuge's Declaration of Taking boundary. Weirs utilize a long narrow funnel-shaped net, set in shallow water using numerous poles. Fish pass into the net, but cannot find their way out. Fish weirs are typically used to capture squid, herring, and small baitfish, but can also impact fish-eating birds through depletion of prey, and sea turtles and marine mammals through entanglement. A loggerhead sea turtle was caught in a fish weir located within the Declaration of Taking boundary in 2007; staff removed the turtle from the net and transferred it to the Sea Turtle Salvage Network.

Fixed gear—Fish Pots: A limited number of fish pots occur within the refuge's Declaration of Taking Boundary, and are used to catch scup and black sea bass. Fish pots are similar in design to lobster pots and are usually fished singly or in trawls of multiple pots (not to exceed 2,500 feet in length).

Fixed gear—Lobster Pots: Commercial lobster pots occur throughout the refuge's Declaration of Taking boundary. Pots are fished as either a single pot per buoy, or strung together in "trawls" of multiple pots (not to exceed 2,500 feet in length). The season is closed annually from January through March (MDMF 2013c).

Fixed gear—Whelk (Conch) Pots: The commercial conch fishery is open from mid-April to mid-December (MDMF 2013a). Wood and wire pots are used to catch channeled whelk and knobbed whelk within the refuge's Declaration of Taking boundary. The pots are open at the top and are generally baited with horseshoe crabs. Pots are placed on sandy bottoms, usually near sea grass beds at depths of 1.5 to 27 m. Pots can be fished singly or in trawls consisting of up to 40 pots (Stevenson et al. 2004).

Mobile gear—Hook and Line (including handlines): Both striped bass and bluefish are commercially harvested in refuge waters. The striped bass commercial fishery is a hook and line-only fishery, with the season going from mid-July until the quota is filled (MDMF 2013d). The commercial bluefish harvest generally starts in Nantucket Sound with the return of migrating bluefish schools beginning in May and closes once the quota is met or the bluefish migrate southward again in October (MDMF 2013d). Commercial hook and line fishing for striped bass and bluefish occurs primarily in rips along the southern tip of South Monomoy; however, fish are also harvested in nearshore open waters throughout the Declaration of Taking boundary. Other species harvested commercially using hook and line gear (e.g., demersal longline) include black sea bass, cod, haddock, pollock, flounder, hake, and other groundfish, and dogfish (*http://www.capecodfishermen.org/the-fishermen*; accessed December 2013).

Mobile gear—Mid-water and Otter Trawls: Trawls are essentially large nets towed behind boats through the water at different depths, with large or coarse mesh toward the front that progressively decreases to finer mesh toward the rear of the net with the net kept open by trawl doors. The trawl doors and net opening function to herd fish into the finer meshed rear section of the net. Mid-water trawls target pelagic species suspended in the water column above the bottom, only infrequently contacting bottom substrates. Rope trawls are commonly used in the mid-water Atlantic herring and mackerel fisheries. Otter trawls target bottom-dwelling groundfish including cod, haddock, pollock, flounder, hake, dogfish, skate, and monkfish and therefore are in almost constant contact with the bottom. The 50-foot groundfish trawler the Joanne A III is the last remaining such vessel operating as a day boat from Chatham Harbor *(http:// ccchfa.org/media/documents/MTF_Amaru_2.2013.pdf;* accessed May 2013). Trawling does not likely occur within the Declaration of Taking boundary due to the shallow depths and heavy boating traffic.

Mobile gear—Troll Lines (commercial): These are a series of baited hooks or lures attached to two to four main troll lines by leaders, towed behind the tow vessel at different depths through the water column, rarely touching bottom, and separated using outriggers. Troll lining as described above does not occur within the Declaration of Taking boundary. However, some local fishermen sometimes use the term "troll line" when referring to demersal longline gear included in the above hook and line discussion.

Mobile Gear—Strike Nets and Gill Nets (commercial): Strike nets are set out in a circle, and then the boat runs in a circle to move the fish, into the net, which is hauled back immediately harvesting the fish alive. Strike nets are most commonly used locally to harvest bluefish during the warmer June 1 to October months (*http://www.capecodfishermen.org/bluefish;* accessed December 2013). Gill nets are anchored, or surface or drifting vertical walls of webbing, buoyed on top and weighted at the bottom, designed to capture fish by entanglement, gilling, or wedging (322 CMR 12.00(7)). Different mesh sizes are what determine the size classes of fish taken by these nets. Cod, haddock, flounder, pollock, hake, dogfish, skate, and monkfish are the species most commonly taken using bottom tending or "sink" gillnets in the Monomoy region during winter months (*http://www.capecodfishermen.org/the-fishermen*; accessed December 2013). Gillnet use is however prohibited in Nantucket Sound, including nearshore waters around Monomoy from April 1-November 15 (Chapt. 130, 322 CMR 4.09).

Placement of moorings (commercial and recreational): There are no exisiting moorings within the Declaration of Taking. However, in the summer of 2007, a commercial fishing boat (approximately 65 feet in length) placed a mooring block, which likely weighs about 5,000 pounds, on the west side of North Monomoy Island just outside the refuge boundary. The lack of mooring space within the Town of Chatham is a potential problem and we anticipate there would be interest in placing moorings within the refuge. This is not a use found appropriate for refuge waters, so moorings will not be allowed within the refuge boundary, except to assist refuge management activities.

USFWS

South Monomoy Island

Dredging: The Army Corps of Engineers permits limited dredging within the Declaration of Taking near the refuge boundary. The entrance to Stage Harbor in the northwestern corner of the refuge is dredged almost annually. There is some interest by some citizens and businesses to maintain through dredging the channel that separates Morris Island from North Monomoy Island. Where previously we had supported dredging the Morris Island channel, we are now concerned about adverse impacts to refuge lands from this activity. We must allow the Stage Harbor dredging to occur, and would evaluate all other requests for dredging in refuge waters to protect the Federal ownership interest of the refuge.

Beach renourishment: The Service allowed beach nourishment and revetment installation on the Morris Island portion of the refuge in the winter of 1998 and 1999. In 2005, the Cape Cod Commission approached the Service regarding beach renourishment on Morris Island, which we declined to support. However, the refuge beach on Morris Island has suffered significant erosion in the last 3 years. The Service has been meeting with the Army Corps of Engineers and the Town of Chatham to discuss the possibility of placing dredged material in the refuge, including possibly near Minimoy Island. The refuge would be willing to consider this activity if it would benefit beach nesting birds. In the last 5 years, Minimoy Island has annually hosted as many as 40 to 50 pairs of roseate terns, 1,000 pairs of common terns and piping plovers, American oystercatchers, and black skimmers.

Refuge Uses Found Not Compatible—Current

Horseshoe Crabs: During the 1990s, horseshoe crabs were harvested from Monomoy NWR. There was an active market during that time for using the crabs in the production of Limulus amoebocyte lysate (LAL) (Novitsky 1984), an extract of blood cells from the horseshoe crab developed by the biomedical industry to detect pathogenic endotoxins in injectable drugs and implantable

medical devices (Berkson and Shuster Jr. 1999). While (commercial) horseshoe crab harvesting for biomedical use was previously determined to be an appropriate and compatible use on the refuge, in 2002, based on new scientific data, all horseshoe crab harvesting was found incompatible with the refuge's purpose and mission and has not been allowed since. That compatibility determination provided a thorough synthesis of information available at that time. A summary of the justification for finding all horseshoe crab harvesting not compatible at Monomoy NWR is presented here.

> Both types of harvest result in horseshoe crab mortality. Although crabs harvested for biomedical use are eventually returned to the waters, some mortality still occurs during the transport, handling, and bleeding process, and this mortality may be significant (Wenner and Thompson 2000, Walls and Berkson 2000, Leschen and Correia 2010). Additionally, horseshoe crabs' reproductive cycle makes them vulnerable to over-exploitation. The reproductive strategy of congregating in large numbers on beaches to spawn makes them easy targets for any harvester in both the intertidal and subtidal areas close to spawning beaches. Shallow water harvesters focus their efforts on high tides when the horseshoe crabs are moving into shallow waters to breed. The gentle topography of the west side of Monomoy NWR (including North Monomoy Island and the north tip of South Monomoy Island) allows horseshoe crab harvesters to easily collect animals in the intertidal areas on spawning beaches, and, in the subtidal areas, on their way to the spawning beaches. Because this species does not breed until reaching 9 to 10 years of age, declines in populations may not be realized for many years, and populations will be slow to recover from overharvesting.
>
> Resulting loss of spawning crabs and eggs may impact migratory birds. Harvest for the biomedical industry and the commercial bait fishery both target gravid females that are collected as they approach, or while on, spawning beaches. It is likely that these uses result in a decrease in the number of horseshoe crab eggs that are deposited on the beaches in the year of harvest. In Delaware Bay, the reduction in spawning horseshoe crabs resulted in a 70 percent decline in horseshoe crab eggs (Tsipoura and Burger 1999), and this decline has been linked to subsequent declines in shorebirds on the New Jersey shores (Niles and Clark 1997). A number of species of shorebirds rely on Monomoy NWR during the spring and fall migration for habitat for feeding and resting, and we have confirmed that horseshoe crab eggs are one of the food items consumed by shorebirds at Monomoy NWR. While we have not identified all of the species that feed on horseshoe crab eggs on the refuge, this information is consistent with numerous studies from Delaware Bay that document the importance of horseshoe crab eggs to shorebirds during the spring migration. Given that Monomoy NWR is a critical spawning site for horseshoe crabs and is a critical migratory stopover site for shorebirds, it is likely that horseshoe crab eggs are an important food item in shorebirds' diets and a critical part of the food web on Monomoy NWR.

Refuge law enforcement has apprehended individuals harvesting illegally for bait within the refuge Declaration of Taking boundary. The National Park Service also does not allow harvesting of horseshoe crabs within their quarter-mile boundary of the Cape Cod National Seashore. The horseshoe crab harvest appropriateness and compatibility questions were again re-examined during development of this CCP in light of new scientific and monitoring information that has become available. A new finding that horseshoe crab harvest is not an appropriate use of refuge lands is included in appendix D.

Refuge Archaeological, Historical, and Cultural Resources

Cultural resources include a wide variety of objects and locations that are evidence of past human activities. These resources may exist below ground, such as archaeological sites, or may be encountered above ground, as with historic buildings and other structures, in addition to landscapes, viewsheds, or ceremonial sites. The Federal government is legally responsible for the preservation and management of cultural resources that are located on Federal lands, and must consider the potential impacts of Federal actions on cultural resources wherever they may exist.

Monomoy NWR contains a variety of known cultural resources dating as far back as Paleo-indian cultures. These include Pre-Contact Native American sites on Morris Island, and the former locations of the historic Whitewash Village, seasonal cottages and camps, shipwrecks, and U.S. Coast Guard lifesaving stations on South Monomoy. The most well known cultural resource on refuge lands is the Monomoy Point Light Station, which includes the lighthouse, keeper's house, and small oil house, and is listed in the National Register of Historic Places. In general, archaeological resources on the refuge may be at risk due to erosion and natural forces.

Because very little of the refuge has been subject to systematic archaeological sampling, it is possible that many archaeological sites, both Native American and European-American, are currently unknown and await discovery. As sites are added to the inventory, the Service will have an enhanced ability to manage them as Federal regulations require.

Native American Archaeological Sites

No Native American sites have been recorded on South Monomoy or North Monomoy. During the Pre-Contact and Contact periods, Native Americans likely visited or settled upon the 8-mile peninsula from which the Monomoy barrier islands were later formed, but exposure to the elements and lack of vegetation has meant that local landforms (e.g., dunes and swales) were subjected to extensive erosion and movement. As a result, Native American archaeological deposits dating to the Pre-Contact period may be deeply buried on the two islands, or may have been deflated by erosion and no longer exist.

Two Native American sites have been recorded on refuge property at Morris Island. Both were shell middens of unknown date, reported by artifact collectors in the mid-twentieth century; little information currently exists for these sites. A third shell midden site, which produced pottery and triangular projectile points, was reported on Morris Island, outside of the refuge boundary. Evidence at this latter site suggests the island was occupied during the Woodland period, so it can reasonably be inferred that Morris Island, in general, witnessed Native American occupation during that time period, and that the Monomoy peninsula to the south was likely settled as well.

Two archaeological surveys related to Federal undertakings have been performed on refuge property. One small survey investigated a boat landing location on Morris Island, and testing was conducted at the Monomoy Point Light Station prior to the rehabilitation project at the light keeper's house. Neither survey recovered any Native American artifacts. No comprehensive archaeological study, such as an overview, has been conducted for the refuge as a whole. It should be assumed that the likelihood for unrecorded Native American archaeological sites is high in all undeveloped locations within the refuge, unless systematic professional sampling has demonstrated the absence of such resources. Areas of comparatively stable ground on the margins of estuaries and shellfish habitats are lands more likely to have been used in the past and represent zones of higher archaeological sensitivity.

The CCP and its management alternatives are required to comply with the National Historic Preservation Act (Sec. 106), which entails consultation with federally recognized American Indian tribes. The Mashpee Wampanoag

Tribe and the Wampanoag Tribe of Gay Head (Aquinnah) are the federally recognized tribes that are directly descended from the Native tribes that occupied southeastern Massachusetts and the Cape Cod region during the European contact period. The Service consulted with these tribes as part of the CCP process.

Historic Structures and Archaeological Sites

The following information was taken from the files onsite at the Region 5 U.S. Fish and Wildlife office in Hadley, MA.

Monomoy Point Light Station

In 1823, a lighthouse with an iron lantern room and wooden tower extending above the roof of a brick keeper's house was built on Monomoy Point (formerly known as Sandy Point). This lighthouse had a fixed white light illuminated by eight lamps with reflectors. The Monomoy Point Light, along with the Great Point Light on Nantucket Island, marked the entrance to Nantucket Sound for vessels in the Atlantic.

In 1842, I.W.P. Lewis, a civil engineer with the U.S. Lighthouse Survey, recommended replacement of the entire light station. In 1849, a new 40-foot cylindrical cast-iron tower was built (the existing lighthouse). The two-story wooden keeper's house was also constructed. According to an inspection report dated in 1850, the new iron lighthouse was "neither large enough, nor high enough, nor stiff enough." The lack of stability was due to poor footings. The earlier tower, which was masonry, began coming apart from the strong winds. The tower was later lined with brick to reduce the sway and provide insulation from the winter cold and summer heat.

The first lightship, Light Vessel No. 2, was placed at Pollock Rip in 1849 to assist the lighthouse on Monomoy Point in alerting ships to the dangerous currents. Light Vessel No. 2 was at Pollock Rip from 1849 to 1875. Eight lightships were on station at Pollock Rip from 1849 to 1969 (*http://home.comcast.net/~debee2/mass/Monomoy.html*; accessed February 2012).

The Lighthouse Board recommended upgrading the lighthouse to a second-order light in 1872 to better guide vessels through the waters; however, Congress never approved the recommendation, and the tower was instead painted red to increase its daytime visibility. In 1892, trusses were fastened to the tower in a short-lived attempt to increase stability and prevent vibration.

The opening of the Cape Cod Canal in 1914 enabled coastal vessels to avoid the dangerous waters around Monomoy Point. When the Chatham Light was refitted with increased power in 1923, the Monomoy Point Lighthouse was decommissioned. The government sold the station to George Dunbar, the first of several private owners, who made few changes to the property. By 1958, all equipment and glass in the light lantern had been removed. The property was sold to the Audubon Society in 1964 (Historic American Engineering Record).

The society made several improvements to the keeper's house, which served as a destination for guided tours viewing the extensive bird populations on Monomoy. The Service acquired the property in 1977.

The Monomoy Point Light Station is a structural complex listed on the National Register of Historic Places. Rehabilitation of its three structures, the 40-foot tall, cylindrical, cast-iron tower, keeper's house, and brick oil house, began in August 2010 (Oak Point Associates 2009). An archaeological investigation completed prior to the rehabilitation project found extensive evidence resulting from domestic occupation of the keeper's house (Binzen 2010 personal communication). The light station structures are on lands excluded from the Monomoy Wilderness when designated in 1970, but the site is largely surrounded by refuge lands designated as wilderness that must be crossed to access the structures.

U.S. Life Saving Stations
The waters surrounding Monomoy Point were historically the most hazardous in the Northeast, due to the shallow shoals, strong rip currents, and storms forming where the Atlantic Ocean meets Nantucket Sound. More than 3,000 shipwrecks have occurred in the waters surrounding Cape Cod over the last 300 years. After the U.S. Life Saving Service was established in 1872, three life-saving stations were built on Monomoy. Despite the lighthouse and the use of lightships, there were numerous additional shipwrecks off Monomoy Point.

The first lifesaving station was built on Morris Island near the current refuge administrative complex and designated as LSS #13 Chatham. The second lifesaving station, LSS #14 Monomoy, was located below Inward Point, near a cluster of cottages that were known as the Hammonds Bend Camps. A third station, Monomoy Point, was built at the southern tip of Monomoy, and subsequently expanded to a U.S. Coast Guard base complete with a residence and equipment building in addition to the original lifesaving station structure. None of the structures from the lifesaving stations still exist, although some scant surface evidence of the Coast Guard station buildings is still visible.

Seasonal Camps and Fishing Facilities
According to an account from Harry D. Ellis, who resided on the island circa 1900, "Between Inward and Monomoy Points stood three weir shanties, occupied by the crews which operated the weirs. The weirs were placed off the west shore (in Nantucket Sound) and as a convenience the boats and gear were kept at these shanties." No evidence of the shanties of the Consolidated Weir Company is visible today. During the same period, the Monomoy Branting Club had at least three buildings that were used seasonally by sportsmen. These structures no longer exist.

Seasonal Cottages
The seasonal settlement at Hammonds Bend comprised about two dozen cottages and outbuildings. Families maintained a tradition of summer visits to these modest and remote abodes. Although these residences no longer exist, photographic evidence from the mid-twentieth century shows they were single-story dwellings sided with wood shingles.

Located closer to the Monomoy Point Light Station were other small cottages, also no longer extant, that made up the Jones Small Camp, the Edward J. Tripp Camp, and the John T. Mason II Camp.

Whitewash Village
During the early 1700s, a deep natural harbor at Powder Hole near Monomoy Point attracted a settlement that would come to be known as Whitewash Village. Local historians have reported various descriptions, although accounts of life for the historic village are scarce, as Chatham lost its town records to a fire in 1827 and its parish records during a fire at the Congregational Church in 1861 (Seufert-Barr 1995). The settlement was dealt a blow when its harbor was washed away during a hurricane around 1860.

The account from H. D. Ellis describes the community as it existed during the early 1900s:

> At Monomoy Point itself was a cluster of dwellings occupied by the lobster fishing fraternity. Some were built along the shore of the Powder Hole, almost a circle where the tide flowed and ebbed and made a deep little body of water… I do not now recall the names of all the Pointers but on "this side" of the Powder Hole came first the abode of old Bill Bloomer. Next was our Ellis cottage, followed by houses of George Bloomer and young Bill Bloomer- both sons of old Bill. Then came the old store which in previous times had fitted out fishing

> schooners… The old store was kind of a divider between the two sides… The Point Coast Guard Station had not been built during the earlier years of our stay, but the Monomoy Point Light was there.
>
> All of these residents (lobster fishermen) were for the summer only. We are speaking of the era when all the boats had sail power only, making it necessary to live as close as possible to where the [lobster] pots were set. These years were the late eighteen hundreds and early nineteen hundreds… The houses at the Point were built of lumber and laths which were picked up along shore. At that time there was a considerable amount of flotsam and jetsam which came from wrecked vessels and in some cases where the deck load was thrown or washed overboard. The finished lumber came from Chatham.

A report to the Commonwealth of Massachusetts on the status of the quahog fishery described the Powder Hole during the period 1905 to 1910 when it served as a field laboratory for early quahog culture and growth experiments (Belding 1912), including a site map (figure 2.14), as follows:

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Sanderlings

> During the period from 1905 to 1910 [quahog] growth experiments were conducted in the Powder Hole…The natural aquarium of several acres, teaming with shellfish life, was leased for experimental purposes by the Commonwealth, and proved by its protection and variety of natural conditions in a limited area, a most satisfactory location for a quahog investigation. In 1906 a small shanty was fitted up as a laboratory, and a raft of 20×10 feet was anchored in the deeper water of the Powder Hole. Growth experiments for a period of four years were conducted by suspending boxes of sand from the raft at various depths, while several methods of spat collecting were tried. In the flats and waters of the Powder Hole, under different conditions as regards current, soil, and depth of water, a number of cultural experiments were established.
>
> In former years the Powder Hole was a spacious harbor where hundreds of vessels could anchor, but the sand bars have so shifted that at the present time nothing remains but an almost enclosed body of water of perhaps 3 acres, connected to the ocean on the bay side by a narrow opening through which a dory may enter at high tide. The opening changes constantly, owing to the shifting nature of the sand, and has successively worked from the south to the north side, closed and reopened again at the south at intervals of one and a half years. A large part of the original harbor is now dry land or salt marsh, while on the north and west side is a sand flat of 3 acres, which until 1910 contained an abundant quantity of softshell clams. The harbor itself is slowly diminishing in size, due to the encroachment of the sand, and will doubtlessly eventually become a small pond, not connected with the ocean.
>
> The water on the north and west sides averaged 15 and 18 feet in depth, gradually shoaling to the south and east. In the shallow water the soil was covered with an abundant growth of eelgrass. The rise and fall of the tide was about 1 ½ feet on the average, but extremely erratic, as the force and direction of the wind and position of the opening were important in determining the amount of water passing through the narrow inlet.

The channel connecting the Powder Hole and the ocean became blocked during the summer of 1908, with the result that there was a stagnation of the water in the Powder Hole during part of the growing months.

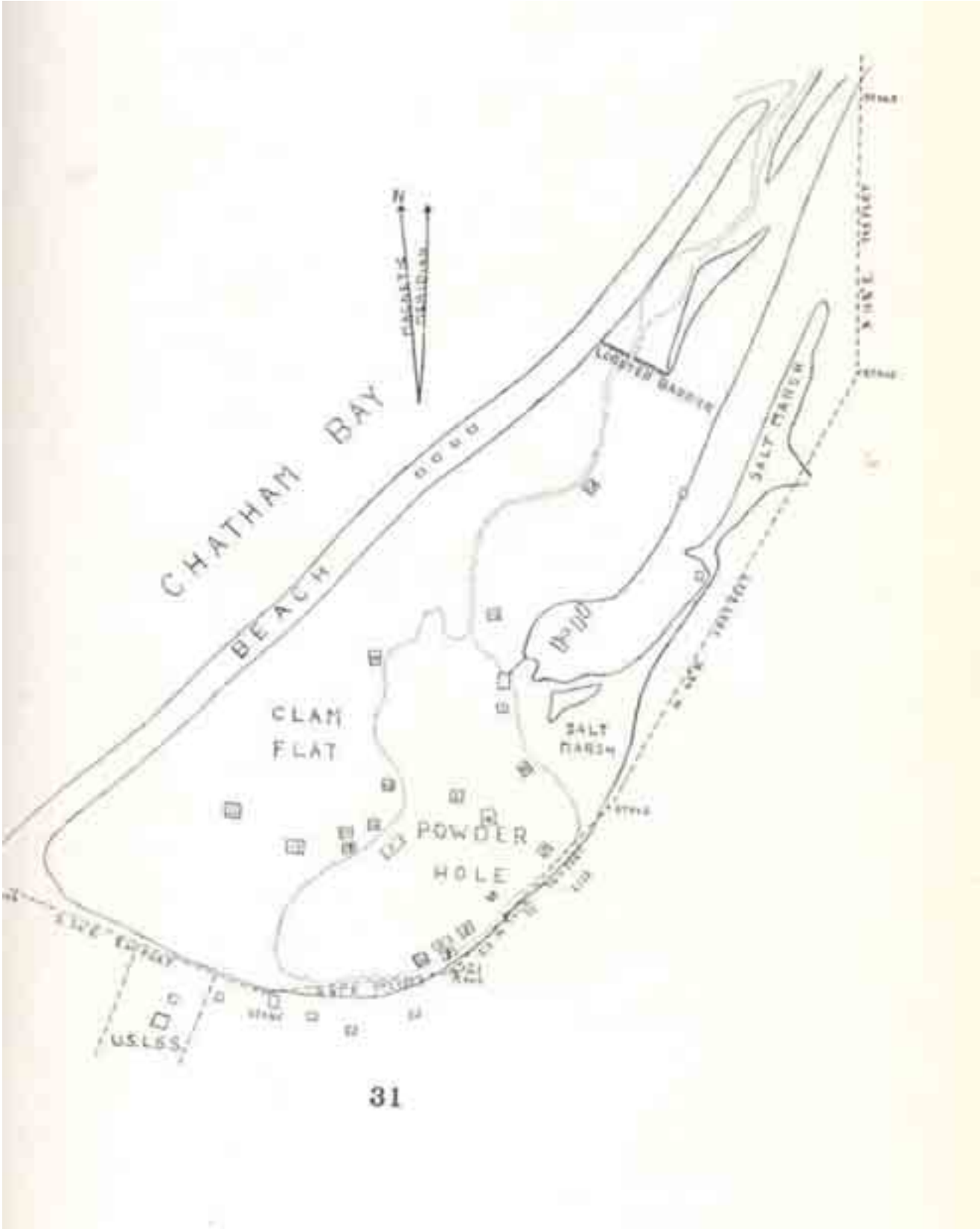

Figure 2.14. Powder Hole, Circa 1910 (Belding 1912).

Today, little evidence of the historic Whitewash Village exists on the ground surface because the buildings had minimal foundations and the vicinity has been affected by sand activity such as erosion and dune formation. A variety of archaeological deposits and features may be preserved beneath the ground surface, but also have been subject to wind and erosion. All the buildings at Whitewash Village (consisting of approximately one dozen cottages and outbuildings) were either destroyed by storms or demolished by the Service after establishment of the Monomoy NWR. No formal study has been conducted to map and inventory historic archaeological resources at the refuge. The historic archaeological record at the refuge may possess research value as an opportunity to investigate an early American fishing village, if any associated archaeological resources still possess integrity.

Regional Socioeconomic Setting

Economic Overview

The Town of Chatham is known as a resort, retirement, and artistic community. Chatham, one of the older townships of Cape Cod, was settled in 1656 by a handful of Pilgrims, whose surnames still dominate the Town's census list. The town was later incorporated in 1712. Originally a farming community, its inhabitants found deep-sea fishing more lucrative. Fishing has been a part of Chatham's cultural identity for over three hundred years. Abundant stocks of groundfish such as Atlantic cod, haddock, redfish, hakes, and flounders supported Chatham's fishing industry throughout much of its history. In the early 1700s, Chatham's fleet was one of the largest in New England, consisting primarily of small day boats fishing close to shore for cod, mackerel, and shellfish. In these early years, fishing fueled the local economy and many residents either fished or were employed in trades related to fishing (*http://www.wickedlocal.com/chatham/news/x422900698/Smaller-fleet-fewer-fish-but-after-300-years-fishing-still-defines-Chatham?zc_p =1#axzz2PSYG7wUH*; accessed April 2013).

By the late 19th and 20th centuries, large fleets of schooners sailing from Gloucester and Boston targeted cod and other groundfish along offshore banks from Cape Cod to Newfoundland. The majority of cod were preserved with salt prior to the vessels returning to port. Overfishing by the early hook-and-line fleets was occurring at this time and stocks of Atlantic halibut and other species began to decline. At the turn of the 20th century technological innovations such as refrigeration and railroad transportation expanded the commercial market for fresh fish. Steam-powered trawl vessels quickly replaced sailing schooners. At the end of World War I, following the introduction of the diesel powered trawler, the number of targeted species increased. Trawlers shifted from harvesting primarily cod to harvesting species such as haddock, redfish, and flounders throughout the 1930s, 1940s, and 1950s.

In the early 1960s, groundfish stocks faced additional exploitation from factory-based trawlers from eastern Europe and Asia that harvested unsustainable amounts of haddock, hake, and herring from New England waters. A quota-based management system was instituted in 1970 to regulate foreign catches and reverse the severe declines experienced by most groundfish species during this period. The Magnuson Fishery Conservation and Management Act of 1975 officially ended the participation of foreign fishing fleets in U.S. waters within 200 miles of the coast. Following the elimination of the foreign fleets, some stocks rebounded, only to be overfished again by domestic fleets. Stock biomasses of many groundfish reached record lows in the early 1990s, prompting the passage of the Sustainable Fisheries Act of 1996, which requires that overfished populations be restored (*http://www.nefsc.noaa.gov/history/stories/groundfish/grndfsh1.html*; accessed April 2013).

The ability of the Chatham fishing fleet to survive in a constantly changing industry is a testament to its adaptability. Following record low numbers of groundfish in the early 1990s, some species began showing signs of recovery in 2003, when 2.8 million pounds of groundfish were landed at the Chatham Fish Pier (figure 2.14). Since 2009, however, groundfish landings have plummeted and less than 700,000 pounds were landed at the pier in 2012 (less than 30 percent of the cod quota was caught). In the absence of the more lucrative groundfish species, the fleet has been forced to target less profitable species like skate and dogfish. Dogfish landings have drastically increased from 232,360 pounds in 2005, to over 3.3 million pounds in 2012 (figure 2.15). Together, skate and dogfish represented 82 percent of the total 2012 landings at the Chatham Fish Pier (*http://www.ccchfa.org/media/documents/CCC.FutureofChathamFishing.2.28.13.pdf*; accessed April 2013).

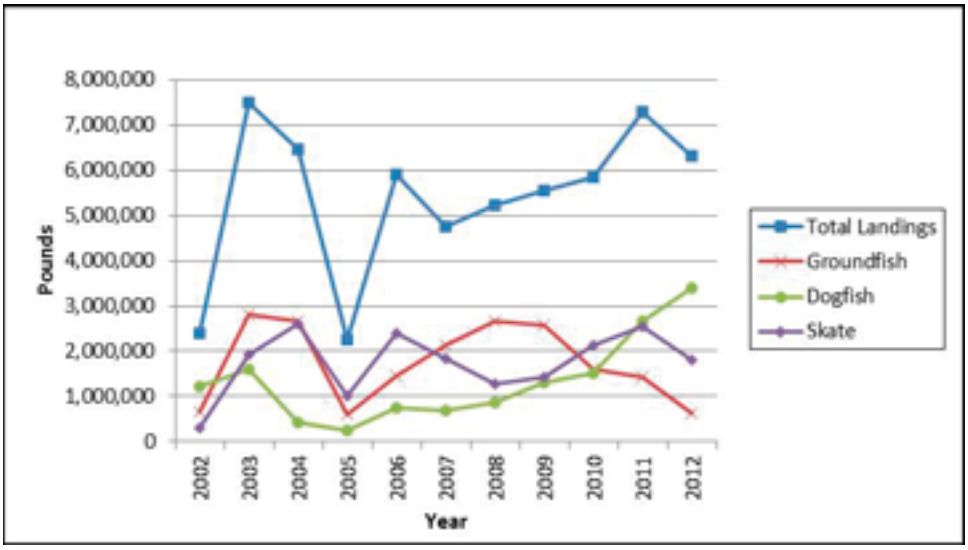

Figure 2.15. Chatham Fish Pier Landings 2002 to 2012. Source: Chatham Fish & Lobster Company Inc. and Nantucket Fish Company Inc.

Population Demographics

Although the population of Massachusetts grew by approximately 3 percent between 2000 and 2010, the County of Barnstable had a decrease in population by the same amount (U.S. Census Bureau 2010). At the same time, the region became more diverse, with an increase of 56 percent of people who identify themselves as Hispanic or Latino, and a 4 percent decline in the number of people who describe themselves as white (U.S. Census 2010). The number of Cape Cod residents identifying themselves as Asian increased by 63 percent, the Native American population increased by 7.2 percent, and the black population by 2.3 percent (U.S. Census Bureau 2010).

The most significant trend in the Cape Cod region is the decline in the younger demographic—a decrease of 21.09 percent in persons "18 and under" between 2000 and 2010. According to the U.S. Census Bureau (2010), approximately 2.6 percent of the population in Chatham CDP is 5 years of age or younger, approximately 9.8 percent of the populations is between the ages of 5 and 19, approximately 88.6 percent is age 18 years or older, and about 40 percent of the area's population is 65 years or older.

Employment rates in Barnstable County decreased by approximately 3 percent between 2000 and 2010. The average per capita income in 2010 for Chatham is $57,006; Barnstable County has an estimate of $33,435, which is equivalent to the per capita income for the State. The average family income in Chatham is

$163,316—a difference of 60 percent compared with the State's average family income of $64,509 between 2006 and 2010 (U.S. Census Bureau 2010).

In 2010, Chatham had a local population of around 1,400. Its labor force is about 40 percent of its population and in 2010, nearly 9 percent of its labor force reported being unemployed. The largest employers in the area, in terms of employment, were (1) the arts, entertainment, recreation, and accommodation and food services; (2) finance and insurance, real estate and rental and leasing, and educational services; and (3) health care and social assistance (U.S. Census Bureau 2010). Together, these three industries employed about 43 percent of the total workforce. Construction and retail trade also employed about 20 percent of total employment, a significant portion of the labor force.

Economic Sectors, including Recreational and Commercial Activities

As previously described, the refuge consists of lands located on Morris Island, North Monomoy Island, South Monomoy, and open waters within the Declaration of Taking. The visitor contact station on Morris Island is accessible by car. North Monomoy Island and South Monomoy, the majority of which is designated as wilderness, are accessible primarily by ferry or private boat. Motor boats are allowed in the Monomoy wilderness area because the Wilderness Preservation Act allows the use of motor boats to continue where these uses have already been established and deemed desirable by the Secretary of the Interior (16 U.S.C. § 1133(d)(1)). There is no supply of potable water on the refuge. The refuge is open year-round, with most visitation occurring during the summer tourist season from late spring to early fall. The refuge offers wildlife viewing sites, hiking trails, and extensive fishing opportunities.

Most refuge visits, especially those to the Monomoy Islands, occur between May and October, peaking in June, July, and August. The heaviest visitation is at the headquarters complex and the point on Morris Island, near Godwit Bar on North Monomoy Island, the southern third of South Monomoy, and the northern tip of South Monomoy (Inward Point). In recent years, surf casters have utilized most of the edges of North Monomoy Island and the waters surrounding the northeast end of South Monomoy. Popular shellfishing areas change even more frequently, but the flats on the north end of South Monomoy, the south end of North Monomoy Island, and the east side of Minimoy Island have been used the most since 2007. Birdwatchers who frequent North Monomoy Island often utilize the access corridor that bisects the salt marsh and leads to expansive flats on the west side where shorebirds forage (Koch 2011 personal communication).

Additionally, many summer visitors come to the refuge primarily for sunbathing and swimming. Popular areas include the beaches of Morris Island, the east side of North Monomoy Island adjacent to the boat channel, sandbars between the islands, and the beach just west of Powder Hole.

In 2012, the refuge reported that a total of 33,150 people visited the refuge. The expenditures associated with the recreational activities of Monomoy visits, including fishing, wildlife viewing, and beach and water recreation contributed slightly less than $260,000 to regional output (Maillett 2012). Monomoy NWR and adjacent Nauset/South Beach are unmatched on the Cape for opportunities to view a wide variety of migrating shorebird species. In addition, the wilderness status and difficulty of access create a unique environment for visitors to experience its solitude and naturalness. The variety of Monomoy NWR wildlife attracts birdwatchers from throughout the Northeast, and many birding clubs and other outdoor recreational groups organize field trips to Monomoy NWR. Two for-hire vessel operators have provided ferry services to the refuge and seal tours for several years. In addition to the wildlife watching cruises offered by Outermost Harbor and Monomoy Island Ferry, both the Massachusetts Audubon

Society and the Cape Cod Museum of Natural History offer longer guided trips. These groups plan seasonal visits for small groups (i.e., fewer than 30) primarily to observe migratory shorebirds. Participants pay a fee to the organizations, which then arrange for transportation to the refuge and an interpretive guide.

Shellfishing

Over the course of the last 20 years, Chatham has been one of the top shellfish producing towns in the Commonwealth of Massachusetts. Collectively, Chatham has a total of 101,763 acres available for shellfishing in 17 State-designated shellfish areas. Several of these areas are commonly harvested for softshell clams and quahogs during low tide periods. Of these areas, Monomoy Island (SC47) is the largest designated area at 37,831 acres, representing nearly 80 percent of the tidal shellfish areas. In fact, the Monomoy area, which has no seasonal closures, has a greater relative importance in the entire area. In contrast, many of the tidal areas within the town are conditionally approved for harvest. This usually means that these areas will be closed to harvest if fecal coliform bacteria levels exceed National Shellfish Sanitation Program standards.

In 2011, nearly 1.4 million live pounds of shellfish were harvested in the Chatham area, and more than one-half of the harvest originated from Monomoy. About 50 percent of the Monomoy harvest was northern quahogs (786,632 live pounds). In 2011, Monomoy shellfishermen also landed more than 20,655 pounds of bay scallops, 10,449 pounds of soft-shell clams, and 42,982 pounds of whelks.

A brief description of the types of shellfish harvested in Chatham waters follows.

Mussels

Mussel harvesting has occurred in the open waters north of North Monomoy Island. We have no information on how often this has occurred, how many people harvest mussels, or what the economic value of the mussel harvest is. Over the past 20 years, on average, the typical mussel harvest has been about 28,000 bushels (Maillett 2012). Mussel harvest was the primary reason for the record total harvest levels in 1990, 1991, 1992, and 2008. In the recent past, most of the mussels were harvested out of Pleasant Bay. Mussels have also been harvested out of Chatham Harbor.

Softshell Clams

In 2002, the peak year for soft-shell clam harvest in Chatham, the total amount of harvest was 78,000 bushels (Maillett 2012). According to the Shellfish Constable's annual reports, the majority of the harvest, not only in the peak year of 2002 but for all years, came from Monomoy and Nauset/South Beach. Since that peak year though, harvest levels have dropped precipitously. In 2009, the total amount of softshell clams harvested was 4,000 bushels, about only 5 percent of the peak harvest in 2002. In 2011 the harvest of softshell clams rebounded to nearly 18,000 bushels. According to the 2010 Shellfish Constable report, the increasing harvest of softshell clams is now primarily coming out of the north side of town (Chatham Harbor and Pleasant Bay). The recent decline in the harvest of softshell clams has been attributed to the changing geophysical conditions of South Monomoy.

Quahogs

In contrast to the softshell clams, quahog harvests have shown a steady and stable increase between the years 2001 and 2008, and have pretty much stayed between 10,000 and 20,000 bushels per season (Maillett 2012). The average annual harvest over the past 20 years has been about 14,000 bushels. Common Chatham shellfish areas where quahogs are harvested include Monomoy, Oyster Pond, and Mill Pond. Oyster Pond, however, is conditionally approved by the State and subject to seasonal closures.

Bay Scallops
Bay scallops are typically not as plentiful in Chatham's waters compared to other species. Typically, annual harvest levels are around 500 bushels (Maillett 2012), although there can be "spikes" in scallop landings affected by market values and local abundance. For example, 2009 was a banner year when the town reported more than 10,000 bushels of bay scallops were harvested. Not since 2001 has the town reported a bay scallop harvest greater than 1,000 bushels. These scallops were mainly harvested from the "southway" between Nauset/South Beach and Monomoy, the outer part of Stage Harbor, and Oyster River.

Commercial Fishing
There is some commercial fin fishing occurring in refuge waters, particularly in the southwest corner of the Declaration of Taking. Fishermen have historically harvested striped bass, bluefish, black sea bass, scup, fluke, lobster, whelk, and sea clams in Nantucket Sound and the subtidal waters of the refuge. Because the open waters of the refuge constitute a minor portion of the fishing zones, the amount of activity in this area is small and the majority of the fish in this area are harvested though rod and reel. We have no information about the economic value of this catch.

Guided Recreational Fishing
Monomoy NWR provides exceptional fishing opportunities. Sport fishing activities on the refuge have been a significant factor in the local economy; recreational fishing and guided excursions to the Monomoy Refuge in 2012 contributed close to $100,000 in visitor spending to the local economy (Maillett 2012). Guide fees vary by the type of fishing and amount of time on the water. Typical rates for fishing the flats from a boat for a party of one or two anglers ranged from $375 for 4 hours to $575 for an 8-hour session. Wade fishing tends to cost less, from $250 for a 6-hour trip to $300 for an 8-hour trip, plus ferry fees ($15). Guide fees do not include tips, which typically run about 20 percent (*http://www.fishingthecape.com*; accessed February 2011).

Transportation and Wildlife Watching Services
There have been two principal ferry operators who provide the public transportation to Monomoy NWR and the flats—Monomoy Island Ferry and Outermost Harbor. In addition to providing transportation to the refuge, these ferry operators have also provided boat tours around the island for wildlife viewing (primarily seals).

Seals on South Monomoy Island

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Monomoy Island Ferry
The Monomoy Island Ferry Company has the Rip Ryder, a 32-foot, twin engine power boat with a capacity of 20 passengers in addition to the captain. The company has been operating for over 20 years and boards passengers right on Morris Island, outside refuge headquarters. During the last decade, the Rip Ryder shuttled both fishing passengers and birders back and forth to North Monomoy Island and Nauset/South Beach for a fee. This service was effectively suspended in 2012. The company now primarily offers 90-minute seal cruises, which depart the refuge at 9:30 a.m., 11:30 a.m., 1:30 p.m., and 3 p.m. In 2012, the charge was $35 per adult and $30 per child. Monomoy Island Ferry will also shuttle birding group trips to South Monomoy, using either a small vessel for groups of six or fewer or a larger vessel for groups of 12 or fewer, at a charge of $360 for the small vessel and $720 for the larger vessel (*http://www.monomoyislandferry.com/*; accessed February 2013).

Outermost Harbor
Outermost Harbor Marine operated a shuttle to both North Monomoy Island and Nauset/South Beach for fishermen, birders, and recreationalists. In 2009, the charge was $20 per person for shuttle service to Monomoy NWR. Outermost Harbor Marine operates out of the marina off Seagull Road, approximately ½ mile south of Chatham Light (*http://www.outermostharbor.com/*; accessed March 2011). In 2013, Outermost Harbor Marine suspended its water taxi service to the refuge for business reasons (*http://outermostharbor.com/water-taxi/*; accessed February 2013).

Overall, recreational visits to the refuge contribute about $1,500,000 to the town's economy (Maillett 2012).

Refuge Contributions to the Local Economy

The operation of the National Wildlife Refuge System not only provides wildlife with habitat but also provides visitors with opportunities to enjoy a variety of wildlife-dependent recreational and educational activities. Where it contributes to the purpose of the refuge and is compatible, an economic use such as haying or timber removal may be allowed. The operation of an individual refuge is much like that of any small business. Refuge budgets are spent on salaries, expenses, and payments, much of which are spent within the local community.

In fiscal year 2012, Monomoy NWR employed a refuge manager and two permanent biologists, one full-time term wildlife biologist, one part-time student employee, two seasonal biological technicians, and several seasonal interns. Salaries for the year were about $235,000 for the full time workers and about $80,000 for the seasonal workers.

The Refuge Revenue Sharing Act of 1935, as amended, provides annual payments to taxing authorities, based on acreage and value of refuge lands. We have contributed refuge revenue sharing payments to the Town of Chatham since the refuge was established. Money for these payments comes from the sale of oil and gas leases, timber sales, grazing fees, the sale of other refuge system resources, and from congressional appropriations. The actual refuge revenue sharing payment varies annually because Congress may or may not appropriate sufficient funds to make full payment. Payments are based on one of several formulas. In Massachusetts, the payments are based on three-quarters of 1 percent of the appraised market value. The purchase price of a property is considered its market value until the property is reappraised. The Service reappraises their properties every 5 years.

The actual Refuge Revenue Sharing payments made to the Town of Chatham by the refuge for the last 6 fiscal years (FY) are shown in table 2.20. The most recent refuge revenue sharing payment was based on 7,604 acres. At the next reappraisal, the acreage will increase due to the attachment of Nauset/South Beach to South Monomoy Island.

Table 2.20. Refuge Revenue Sharing Payments for Monomoy NWR.

Fiscal Year	2007	2008	2009	2010	2011	2012
Payment	$32,805	$25,452	$23,917	$22,533	$24,146	$22,690

Monomoy NWR also spent approximately $63,000 (FY 2011) annually on materials and services to operate the refuge (Maillett 2012). Again, most of this money was spent locally.

Refuge Administration

Refuge Establishment and Special Designations

Monomoy NWR was established on February 10, 1944 through a Declaration of Taking by the Secretary of the Interior (District Court of the United States for the District of Massachusetts, Misc. Civil No. 6340). This taking extends from the mean low water line on the eastern shores of the refuge and to an area within Nantucket Sound identified by latitude/longitude coordinates on the western side. Included within the Declaration of Taking are all the lands lying above mean low water, including a portion of Morris Island, all of Monomoy Beach, North Monomoy Island, and South Monomoy, Shooters Island, all land covered by the waters of landlocked ponds, and all islands, islets, sand bars, and tidal flats lying in Nantucket Sound, Chatham Bay, and Stage Harbor, all lying within the specific exterior limits. This rough acreage was estimated in 1944 to be about 3,000 acres, which roughly corresponded to the area above mean high water, although the written description of the entire Declaration of Taking area well exceeded that amount as it used some explicit boundary points and mean low water along the eastern shore. The western boundary of the Declaration of Taking was established in recognition that geophysical processes would change the shape and location of the refuge, and all lands and waters above mean low tide, as well as other features that are submerged within the fixed western boundary, were to remain as part of the Monomoy NWR. This land was acquired, "together with all accretioned land and singular water and riparian rights and other rights, tenements, hereditaments and appurtenances thereunto belonging or in any wise appertaining." The Declaration of Taking was upheld by the District Court of the United States on June 1, 1944. It is noted that the official acreage of the refuge was not accurately determined at the time of taking, which significantly exceeded 3,000 acres.

The boundary is fixed by specific coordinates on the north, west, and south and is ambulatory on the east. Because of this, the size of the refuge changes over time as lands move, erode, or accrete. In 2000, a global positioning survey along the mean high and mean low water lines was conducted. The acreage determined to be above the high water line was 1,838 acres, the acreage above the mean low water line was 3,599 acres, acreage submerged under water was 4,005 acres, and the total acreage within the Declaration of Taking was 7,604 acres. In 2001, the Service's Chief Surveyor reviewed the survey and found that the map was an accurate depiction of the conditions as of September 15, 2000 (Kopach 2002). In 2013, the refuge boundary was expanded to include an area on Nauset/South Beach. This additional 717 acres brings the total refuge ownership to 8,321 acres. Coincidentally, in 2013 a breach occurred on Nauset/South Beach in the vicinity of this new boundary.

Submerged lands within the fixed boundary are included based on historical records that indicate an emphasis on controlling and restoring these lands due to their value for waterfowl. The extensive sea grass beds on the west side of Monomoy Island were recognized for their value to wintering waterfowl, in particular. Throughout the initial designation process for the refuge, the Monomoy area was recognized as an "outstanding waterfowl area" and as "one of the finest shorebird beaches in North America" (Salyer 1938) and for the eelgrass

(*Zostera*) beds in shoal waters northwest of Inward Point on the Common Flats (Griffith 1938) that were described as "dense" beds in 1929 (Hotchkiss and Ekvall 1929). The biological values of this area helped define the refuge boundary. Deeds are to be interpreted consistently with the framer's intention, and it is clear from the historical records that areas containing sea grasses formed an important basis for establishing the refuge, therefore, including these submerged lands within the fixed western boundary is appropriate.

Also within the Declaration of Taking are transitory rivulets that run through the refuge or may form channels or bays stretching across areas of lower water. Based on geomorphological advice concerning the integrity of an intertidal system and upon approaches based on international treaty and Supreme Court cases, the surveyors drew straight lines across the "headlands" of such features rather than tracing mean low water up and through these landforms. We believe this is the correct cartographic approach to follow.

Additionally, the transfer of submerged lands to the Commonwealth of Massachusetts as a result of the 1953 Submerged Lands Act did not include lands within the exterior perimeter of the Declaration of Taking. These lands have been subject to Federal jurisdiction and control since refuge establishment, although actual refuge management of these submerged and tidal lands has been limited. In subsequent litigation by the Commonwealth of Massachusetts on the 1953 Submerged Lands Act, Massachusetts claimed all of the waters of Nantucket Sound, which included the waters west of Monomoy within the Declaration of Taking. The Supreme Court held that the submerged lands west of Monomoy Point were not Massachusetts' internal waters at the time of the formation of the Union. Therefore, the submerged lands within the Declaration of Taking were already acquired as federal land, excepted from the Submerged Lands Act, and subject to federal jurisdiction and control when the Commonwealth received the surrounding lands in 1953.

Included in this area, and therefore falling under refuge jurisdiction, is the area of open water in the Morris Island channel that was land when the refuge was established. This area clearly lies within the coordinates of the Declaration of Taking.

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Salt pond along Morris Island Trail

The east boundary of the refuge is an ambulatory boundary, meaning it moves as the mean low water line moves. Monomoy Island itself has shifted west since the refuge was established; as described earlier in this chapter, it has split into North and South Monomoy Islands. This is a dynamic system, so the eastern boundary will never be static, and refuge acreage figures will change over time as land and water characteristics change.

Approximately 717 acres of Nauset/South Beach became part of Monomoy NWR as a result of a long period of coastal accretion and erosion. However, before the new cut in Nauset/South Beach occurred, it had attached to the refuge in 2006. The Southway, a channel between South Monomoy Island and Nauset/South Beach, had been filling in slowly for several years. This attachment, the result of many years of sand movement southward from Cape Cod Atlantic-facing sandy beaches to the north, created complications related to property boundaries

and jurisdictional issues. The Declaration of Taking defined the Monomoy NWR eastern boundary (Atlantic Ocean side), as mean low water. This definition served as long as Monomoy remained an island, but once Nauset/South Beach attached to it, a new boundary reflecting the joinder of Nauset/South Beach and South Monomoy Island needed to be identified. Further complicating the boundary determination is that South Beach is a continuation of Nauset Beach, which was the original landform forming the southern boundary in the designation of the the National Park Service's Cape Cod National in 1960. Furthermore, national seashore designation extends ¼ mile out from the mean low water line so now the Cape Cod National Seashore jurisdiction overlays Monomoy NWR as well.

The Town of Chatham, the National Park Service, and the U.S. Fish and Wildlife Service all had interests and rights in the ownership and management of parts of Nauset/South Beach at the time the final attachment occurred. In 2007, an agreement (called the "handshake agreement") with the Town of Chatham, the National Park Service, and the Service was temporarily established for management of the joinder area. The attachment point, or "thread," was vague, but the three entities agreed that the Service would manage all lands west of the thread and the town would manage all lands east.

In 2008, a signed memorandum of understanding (MOU) formalized the handshake agreement among the National Park Service, the Service, and the Town of Chatham. The MOU contained an agreement among the parties to establish an administrative boundary for use in determining jurisdictional authorities among and between parties. This boundary was intended to be temporary until a permanent solution regarding Department of the Interior jurisdiction (the overlap of the Cape Cod National Seashore onto Monomoy NWR) was resolved.

Since the establishment of this short-term agreement in 2007, the land connection grew longer and wider. It became very difficult to define a line that demarcated the point of physical connection at mean low tide. Because all parties to the MOU maintained close communication and worked together, the difficulty defining a line demarcating this changing area did not become an issue throughout the 5 years of the agreement. However, at the expiration of the MOU in January 2013, we had not reached agreement on how to define a new boundary. The original agreement inadvertently erred in the designation of an administrative boundary. Later, all three parties to the MOU could not agree on where the new boundary, reflecting the geomorphological changes that had occurred over the past 5 years, should be. This issue became moot, however, in early 2013 when South Monomoy became an island once again. Approximately 717 acres of Nauset/South Beach attached to South Monomoy and are now part of the refuge. There is an additional area to the west of Nauset/South Beach that could fall under the jurisdiction of the Service as well. It has not been determined yet if a new agreement is needed and, if so, who will be the parties to the agreement.

The northern part of Nauset/South Beach is still connected to the Town of Chatham mainland. Interestingly, the February 2013 breach in Nauset/South Beach occurred exactly where the Service would have indicated the revised boundary should be. The administrative boundary was inadvertently decided based on riparian (riverine) principles, but those are not appropriate in this littoral (ocean) environment. When there is a coastal accretion affecting multiple landowners, the principle of equitable division applies. Application of this principle retains direct access for all littoral owners to the shoreline directly across from their upland property.

Before the February 2013 break, we had determined that the legal doctrine of equitable division (see *Lorusso vs. Acapesket Improvement Association, Inc.*

408 Mass. 772, 1990) should define the new refuge eastern boundary. This would be in accordance with Massachusetts land law for defining changing boundaries in coastal locations. The Massachusetts Supreme Judicial Court, in deciding the *Lorusso* case, stated [that] "when two or more littoral owners have rights to simultaneously formed accretions, the rights of the owners in the accretions are to be determined by the doctrine of equitable division." According to the court, "the object of apportioning simultaneous accretions among lots of littoral land is to give each owner the same proportion of the new waterfront that he would have had if the accretions had never occurred" and "division on a non-navigable river frontage is so made as to give each relatively the same proportion in his ownership of the new river line that he had in the old." The administrative boundary defined in the now expired MOU did not accurately portray the changing legal boundary, nor did it supersede existing legislative boundary definitions or land ownership interests. The principle of equitable apportionment or equitable division involves retaining direct access for each littoral owner to the shoreline directly across from their upland, so the line of division is made in an east-west division. Based on existing refuge ownership near the northern part of the refuge, this line occurs exactly where the break occurred in February 2013.

The basis for our determination regarding our ambulatory eastern boundary, upheld by both Federal and State law, is that ambulatory boundaries based upon a shoreline erode and accrete with coastal changes, so that where the ocean or mean low water are set as a boundary, the imperceptible daily tides will shift the relative ownership of the land. The Commonwealth of Massachusetts' law of erosion and accretion are in accord. Thus, along the Atlantic Ocean, where the Declaration of Taking uses the mean low water line as the boundary and where the southeastern shoreline has eroded, the refuge has lost land. To the northeast, where the refuge has gained land, the accretions belong to the United States.

Wilderness Designation

On October 23, 1970, Monomoy NWR was afforded additional protection when Public Law 91-504 designated as wilderness most of the land and intertidal areas within the refuge. The wilderness area designation extends to mean low water. Wilderness designation imposes constraints on how lands and waters within the wilderness area can be used. The use of motorized equipment and mechanized transport is not generally allowed in wilderness areas. Motorized boating is allowed in Monomoy's waters because it was an established use when the wilderness designation occurred. Section 5 of Public Law 91-504 provides that wilderness areas shall be administered in accordance with the provisions of the Wilderness Act (Public Law 88-577), and Section 4(d)(1) of that law allows that the use of motorboats, where already established, may be permitted to continue (subject to restrictions deemed desirable).

There were two tracts of land that were excluded from the wilderness areas: Inward Point and Powder Hole. These areas were excluded from the Monomoy Wilderness because they contained summer cottages and other facilities still being used or in private ownership. Except for the light station, these facilities no longer exist, and land title has since transferred to the United Sates for all parcels. The Powder Hole exception also included 4 acres that were owned by the Massachusetts Audubon Society at the time of wilderness designation. This private inholding contained the Monomoy Point Light Station, which was subsequently purchased by the Service and added to the refuge. The law establishing the Monomoy Wilderness identified the two exceptions as approximately 90 and 170 acres, but later Regional Director Richard Griffith more accurately measured them as being 73 acres (Inward Point) and 137 acres (Powder Hole). In 2001, Service surveyors recalculated the size of these areas to 595 acres, as the exclusion areas extend to mean low water. Although these two areas were excluded from the wilderness designation, Congress intended for the

Secretary of the Interior to manage the entire area consistent with the concept of wilderness (House of Representatives, Report No, 91-1441). Due to the dynamic nature of the landscape, the configuration and actual acreage of the Monomoy Wilderness has constantly changed over the past 40 years. Most recently, in 2013 an additional 717 acres in the Nauset/South Beach area attached to the refuge and became part of the wilderness area.

The Monomoy NWR planning team initiated a wilderness review, as required by refuge planning policy, to determine if portions of the refuge (lands and waters in fee title ownership) that were excluded from the original 1970 wilderness designation were suitable for detailed study as wilderness study areas and potentially proposed for designation as a wilderness. Appendix E summarizes the inventory phase of the wilderness review for those portions of Monomoy NWR excluded from the original 1970 wilderness designation. That draft wilderness inventory (appendix E) determined that none of the current non-wilderness portions of South Monomoy excluded from wilderness designation in 1970 yet meet the eligibility criteria for further detailed study as wilderness study areas, as defined by the Wilderness Act, during the 15-year plan period. The refuge will again undergo a wilderness review in 15 years as part of the next planning cycle, at which time wilderness study area designation and the wilderness study and recommendation phases will be reconsidered for the Inward Point and Powder Hole areas. We may also conduct a wilderness review prior to the next planning cycle, should significant new information become available, ecological, or other conditions change, or we identify a need to do so.

Wilderness Character Report

In 2012, Wilderness Fellow Taryn Sudol completed a report, "Wilderness Character Monitoring Report: Monomoy Wilderness" that addresses the five tangible and measurable qualities of wilderness character: untrammeled, natural, undeveloped, solitude or primitive and unconfined recreation, and other features. Since few existing wildernesses actually have the data that extends back to designation for the measurements created at the time of the monitoring report, this initial condition assessment will be the substitute. Baseline conditions must be set as a reference point against which change over time is measured and evaluated. Ideally, all baseline data would have been collected at the time of designation. For the Monomoy Wilderness, the baseline assessment year is FY 2012. With the baseline in place, change can be monitored over time. The discussion below is adapted from Sudol's report (2012). This report can be accessed at the refuge's Web site: *http://www.fws.gov/northeast/monomoy/*.

Refuge at dusk

Ravin Thomasson 2013

Untrammeled
At present, it seems that nearby developments have not trammeled the wilderness' physical processes. Current management techniques result in minimal trammeling and little effort is needed to restore the wilderness' natural systems and to ensure that the most fragile and endangered wildlife persists; if this management success endures, then even less trammeling would occur in the future.

Natural
The main risks to Monomoy's naturalness are the chances of its being overrun with non-native species or having its existing habitats shift or decline due to climate change. Uncharacteristic alterations in sea level, temperature, precipitation, or soil moisture, and frequency and magnitude of storms may cause a distorted landscape that would not have happened absent mankind's effect on global warming.

Undeveloped
Although considerable artifacts and human debris are left, they appear and disappear with the shifting sands and vegetative regrowth. Today, developments and physical structures on Monomoy are limited to management tools (e.g., nest enclosures), signage, and research equipment. Motorized vehicles, mechanical transport, and motorized equipment are precluded from visitor use, and the administrative use of such is only to be permitted during outstanding occurrences and when deemed the minimum necessary. In fact, such use is generally nonexistent due to access issues and the types of activities conducted.

Solitude or Primitive and Unconfined Recreation
Outside the wilderness boundary, commercial and recreational fishing regularly occur along with other coastal activities such as kite surfing. Boat traffic is heavy during the summer; seal tours and fishing boats circulate South Monomoy. Commercial, military, Coast Guard, media, and recreational aircraft sometimes fly low over the Monomoy Wilderness, briefly interrupting a feeling of solitude or isolation. Such solitude is also intruded upon by the view of houses and prominent water towers that sustain the mainland communities.

Other Features
The principal exception is the Monomoy Lighthouse. This 40-foot high, cherry-red tower, alongside the wood-shingled light keeper's house and brick oil shed, stands on one of two excluded portions of the wilderness of South Monomoy.

The Eastern Massachusetts NWR Complex and Staffing

Since the refuge was established, it has been administered as a satellite of the Eastern Massachusetts NWR Complex located in Sudbury, Massachusetts. We use the term refuge complex (complex) to describe two or more individual refuges, typically in the same region of a state or adjoining states, administratively combined under a single refuge manager's responsibility. Present staffing for the complex includes 16 permanent positions, 13 located at the complex headquarters in Sudbury. Monomoy NWR currently has three permanent full-time staff positions: the refuge manager and two wildlife biologists. Seasonal biological technicians, term staff positions, and summer interns vary each year depending on funding. Oversight of the refuge is provided by the project leader of the complex, and staff from the refuge complex regularly assist Monomoy NWR staff throughout the year with the full range of refuge management activities, including biological surveys and monitoring, visitor services activities, construction and maintenance, outreach, and law enforcement. Appendix G shows the staffing chart for Monomoy NWR.

Refuge Funding

Successful implementation of the CCP for each refuge relies on our ability to secure funding, personnel, infrastructure, and other resources to accomplish the actions identified. This includes staffing, maintenance, major construction

projects, and individual resource project management capability, e.g., basic operational expenses such as utilities, office supplies, field supplies, travel, and discretionary biological and visitor services funding that supports shorebird study and management; beach nesting birds' predator and competitor management; northeastern beach tiger beetle research and management, refuge brochures, signage, etc. Most of these projects have been identified as Tier 1 or Tier 2 Projects in the Refuge System's Refuge Operations Needs System database (RONS). Appendix H lists RONS projects and their recurring costs, such as salaries, following the first year, as well as a list of projects in the Service's current Maintenance Management System (MMS) database for the refuge complex. Currently, the MMS database lists $1,195,273 in maintenance needs for Monomoy NWR. This number, however, is outdated and in need of revision.

Monomoy NWR does receive a specific budget allocation annually but, as with staffing, it is insufficient to support the refuge's operations and needs. The complex provides significant support. Funding requests and assistance to Monomoy Refuge are addressed in the same fashion as for the other refuges in the complex. Table 2.21 shows the specific allocation for Monomoy NWR and for the entire refuge complex for fiscal years 2007 to 2013.

Table 2.21. Fiscal Year Funding for Monomoy and Eastern Massachusetts NWR Complex.

Fiscal Year	2007	2008	2009	2010	2011	2012	2013
Base Funding (Operations)							
Monomoy NWR	$274,370	$330,706	$346,343	$360,685	$366,545	$364,713	$354,194
Eastern Mass NWR Complex*	$2,070,809	$2,181,898	$1,919,276	$1,949,686	$2,109,679	$2,077,697	$1,545,974
Project, Temporary, Construction, and Other Funds							
Monomoy NWR	$26,200	$76,200	$1,686,633	$137,538	$93,338	$465,493	$92,811
Eastern Mass NWR Complex*	$2,898,619	$497,465	$4,560,000	$2,022,800	$227,302	$470,289	$895,927
Total Fiscal Year Budget							
Monomoy NWR	$300,570	$406,906	$2,032,976	$498,223	$459,883	$830,206	$447,005
Eastern Mass NWR Complex*	$4,969,428	$2,679,363	$6,479,276	$3,972,486	$2,336,981	$2,547,986	$2,441,901

**All complex budget numbers include Monomoy NWR funds. These numbers include one-time construction projects, land acquisition funds, contributed funds, quarters income, etc.*

The allocation for fiscal year 2014 is expected to be flat or slightly less than previous years due to budget cuts. These numbers include funding of one-time construction projects, funding from the American Recovery and Reinvestment Act (ARRA) for the Monomoy Point Lighthouse and energy projects, income received from donations, quarters, and grants, as well as base funding for operations and maintenance.

Refuge Facilities, Infrastructure, and Maintenance

All refuge facilities currently in use include the refuge headquarters/visitor contact station, the dormitory/maintenance building, and a public restroom, all located on Morris Island. Periodic maintenance of existing facilities is critical to ensure safety and accessibility for refuge staff and visitors. The headquarters and dormitory were renovated in 2002, and ongoing energy efficiency improvements completed in 2010 included two 30-tube (approximately 48 sq. ft.) solar-thermal panels installed on the refuge dormitory, providing up to 10 gallons

of domestic hot water per hour and connected to a tank-type electrical water heater. The public restroom was constructed in 2004 at the refuge headquarters.

The National Weather Service (NWS), an agency within the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) had been co-located with the refuge at the Morris Island administrative complex since 1971; this joint tenancy is expected to continue at least through the plan period. The NWS has two buildings and a parking area in which they conduct their work. A memorandum of understanding guides the dual-use of the Morris Island facilities. The current refuge headquarters and visitor contact station building were actually constructed and occupied as an administrative office for the Environmental Science Services Administration, forerunner to the National Weather Service.

On South Monomoy, refuge structures currently listed on the National Register of Historic Places include a lighthouse, keeper's house, and small oil house built in the early 1800s for the Monomoy Point Light Station. These buildings are currently closed to the public, but it is our intention to open these facilities to local historical tour groups. These buildings require regular maintenance and received major repairs in 2011, but additional repairs can be expected in order to meet safety standards.

This CCP will explore the expansion of current infrastructure or establishing an alternative visitor contact station in the local community to help alleviate the overcrowding that would occur with increased staff.

Right-of-Way

The refuge has 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. Encroachments on the Wikis Way right-of-way will be resolved separately from this planning process.

Findings of Appropriateness and Compatibility Determinations

Chapter 1 describes these two decision processes in detail. When the refuge manager publishes a compatibility determination, it stipulates the required maximum reevaluation dates: 15 years for wildlife-dependent recreational uses and 10 years for other uses. However, the refuge manager may reevaluate the compatibility of any use at any time, in some cases sooner than its mandatory date, or even before the CCP process is complete, if new information reveals unacceptable impacts or incompatibility with refuge purposes. Refer to appendix D for an updated list of compatibility determinations and associated findings of appropriateness for refuge activities for our preferred alternative.

Partnerships

Monomoy NWR has been involved in many partnerships since its establishment in 1944. These would not have been possible without the cooperation of conservation organizations, town and county community leaders, State and Federal agencies, universities, and local elected officials. Those partners continue to be active in land conservation for the common goal of maintaining the aesthetic, cultural, economic, and ecological values of the region for future generations.

Our partnerships continue to expand to include not only groups and individuals interested in land conservation, but also those interested in habitat and species management, recreation and visitor services, and education and public outreach.

These partners include Mass Audubon, with whom we have a cooperative agreement that enables us to combine resources to facilitate monitoring, management, and habitat restoration efforts for piping plovers, least terns, American oystercatchers, and northeastern beach tiger beetles on Nauset/South Beach. For the last 3 years, we have been working with the Conserve Wildlife Foundation of New Jersey to study red knot migration and its regional

significance. The American Oystercatcher Working Group assists us with banding oystercatchers on the refuge and we participate in meetings. We have also worked well with the Town of Chatham, which, in particular, has allowed access to Nauset/South Beach and other lands for red knot research, has engaged us in shellfishing discussions, and has shared aerial photography.

Conservation Organizations:
- American Oystercatcher Working Group
- Cape Cod Stranding Network (International Fund for Animal Welfare)
- Conserve Wildlife Foundation of New Jersey
- Friends of Assabet River NWR
- Friends of Monomoy NWR
- Gulf of Maine Seabird Working Group (GOMSWG)
- Manomet Center for Conservation Sciences
- Mass Audubon
- Northeastern Beach Tiger Beetle Working Group
- Red Knot Working Group
- Seabird Ecological Assessment Network (SEANET)
- Wildcare Rehabilitation Center
- Cape Cod Museum of Natural History
- Student Conservation Association
- Americorps-Cape Cod
- Senior Americorps

Town and County Governments:
- Chatham Department of Health and Environment—Coastal Resources Program
- Chatham Public Schools
- Chatham Department of Public Works
- Chatham Department of Community Development.

Federal and State Agencies:
- Massachusetts Department of Conservation and Recreation, Division of State Parks and Recreation
- Massachusetts Division of Fisheries and Wildlife (MassWildlife)
- Massachusetts Division of Marine Fisheries (MDMF)
- National Marine Fisheries Service (NMFS)
- National Park Service, Cape Cod National Seashore
- USGS Patuxent Wildlife Research Center
- Federal Highway Administration
- National Weather Service

Universities and Other Educational Institutions and Organizations:
- Antioch University New England
- Tufts University School of Veterinary Medicine
- University of Rhode Island
- Clemson University
- University of Massachusetts
- University of Maine
- Provincetown Center for Coastal Studies
- Woods Hole Oceanographic Institute

Friends Group
A revitalized Friends of Monomoy National Wildlife Refuge organization continues to grow after a brief period of inactivity, and supports visitor services and biological activities on the refuge. They have assisted in developing and implementing interpretive programs and tours on the refuge in the past, written grant proposals, and could be invaluable in supporting those priority programs and helping respond to the requests for programs that far exceed the refuge's ability to meet them.

Volunteer Programs
Our active volunteer program involves student interns from all over the country, as well as local residents, clubs, and organizations. Every summer, the refuge hosts volunteer student interns, who are generally college-aged students or recent graduates. Interns spend time assisting with various refuge projects in return for housing and, when funding permits, a small daily living stipend. Their duties include collecting biological data, monitoring public use, leading nature walks and interpretive programs, designing educational displays, writing monitoring plans and grant proposals, greeting the public, and conducting maintenance on refuge equipment and facilities.

Special Use Permits, including Research

Special use permits are issued to individuals, organizations, and agencies requesting the use of refuge facilities or resources beyond what is available to the public; this includes conducting research projects in the refuge. In order to ensure that wildlife disturbance is minimized, special conditions and restrictions are identified for each request. On average, the refuge issues about 12 permits each year, with project periods ranging from 1 day to 1 year, depending on the scope of the request. The refuge manager issues special use permits on a case-by-case basis after determining whether the use is compatible with refuge purposes.

Refuge staff, graduate students, conservation organizations, and others have conducted numerous surveys and studies on the refuge, each covered by a special permit. A sampling of those research efforts is provided in table 2.22. Additional information on these studies can be obtained from refuge headquarters.

Table 2.22. Sample of Special Use Permits for Monomoy NWR Since 2000.

Year(s) Issued	Organization/Permittee	Purpose
2000	Virginia Polytechnic Institute and State University/Jim Fraser	Piping plover study
2000 to 2001	National Park Service, University of Rhode Island, and Massachusetts Audubon Society	Population demographics and spawning densities of the horseshoe crab
Annually	Blair Nikula	International shorebird surveys
2007	University of Massachusetts- Amherst, Entomology Department	Brown-tail moth survey
2007	Cornell University	Nitrogen disposition study
2001 to 2002	Manomet Center for Conservation Sciences	Study of organophosphate levels in night herons
2001–2012	National Marine Fisheries Service	Gray seal population and diet studies
2003 to 2005	I.C.T. Nisbet and Company Scientific Consulting	Follow-up studies to investigate effects of Buzzard's Bay oil spill on common terns nesting on Monomoy NWR
2008	Provincetown Center for Coastal Studies	Photo identification of individual gray seals and harbor seals on South Monomoy
2007	Antioch University	Roseate and common tern use of staging sites during the post-breeding period
2005	Town of Chatham	Investigation on impacts of commercial shellfishing within refuge boundary on shorebirds

Mosquito Management
The refuge lies within the jurisdiction of the Cape Cod Mosquito Control Project. The CCMCP has conducted mosquito control activities on Morris Island (both on and off-refuge) since the CCMCP was organized in 1930. Mosquito and arbovirus

surveillance, monitoring, and treatment within the refuge historically focused on several small saltwater wetland areas on Morris Island harboring *Ochlerotatus cantator* and *O. sollicitans*, "bridge vectors" for West Nile virus transmission to humans. The CCMCP controlled larval mosquitoes in these small pools from at least 1983 until August 2001, when the practice was suspended pending review of the Service's new compatibility process. In July 2003, the Service found mosquito surveillance and limited mosquito control to be compatible, and the CCMCP resumed surveillance and larvicidal mosquito control of select mosquito species.

The refuge has worked with the CCMCP to reduce the quantity of insecticides used on refuge lands and ensure activities are consistent with the Service's policies. Mosquito management is a complicated issue for the refuge. Monomoy NWR is adjacent to residential beach communities where nuisance issues are amplified. The control of mosquitoes is a State priority and a reality of management of salt marshes in Massachusetts, and on the refuge as well. Pesticide treatment is not be used on Monomoy NWR solely for nuisance mosquito relief, and is only considered when there is a demonstrated human or wildlife health risk. Only pesticides identified in the special use permit and for which a pesticide use proposal has been submitted and approved are used on the refuge. Two types of treatment historically employed to control refuge mosquito populations within salt marsh habitats are larvicide (*Bacillus thuringiensis* var. *israelensis* (Bti) and Aquabac) and pupacide (Agnique). No adulticides have been used in recent decades.

West Nile virus was first detected in birds, mosquitoes, and humans in Barnstable County in 2003. West Nile virus was detected in mosquito pools in 2003 to 2006 (Towns of Falmouth and Barnstable) and 2008 to 2009 (Towns of Barnstable and Bourne). West Nile virus was detected in dead birds (primarily corvids) in Barnstable County in 2005 (three positive samples, including one from Harwich) and 2006 (nine positive samples, including two each from Dennis and Brewster) before testing of dead birds was discontinued in 2009. Two human West Nile virus cases were documented in the Town of Barnstable, one case in 2003 and another in 2007. There have been no human West Nile virus cases documented for Chatham or surrounding communities (Harwich, Dennis, Brewster, or Orleans). West Nile virus has not yet been detected in humans, dead birds, or mosquito pools in Chatham.

Periodic outbreaks of eastern equine encephalitis virus, with an epicenter in southeastern Massachusetts just west of Cape Cod, are also documented. The majority of human eastern equine encephalitis virus cases have occurred in Norfolk, Bristol, and Plymouth counties, although some cases are documented for Middlesex County, Essex County, and as far west as Worcester County. Although the historic eastern equine encephalitis virus epicenter lies just to the north and west, Cape Cod and the islands (Martha's Vineyard and Nantucket) have no documented human eastern equine encephalitis cases or deaths. During 2012, eastern equine encephalitis virus was isolated for the first time in the mid- to lower-Cape region from mosquitos captured adjacent to Nickerson State Park in Brewster, but there are no eastern equine encephalitis virus occurrence records yet from Chatham or Harwich.

Hooded merganser

Tim McCabe

Larvicide treatments to reduce the threat of human transmission of West Nile virus were applied annually to select Morris Island wetland areas along the refuge boundary from May to October, after monitoring

Peter Paton 2013/University of Rhode Island

Tern colony

indicated *O. cantator* and *O. sollicitans* larval counts exceeded an average of 5 larvae per standard (350 ml) dipper.

Pupacides are only used when large numbers of mosquitoes are considered an immediate threat to human health and thresholds developed by the appropriate public health authority are exceeded, such as when there is active transmission of mosquito-borne disease from refuge-based mosquitos or within flight range of vector mosquito species present on the refuge.

Adulticide treatments have not been applied on or near Monomoy NWR in recent decades, but were applied just west of Cape Cod during 2006, 2010, and 2012. In August 2006, an eastern equine encephalitis virus outbreak prompted the Governor to declare a public health emergency for Plymouth and Bristol Counties, well west of Chatham. Aerial spraying of adulticides was used for the first time in 16 years. In August 2010, the Massachusetts Commissioner of Public Health issued a certificate of public health hazard due to the high risk of eastern equine encephalitis virus transmissions to humans for this same area; this again prompted aerial spraying of the adulticide sumithrin. In 2012 the same general area was treated with adulticides due to a high risk of eastern equine encephalitis virus transmission. For additional details on the refuge's mosquito management program, refer to the Mosquito Control Compatibility Determination in appendix D.

Chapter 3

USFWS

Beach habitat on the refuge

Alternatives Considered, Including the Service-preferred Alternative

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

Introduction

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

Formulating Alternatives

Relating Goals, Objectives, and Strategies

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

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

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

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

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

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

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

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

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

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

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

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

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

Actions Common to All Alternatives

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

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

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

Conducting Resource Management and Public Use Activities Consistent with Wilderness Principles

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

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

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

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

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

Conducting a Wilderness Review

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

Wilderness Inventory Phase

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

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

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

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

Wilderness Study and Recommendation Phases

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

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American black duck duckling

In the study phase, a range of management alternatives are evaluated to determine if a WSA is suitable for wilderness designation or management under an alternate set of goals and objectives that do not include wilderness designation. The recommendation phase consists of forwarding or reporting the suitable recommendations from the Director through the Secretary and the President to Congress in a wilderness study report. The wilderness study report is prepared after the record of decision for the final CCP has been signed. Areas recommended for designation are managed to maintain wilderness character in accordance with management goals, objectives, and strategies outlined in the final CCP until Congress makes a decision or the CCP is amended to modify or remove the wilderness proposal.

Adaptive Management

All the alternatives will employ an adaptive management approach for improving resource management based on what is learned from management outcomes. In 2007, Secretary of the Interior Kempthorne issued Secretarial Order No. 3270 to provide guidance on policy and procedures for implementing adaptive management in departmental agencies. In response to that order, an intradepartmental working group developed a technical guidebook to assist managers and practitioners: "Adaptive Management: The U.S. Department of Interior, Technical Guide." It defines adaptive management, the conditions under which we should consider it, the process for implementing it in a structured framework, and evaluating its effectiveness (Williams et al. 2009). You may view the guidebook at *http://www.doi.gov/initiatives/AdaptiveManagement/documents.html* (accessed August 2011).

The guidebook provides the following operational definition for adaptive management:

> *"Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance*

> *of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social and economic goals, increase scientific knowledge, and reduces tensions among stakeholders."*

This definition gives special emphasis to the uncertainty about management impacts, iterative learning to reduce uncertainty, and improved management as a result of learning. At the refuge level, monitoring management actions and outcomes, and key resources, will be very important to implementing an adaptive management process. Our threatened and endangered species, migratory birds, wildlife habitat management, and wilderness stewardship activities are examples of refuge programs or activities in which an adaptive management approach may already be implemented or will be in the near future.

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

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

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

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

Strategic Habitat Conservation

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

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

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

Monitoring and Abating Wildlife and Plant Diseases

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

(1) Manage wildlife populations and habitats to minimize the likelihood of the contraction and contagion of disease.

(2) Provide for the early detection and identification of disease mortality when it occurs.

(3) Minimize the losses of wildlife from outbreaks of disease.

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

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

Monomoy National Wildlife Refuge shore

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

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

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

These are the general strategies for preventing or controlling disease:

(1) Continue to conduct disease surveillance in conjunction with other fieldwork.

(2) Cooperate with State agencies, particularly MassWildlife, and Tufts University by providing access for sampling and following protocols in the event of an outbreak.

(3) Inform volunteers and others who work in the field about the dangers of Lyme disease and measures to avoid contracting it.

(4) Monitor habitats for indicators of the increased occurrence of pests or disease. For example, note changes in flowering or fruiting phenology that do not appear to be linked to global climate change, physical damage, decay, weakening, or sudden death, particularly of major host species; also note changes in wildlife use of habitats, such as the absence of breeding birds that used to appear regularly.

(5) Follow the protocols in national, State, and refuge disease prevention and control plans.

Biological and Ecological Research and Investigations

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

(1) To promote new information and improve the basis for, and quality of, refuge and other Service management decisions.

(2) To expand the body of scientific knowledge about fish and wildlife, their habitats, the use of these resources, appropriate resource management, and the environment in general.

(3) To provide the opportunity for students and others to learn the principles of field research.

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

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

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

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

Controlling Pest Plants and Animals

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

Integrated Pest Management

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

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

Managing Invasive Species

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

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

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

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

(1) Manage invasive species on refuges under the guidance of the National Strategy for Management of Invasive Species and within the context of applicable policy.

(2) Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function, and to prevent new and expanded infestations of invasive species.

(3) Evaluate native habitat management activities with respect to their potential to accidentally introduce or increase the spread of invasive species, and modify our habitat management operations to prevent increasing invasive species populations.

(4) Conduct refuge habitat management (including working through partners) to prevent, control, or eradicate invasive species using techniques described through an integrated pest management plan or other similar management plan that comprehensively evaluates all potential integrated management options, including defining threshold/risk levels that will initiate implementing proposed management actions.

(5) Ensure refuge IPM planning addresses the abilities and limitations of potential control techniques, including chemical, biological, mechanical, and cultural techniques.

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

(1) Treat the most problematic species as funding and staffing permit, in accordance with the selected alternative.

(2) Develop early-detection/early-response readiness regarding new invasions.

(3) Remove the parent sources of highly invasive species (e.g., species that are high seed producers or vigorous rhizome producers).

(4) Maintain accessibility to affected areas for control and monitoring, if possible.

(5) Subject any treatments within the Monomoy Wilderness to a MRA.

Addressing the Threats of Accelerating Sea Level Rise and Climate Change

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

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

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

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

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

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

Volunteer Opportunities and Partnerships

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

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

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

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

Refuge Staffing and Administration, Including Boundary Issues

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

Permanent Staffing and Operational Budgets

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

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

Service employees at the refuge

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

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

Facilities Construction and Maintenance

All the alternatives include the periodic maintenance and renovation of existing facilities to ensure the safety of and accessibility for staff and visitors. Our current facilities are described in chapter 2. They include refuge headquarters/visitor contact station, the dormitory and maintenance buildings, and the Monomoy Point Light Station. Visitor facilities to be maintained under all alternatives include these buildings as well as the headquarters parking lot, the Stage Island parking area, the ¾-mile Morris Island Trail, signs, stairs, overlooks, and moorings. Any new facilities recommended in the final CCP, once constructed, would be placed on the maintenance schedule. All maintenance and upgrades of facilities would incorporate ecologically beneficial and energy-efficient technologies, tools, materials, and practices.

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

Refuge Operating Hours

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

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

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

Access or Right-of-Way (340 FW 3)
The refuge will use and maintain its existing rights-of-way on Tisquantum Road, Wikis Way, and Stage Island Road to access its properties for refuge resource management, public use, and visitor access. At high tide, the refuge shoreline on Morris Island can be inaccessible for most visitors, limiting them to accessing refuge lands and trails via the Tisquauntum Road right-of-way. Refuge staff will work diligently to ensure that adequate signs are in place so visitors can find the trailhead while minimizing disturbance to neighbors. Refuge staff will work with the Quitnesset homeowners association to improve the potentially confusing signs at the Quitnesset entrance, where the public roadway ends and becomes a public right-of-way (easement) over private roadways.

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

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

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

Distributing Refuge Revenue Sharing Payments

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

Completing Step-down Management Plans

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

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

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

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

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

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

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

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

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

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

Visitor Services Plan

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

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

Wilderness Stewardship Plan

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

(1) The WSP will clearly show the strategies and actions we will use and implement to preserve the wilderness resource, and show the linkage between those strategies and actions and the wilderness goals and objectives identified in the CCP.

(2) The WSP will contain indicators, standards, conditions, or thresholds that define adverse impacts on wilderness character and values and that will trigger stewardship actions to reduce or prevent those impacts. The "Wilderness Character Monitoring Report: Monomoy Wilderness" (Sudol 2012) provides the basis for this WSP component. This document is located on the refuge's Web site.

(3) The WSP will describe ongoing and needed monitoring and research, appropriate and compatible uses and associated determinations, and minimum requirement analyses for refuge management activities and commercial services within the Monomoy Wilderness.

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

Protecting Cultural Resources

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

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

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

Alternative Energy Projects

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

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

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

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

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

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

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

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

(1) Promotes safety of participants, other visitors, and facilities.

(2) Promotes compliance with applicable laws and regulations and responsible behavior.

(3) Minimizes or eliminates conflict with fish and wildlife population or habitat goals or objectives in an approved plan.

(4) Minimizes or eliminates conflicts with other compatible wildlife-dependent recreation.

(5) Minimizes conflicts with neighboring landowners.

(6) Promotes accessibility and availability to a broad spectrum of the American people.

(7) Promotes resource stewardship and conservation.

(8) Promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources.

(9) Provides reliable/reasonable opportunities to experience wildlife.

(10) Uses facilities that are accessible to people and blend into the natural setting.

(11) Uses visitor satisfaction to help define and evaluate programs.

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

Appropriateness and Compatibility Determinations

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

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

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

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

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

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

Activities Not Allowed (Uses the Refuge is Officially Closed to)
All areas included in the National Wildlife Refuge System are closed to public access until and unless we open the area for a use or uses in accordance with the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee) and the Refuge Recreation Act of 1962 (16 U.S.C. § 460k-460k-4). Under all three alternatives, the refuge will remain closed to all forms of hunting except waterfowl hunting. The existing deer and small mammal populations are not large enough to sustain a hunt program or the administrative burden of managing such a program.

Bill Thompson/USFWS
Pied billed grebe

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 appendix D we propose the following uses as not appropriate on refuge lands: horseshoe crab harvesting, including within the submerged lands and waters within the Declaration of Taking boundary (refer to the 2002 Horseshoe Crab Harvesting Compatibility Determination); fisheries harvest using bottom disturbing gear and techniques on submerged lands; mussel harvesting; camping; fires; fireworks; bicycling; dog walking; beach use activities such as beach sports, kite flying, grilling, and use of shade tents; organized picnicking; boat mooring, kite boarding, and motorized personal watercraft (e.g., wave runner and jet skis) in refuge waters within the Declaration of Taking boundary; and over-sand vehicles (OSV). We will also phase out dinghy storage on both Morris and Stage Islands and parking in Stage Island Lot 7b under all three alternatives. Appendix D documents the refuge manager's justification for why these are deemed not appropriate. Most of the activities are sufficiently provided for on other nearby ownerships, so the lack of access on the refuge does not eliminate the opportunity.

Special Use Permits

All the alternatives require the refuge manager to evaluate activities that require a special use permit for their appropriateness and compatibility on a case-by-case basis. All research, commercial, and economic uses require special use permits. We will only approve permit requests that are compatible, with the preference being for activities that benefit the refuge or the Refuge System, are manageable by refuge staff, and are consistent with the Wilderness Act if the activity is proposed within designated wilderness.

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

(1) "Refuge management economic uses" that are conducted by the Service or an authorized person or entity to fulfill a refuge purpose or the Refuge System mission.

(2) Other sorts of economic uses conducted by private parties (e.g., commercial guiding to facilitate wildlife-dependent recreation).

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

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

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

Mosquito Management

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

control salt marsh mosquitoes has been issued annually since at least 1983 (2003 Compatibility Determination for Mosquito Control). Monitoring of mosquitoes is required so that larvicidal applications are only conducted when a threshold population size is reached. The two species that are controlled through larvicides are also bridge vectors for mosquito-borne diseases such as West Nile virus and eastern equine encephalitis (EEE). Recent monitoring (CO_2 light trap) by CCMCP of several mosquito species known as human disease vectors collected from the Morris Island area has not revealed any instances of mosquitoes infected with these human transmissible diseases, although EEE was detected in mosquitoes from nearby Brewster during 2012 mosquito monitoring.

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

Additional NEPA Analysis

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

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

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

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

Actions Common to Alternatives B and C Only

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

Proposed Land Acquisition

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

Visitor Services

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

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

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

Waterfowl Hunting

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

New Visitor Contact Facility

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

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

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

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

Alternatives or Actions Considered but Eliminated From Further Study

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

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

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

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

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

Close the Refuge to Clamming

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

Discontinue Predator Management Program

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

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

Allow Horseshoe Crab Harvesting

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

Install a Wind Turbine at Monomoy Point Light Station

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

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

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

Shoreline at Monomoy

Gary M. Stolz/USFWS

Alternative A. Current Management (No Action Alternative)

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

Habitat and Population Management

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

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

Inventories and Monitoring

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

Visitor Services

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

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

Wilderness Management

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

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

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

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

Refuge Administration

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

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

REFUGE GOAL 1: **Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.**

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

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

Rationale

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Strategies

Continue to:

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

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

Monitoring Elements

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

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

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

Rationale

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

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

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

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

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

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

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

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

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

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

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

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

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

Strategies

Continue to:

- Use temporary symbolic fencing to seasonally close all suitable piping plover habitat that is located in areas vulnerable to human disturbance regardless of the presence of pairs by April 1; this may happen earlier if weather allows.

- Use temporary symbolic fencing to seasonally close additional areas that contain breeding piping plovers (May) as nesting or courtship behaviors are observed; maintain these areas as closed until at least July 1, if no nesting has occurred, or until all chicks have fledged (fencing would be removed as staff time allows once these criteria are met).

- Patrol and enforce closed areas during the nesting season.

- Use temporary predator exclosures on piping plover nests that are located in sparsely vegetated areas with nothing obstructing the view of the bird or inhibiting the bird's ability to detect predators.

- Minimize impacts of avian and mammalian predators to nesting plovers through non-lethal and lethal management as described in appendix J.

- Strengthen partnerships to manage lands adjacent to the refuge to ensure the success and survival of piping plovers in the surrounding area and create a larger area of continuous protection.

- Participate in partner-based, high priority, landscape-level piping plover research, which may include resighting banded adults or collecting unhatched eggs for DNA analysis.

- Review 5-year reviews and recovery plan updates for piping plovers within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.

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

Monitoring Elements

- Monitor piping plovers throughout the nesting season to include nest searches in traditional piping plover nesting areas beginning in mid-March; nest visits to monitor and record dates of laying, hatching, or failure, and cause of failure; and chick searches to determine survival or first observed flight (Blodget and Melvin 1996).

- Conduct the piping plover census during the Massachusetts Statewide census window (currently June 1 to 9) and collect spatial data of nest locations to document changes in habitat selection and site fidelity from year to year.

- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings); quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.

- Resight banded adults to contribute to metapopulation studies and determine whether piping plovers nesting on Monomoy refuge wintered or migrated through the Gulf of Mexico after the Deepwater Horizon oil spill.

- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of nesting habitat.

- Update the cover-type map refugewide every 5 to 10 years.

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

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

Rationale

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

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

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

USFWS

American oystercatcher

Until recently, population estimates for American oystercatchers in the United States focused on the Atlantic coast and were compiled from multiple survey efforts, including state breeding surveys and coordinated boat surveys of roost sites. Both types of estimates may have undercounted birds. During the 2002 to 2003 nonbreeding season, the Manomet Center for Conservation Sciences conducted an aerial survey in cooperation with members of the American Oystercatcher Working Group, of which Monomoy refuge is a part. The survey covered the Atlantic and Gulf coasts, and encompassed the entire winter range of the eastern race of American oystercatcher in the United States. The survey resulted in a population estimate of 10,971298± individuals, with 8,500 wintering on the Atlantic coast (Brown et al. 2005). While this aerial survey provided a reliable population estimate at a single point in time, tracking and projecting population trends is more complex and requires a better understanding of the population dynamics of the species. Current information on population trends comes primarily from state and local surveys, which often vary in methodology and coverage. Although survey data show that oystercatchers are continuing their range expansion in the Northeast (Nol et al. 2000), numbers are declining in core mid-Atlantic breeding areas (Mawhinney and Bennedict 1999, Davis et al. 2001).

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

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

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

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

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

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

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

Strategies

Continue to:

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

- Use temporary symbolic fencing to seasonally close additional areas that contain breeding American oystercatchers (May) as nesting or courtship behaviors are observed; maintain these areas as closed until August 1 if the areas remain unused, or until all chicks have fledged.

- Patrol and enforce closed areas during the nesting season.

- Participate in a landscape-level color-banding effort through the American Oystercatcher Working Group to improve productivity estimates on the refuge and contribute to a rangewide understanding of survival, movement, and dispersal, which are critical to understanding and predicting population trends at multiple spatial scales.

- Use temporary solar-powered electric fence in suitable nesting habitat to protect American oystercatchers from mammalian predators.

- Experiment with the use of temporary non-electrified fencing to reduce mammalian depredation.

- Explore the effectiveness of temporary nesting platforms for American oystercatchers to reduce nest loss due to overwash.

- Minimize impacts of avian and mammalian predators to nesting American oystercatchers through non-lethal and lethal management as described in appendix J.

- Strengthen partnerships with Mass Audubon's Coastal Waterbird Program and the Town of Chatham to manage lands adjacent to the refuge to ensure the success and survival of American oystercatchers in the surrounding area and create a larger area of continuous protection.

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

Monitoring Elements

- Monitor American oystercatcher productivity throughout the nesting season by searching nesting areas 1 to 2 times per week beginning in early April to document nest locations, laying, hatching, nest failure or success, and overall productivity.

- Conduct the American oystercatcher census during the Massachusetts Statewide census window (currently May 22 to 31).

- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings); quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.

- Deploy temporary field cameras with digital video recorders near American oystercatcher nests to monitor disturbance, predator activities, and cause of nest loss.

- Resight and report banded adults during migration and staging periods to contribute to metapopulation studies coordinated through the American Oystercatcher Working Group and better understand Monomoy NWR's importance during migration and staging.

Objective A1.4 (Beach Shoreline—Least Tern)

Continue to protect nesting least terns from disturbance.

Rationale

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

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

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

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

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

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

Strategies

Continue to:

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

Monitoring Elements

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

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

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

Rationale

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

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

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

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

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

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

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

Strategies

Continue to:

- Maintain vehicle closures on refuge lands to protect habitat and allow for continued population growth. Cooperate with the Town of Chatham, State of Massachusetts, U.S. Coast Guard, and other partners involved in emergency and public safety operations to protect tiger beetles and habitat when vehicle access is deemed essential to protect human life; this includes increased monitoring when vehicles are present to minimize habitat degradation and mortality by over-sand vehicles.

- Regularly inform and communicate with officials and the public about areas occupied by tiger beetles on the refuge, including Nauset/South Beach, to foster continued support for protection and monitoring of tiger beetles currently using these areas and to allow for continued expansion of spatial distribution.

- Review 5-year reviews and recovery plan updates for northeastern beach tiger beetles within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.

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

Monitoring Elements

- Conduct seven to eight adult beetle activity sampling occasions distributed evenly across the late June to late August period (Kapitulik and Smith 2010); during these visits, perform low intensity mark and resight efforts to estimate the population and calculate survival probability.

- Conduct larval activity site visits in the late September and early October peak period, to measure reproductive success and delineate larval habitat.

- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of spawning habitat.

- Update a cover-type map refugewide every 5 to 10 years.

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

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

Rationale

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

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

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

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

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

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

Strategies
Continue to:

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

Monitoring Elements

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

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

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

Rationale
Staging Terns
Intertidal areas on Cape Cod are extremely important for post-breeding staging common and roseate terns. Researchers have documented a dramatic decline in roseate tern populations since 2000, but not common terns, and this decline has occurred despite intensive management efforts at major colony sites and no apparent major change in either roseate tern adult survival or productivity (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, Schauroth 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

USFWS
Roseate tern

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

Migrating and Staging Shorebirds

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

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

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

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

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

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

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

Bill Thompson/USFWS

Red knot with geolocator

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

Horseshoe Crabs

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

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

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

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

	Number Sampled	With Eggs
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 2011 personal communication) including killifish species (Finley 2011 personal communication) such as striped killifish, eel species such as American eel (Warwell 1897, deSylva et al. 1962), weakfish, northern kingfish, Atlantic silverside, summer flounder, winter flounder (deSylva et al. 1962, Penn and Brockman 1994), striped bass (Martin 1974), and white perch (Shuster Jr. 1982). Observations of other fauna feeding on horseshoe crab eggs, hatchlings, and adults include sand shrimp (Price 1962), eight mollusk species (Perry 1940, as in Shuster Jr. 1982), fiddler crabs (Shuster Jr. 1958 as in Shuster Jr. 1982), blue crab, green crab, spider crab in Barnstable Harbor, Massachusetts (Shuster Jr. 1958 as in Shuster Jr. 1982), devil ray, (Teale 1945 as cited in Shuster Jr. 1982),

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

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

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

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

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

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

Seals

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

Strategies

Continue to:

- Use temporary symbolic fencing to maintain seasonal closures in portions of intertidal mudflats (that are generally established for nesting species) to reduce disturbance to staging and migrating birds. Map 2.7 depicts closure areas implemented in 2012. Closed area and length of season may vary from year to year based on wildlife use and habitat changes.

- Work with partners to determine the relative importance of tern staging sites on Cape Cod, identify problematic disturbances, and develop solutions to minimize disturbances.

USFWS

Seals on South Monomoy Island

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

Monitoring Elements

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

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

Objective A1.8 (Salt Marsh)

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

Rationale

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

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

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

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

One threat to saltmarsh sparrow productivity, especially in places like Monomoy Refuge where the patch size does not restrict habitat, is flooding. Flooding, particularly during new moon tides, is the primary cause of nest failure for the saltmarsh sparrows, which are synchronized to nest immediately after a new moon tide. Vegetation structure and composition are less important in predicting nest success. Females wedge or suspend a nest in medium-high cordgrass just above the substrate or water near the mean high-tide line (Greenlaw and Rising 1994).

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

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

Strategies

Continue to:

- Use temporary symbolic fencing to seasonally close most salt marsh habitat on North Monomoy Island from April to September to minimize trampling of vegetation and invertebrates and minimize disturbance to nesting saltmarsh sparrows and American oystercatchers.

- Support partner efforts to investigate impacts of mercury on saltmarsh sparrows and natural processes that affect mercury speciation and bioavailability.

- Support partner efforts to investigate the hybridization of saltmarsh sparrows and how it affects the population fitness of saltmarsh sparrows and Nelson's sparrows.

- Support partner efforts to investigate changes in tidal marsh bird populations on the Refuge and in eastern Massachusetts by comparing current surveys to historical data.

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

Monitoring Elements

- Conduct annual census and monitor productivity of American oystercatchers as identified in alternative A, objective A1.3.

- Analyze saltmarsh sparrow survey data from previous years to determine population trends and inform future management and inventory needs.

- Update a cover-type map refugewide every 5 to 10 years.

Objective A1.9 (Nearshore Marine Open Water)

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

Rationale

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

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

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

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

Strategies

Continue to:

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

- Support partner efforts to assess distribution and genetic diversity of eelgrass across the region and test it against an experimental factorial design of potential stress parameters.

- Support partner efforts (New England Aquarium and Mass Audubon) to rescue stranded sea turtles and to collect for scientific research dead sea turtles recovered from refuge waters.

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

Monitoring Elements

- Monitor the impact of aquaculture activities initiated within refuge waters, if any.

- Monitor the impacts of dredging projects on subtidal areas within the refuge boundary; this may involve pre-and post-dredging monitoring of substrates, SAV, or benthic communities.

- Conduct opportunistic surveillance year-round to detect field mortality events of marine wildlife, including sea turtles and sea ducks; document observations of sick or dying birds and turtles, and identify, collect, and submit these for analysis at the National Wildlife Health Center in collaboration with the Region 5 Migratory Birds Office and Mass Audubon Sea Turtle Stranding Office.

- Update bathymetry maps refugewide every 5 to 10 years.

REFUGE GOAL 2: **Provide the public with wildlife-dependent recreational, interpretive, and environmental educational opportunities to enhance awareness and appreciation of refuge resources and to promote stewardship of the wildlife and habitats of Monomoy NWR.**

Objective A2.1 (Access and Use)

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

Rationale

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

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

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

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

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

Strategies

Continue to:

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

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

Monitoring Elements

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

Objective A2.2 (Interpretation)

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

Rationale

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

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

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

Strategies

Continue to:

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

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

USFWS

Driftwood on the beach

Monitoring Elements

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

Objective A2.3 (Environmental Education)

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

Rationale

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

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

Strategies
Continue to:
- Host school field trips as requested, as timing and resources allow.

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

Objective A2.4 (Wildlife Observation and Photography)

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

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

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

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

Strategies
Continue to:

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

Monitoring Elements

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

Objective A2.5 (Fishing)

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

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

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

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

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

Strategies
Continue to:

- Allow fin fishing from all refuge lands otherwise open to public use, from ½ hour before sunrise to ½ hour after sunset, in accordance with Massachusetts and Federal regulations, including possessing a saltwater or freshwater fishing license recognized by the Commonwealth of Massachusetts.

- Allow fishing in the open waters, above submerged lands, under State and Federal regulations. Included fishing activities are: demersal long line fishing; mid-water trawl fishing, hook and line/rod and reel fishing; lobster, crab, and whelk pot fishing; and hand-harvest of scallops.

- Allow anglers to fish on Morris Island 24 hours per day in accordance with all Federal and State fishing regulations.

- Allow freshwater fishing in the ponds on South Monomoy during daylight hours.

- Allow commercial fishing guides to conduct fin fishing on the refuge in areas that are open to fishing in accordance with State seasons.

Monitoring Elements

- Estimate the number of fin fishing visits to the refuge.

- Track the number of fishing license violations on the refuge.

Objective A2.6 (Shellfishing)

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

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

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

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

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

Strategies
Continue to:

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

Monitoring Elements

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

REFUGE GOAL 3: **Communicate and collaborate with local communities, Federal and state agencies, and conservation organizations to promote natural resource conservation and to support the goals of the refuge and the mission of the U.S. Fish and Wildlife Service.**

Objective A3.1 (Public Outreach)

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

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

Strategies
Continue to:

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

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

Monitoring Elements

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

Objective A3.2 (Community Support)

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

Rationale

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

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

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

Strategies

Continue to:

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

Monitoring Elements

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

REFUGE GOAL 4: **Ensure that the spirit and character of the Monomoy Wilderness are preserved.**

Objective A4.1 (Wilderness Implementation and Designation)

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

Rationale

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

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

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

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

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

Strategies

Continue to:

- Manage the existing Monomoy Wilderness for naturalness, wildness, and outstanding opportunities for solitude or primitive and unconfined recreation by conducting refuge management operations and visitor uses in a manner that protects wilderness character.

- Continue managing the Inward Point and Powder Hole inventory areas to maintain or enhance their size, naturalness, and opportunities for solitude or primitive and unconfined recreation throughout the 15-year plan period, to the extent that it will not prevent fulfilling refuge establishment purposes or the Refuge System mission (610 FW).

- Use the appropriate response to unplanned wildfire ignitions that provides for public and firefighter safety while recognizing periodic fire as a natural process with long-term benefits to an enduring wilderness resource.

- Where fire exclusion or other man-caused alterations of natural coastal processes have led to unnatural wildland fuel and vegetation conditions, apply prescribed fire to restore a more natural fire regime or migratory bird or endangered/threatened species habitat conditions within the Monomoy Wilderness.

- Maintain wilderness boundary signs at three locations (two boat landings and on Nauset/South Beach).

- Implement management activities that involve temporary rather than permanent uses or site occupancy, create no new surface disturbance, do not involve placement of permanent structures or installations (e.g., temporary symbolic fencing), or use motorized equipment or mechanized transport unless it is the minimum tool possible.

- Provide refuge staff with wilderness stewardship training appropriate for their positions.

- Review all activities proposed within the Monomoy Wilderness and the Inward Point and Powder Hole inventory areas, and ensure they are consistent with wilderness management using the minimum requirements analysis process presented under Actions Common to All Alternatives.

- Review and implement actions recommended in the Wilderness Character Report (Untrammeled; Undeveloped; Natural; Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation; and Other Features/Unique Attributes) within the Monomoy Wilderness.

Monitoring Elements

- Maintain a listing of completed minimum requirement analyses for the refuge.

- Record the number of staff receiving wilderness orientation and number of training records for all refuge staff, volunteers, and interns.

REFUGE GOAL 5: **Protect cultural resources that exist on the refuge.**

Objective A5.1 (Archaeological Resources and Historic Structures)

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

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

Strategies
Continue to:

- Comply with section 106 of the National Historic Preservation Act prior to conducting any ground-disturbing activities on the refuge; compliance may entail any combination of state historic preservation officer/tribal historic preservation officer consultation, literature survey, or field survey.

- Identify, evaluate, and conduct archaeological evaluations, with subsurface testing as necessary, for any project where ground-altering activity is proposed.

- Enforce all Federal cultural resource protection laws and regulations including the necessary provisions of Archaeological Resources Preservation Act to protect cultural resources on the refuge.

- Conduct structural and basic maintenance on the Monomoy Point Light Station to comply with historic preservation standards.

- Develop and implement throughout the plan period a historic site management plan for the Monomoy Point Light Station structures and associated archaeological structures following National Historic Preservation Act sections 106 and 110 and 36 CFR Part 800 collaborative procedures that provide for systematic mitigation over time of the adverse effects from natural weathering, erosion, and decay processes.

Monitoring Elements

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

REFUGE GOAL 6: **Develop and maintain a diverse and inclusive workplace with sufficient resources, including infrastructure and equipment, to work productively toward fulfilling the refuge mission.**

Objective A6.1 (Staffing)

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

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

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

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

(1) Highlight diversity as a core value.

(2) Establish partnerships, sources, and feeder systems.

(3) Recruit and hire a diverse and highly skilled workforce.

(4) Maintain a highly skilled diverse workforce through talent management.

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

Strategies
Continue to:

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

Objective A6.2 (Facilities and Maintenance)

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

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

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

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

Strategies

Continue to:

- Maintain the headquarters and visitor contact station, dormitory and maintenance buildings, and Monomoy Point Light Station to provide a safe working and living environment for refuge staff and volunteers.

- Work with the National Weather Service and maintain a memorandum of understanding with them for use of Service-owned land on Morris Island. Should the National Weather Service at any point decide to relocate their existing operation, the refuge would look into re-utilizing the current National Weather Service buildings and space/site use at the Morris Island site.

- Maintain a fleet of three highway vehicles and three outboard motor boats that provide safe and efficient transport to North Monomoy Island, South Monomoy, Minimoy Island, and offsite locations for resource management and administrative work; replace boats and motors as necessary to maintain a functional fleet.

- Develop potential partnership with the Town of Chatham or U.S. Coast Guard to establish new docks, covered boat storage, and maintenance with secure marine equipment storage and additional parking.

Objective A6.3 (Energy Efficiency)

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

Rationale

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

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

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

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

Strategies

Continue to:

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

Monitoring Elements

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

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

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

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

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

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

Habitat and Population Management

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

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

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

Inventories and Monitoring

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

Visitor Services

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

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

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

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

Wilderness Management

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

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

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

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

Cultural Resources

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

Refuge Administration

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

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

REFUGE GOAL 1: **Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.**

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

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

Rationale

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

Since the reestablishment of a productive common tern colony on Monomoy refuge in the late 1990s, this site has been one of the most important sites in the State, and in some years has provided nesting habitat for more than 50 percent of the State's total population. The increase of nesting common terns in the first few years following the start of the reestablishment project was concomitant with a decline in the number of nesting common terns at Plymouth Beach (USFWS 2000, Blodget 1999). Birds nesting at Plymouth Beach had been subjected to predator pressures prior to abandoning that site and moving to Monomoy NWR, suggesting that, at the time, Monomoy NWR was more appealing to prospecting terns. Common terns were successfully nesting at Monomoy NWR, and as predator pressures remained unresolved at Plymouth Beach, many terns continued to return to Monomoy NWR to nest in future years, attracting more common terns each year. For several years Monomoy NWR had also hosted an increasing number of roseate terns (USFWS 2000). However, the increasing terns were generally nesting in a similar sized area in successive years, although the shape of the nesting colony changed somewhat. Impacts of increased nesting density were not specifically studied, but anecdotal observations suggested increased neighbor aggression and disturbance among common terns. In addition, increased aggression was seen between common and roseate terns, and this may have contributed to the decline in roseate tern numbers and their eventual relocation to Minimoy Island (although predation by great horned owl likely also contributed to this shift) (USFWS 2007a). Storm overwash and erosion over the last several years has severely reduced available nesting space on Minimoy Island, and roseate terns have mostly abandoned this site now as well (USFWS 2012).

Tern chick and adult

USFWS

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

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

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

(1) Size and shape of island to be created—dredge material may be placed on existing nesting areas that are or are not islands, but when creating new islands, the ideal size is less than 10 acres. Terns prefer to nest in areas with an elevation of 3 m (10 ft) or less.

(2) Method of deposition—methods that allow control of over the direction and flow of deposition are ideal to create the desired slope and shape and avoid sensitive areas.

(3) Particle size—coarse, clean sand is preferable, and fine sand, silt, clay, and mud are not suitable.

(4) Location—remote islands that are far (at least a mile) from the mainland are preferable because they are less likely to have predators and human disturbance.

(5) Timing—depositing dredge material outside of time windows that are important for fisheries and nesting birds.

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

Strategies

Continue to:

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

Within 1 year of CCP implementation:

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

Within 5 years of CCP implementation:

- Control nonnative invasive plant species throughout dune grasslands using manual tools, herbicides, or prescribed fires to ensure less than 10 percent coverage refugewide, with a control emphasis in tern nesting areas.

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

Monitoring Elements

- Conduct refugewide complete nest counts for both species during the Massachusetts Statewide tern census window (currently June 5 to 20) and collect spatial data via a 60×60 m grid system to determine success of management in maintaining suitable habitat.

- Quantify productivity to determine success of management by recording clutch sizes, hatch success, and fledging success for all nesting roseate terns and approximately 3 to 5 percent of all nesting common terns in the main nesting area.

- Trap banded adults, and band chicks (all roseate terns; subset of common terns, as time allows), to improve fledge success estimates, document nesting site fidelity, contribute to metapopulation studies, and determine whether Monomoy NWR serves as a sink versus a source population.

- Quantify diet by conducting feeding observations of common terns to determine if this is a limiting factor suppressing productivity.

- Document changes in habitat within the grid system, especially before and after habitat management actions, but otherwise at least annually.

- Census laughing, herring, and great black-backed gulls in Area A to track population changes and distribution of predator and competitor species; collect spatial data via a 60×60 m grid for laughing gull nests.

- Monitor nesting attempts of herring and great black-backed gulls in Area A.

- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings) and conduct nocturnal observations to confirm predator presence, and take, thereby improving understanding of species-specific predator impacts; quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.

- Conduct a complete census of all gulls on North Monomoy Island and South Monomoy every 5 years using aerial survey method or ground counts.

- Monitor avian health by conducting surveillance to detect field mortality events, documenting observations of sick or dying birds, and identifying, collecting, and submitting dead birds for analysis at the National Wildlife Health Center.

- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of nesting habitat. (This may help us prioritize areas where dredge material deposition could be beneficial.)

- Update a cover-type map refugewide every 5 to 10 years.

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

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

Rationale

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

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

In this alternative, we would increase management to protect nesting piping plovers in a manner consistent with preserving wilderness character by closing all available high-quality habitat to the public by mid-April. All high-quality habitat (mainly, the upper beach and lower dune areas; refer to alternative A for a description of high-quality habitat) would be closed, with access corridors provided for the public to cross the island or access the interior of the island at various locations determined each season. These access points would be mapped on the annual closed area map and would be posted in public locations (map 2.7). The method of closures would be improved from those referred to in alternative A, objective A1.1, to be more appropriate for preserving wilderness character. Closed areas would be created using fiber rod posts (½-inch diameter) and string. Signs currently used on the refuge for closing areas would be interspersed with the new posts, approximately one sign every 100 meters, to explain the reason for the posted areas. Using this method, closed areas would be visually less obtrusive and more in line with wilderness management, but would still adequately identify closures to visitors. Closed areas would be maintained until all plover chicks within them have fledged or no nesting activity has been initiated by July 1. In addition to predator management already being used in alternative A, we would experiment in this alternative with the use of temporary electric and non-electric predator fencing to protect piping plovers. Refer to the rationale for alternative A, objective A1.3, for a full explanation of when the use of electric fencing is deemed appropriate on the refuge.

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

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

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

Strategies

Continue to:

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

Within 1 year of CCP implementation:

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

- Participate in partner-based, high priority, landscape-level piping plover research, which may include resighting banded adults, collecting unhatched eggs for DNA analysis, or evaluating habitat availability as a limiting factor.

- Use temporary solar-powered electric fence in suitable nesting habitat to protect piping plover nests from mammalian predators.

- Experiment with using temporary non-electrified fencing to reduce mammalian depredation.

Within 5 years of CCP implementation:
- Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to protect habitats from the effects of erosion and sea level rise.

Monitoring Elements
- Monitor piping plovers throughout the nesting season, including nest searches in traditional piping plover nesting areas beginning in mid-March; nest visits to monitor and record dates of laying, hatching, or failure, and cause of failure; and chick searches to determine survival or first observed flight (Blodget and Melvin 1996).

- Conduct the piping plover census during the Massachusetts Statewide census window (currently June 1 to 9) and collect spatial data of nest locations to document changes in habitat selection and site fidelity from year to year.

- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings); quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.

- Resight banded adults to contribute to metapopulation studies and determine whether piping plovers nesting on Monomoy refuge wintered or migrated through the Gulf of Mexico after the Deepwater Horizon oil spill.

- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of nesting habitat.

- Update a cover-type map refugewide every 5 to 10 years.

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

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

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

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

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

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

Strategies

Continue to:

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

Within 1 year of CCP implementation:

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

Within 5 years of CCP implementation:

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

Monitoring Elements

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

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

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

Rationale

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

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

Strategies

Continue to:

- Patrol and enforce closed areas during the nesting season.

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

Within 1 year of CCP implementation:

- Use temporary symbolic fencing to close all suitable least tern nesting habitat in May, and additional areas as nesting behaviors are observed; maintain these areas as closed until August (when chicks have fledged), or until they are no longer being used by breeding birds.

- Use lethal predator management to protect nesting least terns if the population reaches or exceeds 10 percent of the State population.

Within 5 years of CCP implementation:

- Use temporary solar-powered electric fence in suitable nesting habitat to protect least terns from mammalian predators.

- Use temporary chick shelters to provide chicks with shade and protection from avian and mammalian predators; chick shelter design would be modified from other successful designs to address the most common predators on Monomoy refuge.

Monitoring Elements

- Monitor least tern nesting periodically through the nesting season by searching nesting areas once per week beginning in mid-May to qualitatively estimate reproductive success; if the population reaches 10 percent or more of the Statewide population, quantitatively assess productivity using methods that have been standardized at other sites.

- Conduct a census of nesting least terns during the Massachusetts Statewide tern census window (currently June 5 to 20) and record general locations of nesting sites.

- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings); quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.

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

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

Rationale

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

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

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

Strategies

Continue to:

- Maintain vehicle closures on refuge lands to protect habitat and allow for continued population growth; cooperate with the Town of Chatham, State of Massachusetts, U.S. Coast Guard, and other partners involved in emergency and public safety operations to protect tiger beetles and habitat when vehicle access is deemed essential to protect human life. This includes increased monitoring when vehicles are present to minimize habitat degradation and mortality by OSVs.

- Regularly inform and communicate with the public about areas occupied by tiger beetles on the refuge, including the part of Nauset/South Beach that is now part of South Monomoy Island, to foster continued support for protection and monitoring of tiger beetles currently using these areas and allow for continued expansion of spatial distribution.

- Review 5-year reviews and recovery plan updates for northeastern beach tiger beetles within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.

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

Within 5 years of CCP implementation:

- Facilitate and expand research opportunities on the refuge to fill data gaps that will promote tiger beetle recovery including, but not limited to, genetic work to determine differences between beetle populations in Massachusetts and Chesapeake Bay.

- Work with the New England Ecological Services Field Office staff to determine other potential areas for translocation on the refuge or other viable sites in New England or New Jersey for population augmentation or introduction.

- Work with the New England Ecological Services Field Office to utilize Monomoy refuge as a donor population for newly identified sites, while ensuring that the Monomoy population is not adversely impacted.

Monitoring Elements

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

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

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

Rationale

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

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

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

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

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

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

Strategies

Continue to:

- Allow nonnative rugosa rose to remain on refuge areas where wading birds nest.

- Use temporary symbolic fencing to seasonally close primary nesting areas in portions of the refuge with high seasonal public visitation to provide disturbance-free nesting opportunities for wading birds.

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

Within 5 years of CCP implementation:

- Implement standard buffer distances for seasonal closures based on findings at other sites, and modify to be more restrictive at Monomoy refuge if buffers are not sufficient.

- Evaluate regional importance of maritime shrubland on Monomoy refuge to migrating land birds and, if appropriate, periodically evaluate habitat conditions (including species composition, nonnative plant presence, and community structure).

- Utilize biological, mechanical, chemical, and fire management to reduce nonnative species in maritime shrublands deemed important for migrating land birds.

Monitoring Elements

- Annually count active wading bird nests in primary nesting areas once between mid-April and mid-May, approximately one week prior to peak hatch to minimize disturbance impacts and depredation by gulls.

- Conduct a complete census of all wading birds refugewide every 5 to 10 years using aerial survey method or ground counts, and in conjunction with Statewide efforts.

- Oversee mist netting efforts conducted by Monomoy Banding Station staff/volunteers at the south end of South Monomoy from August through November to quantify abundance of neotropical migrants and evaluate importance of Monomoy refuge to shrubland-dependent birds.

- Map locations and record abundance of invasive/nonnative species; monitor changes in species composition, and evaluate effectiveness of control techniques implemented.

- Update a cover-type map refugewide every 5 to 10 years.

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

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

Rationale

Migrating and Staging Birds

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

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

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

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

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

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

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

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

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

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

Strategies
Continue to:

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

Within 1 year of CCP implementation:

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

Within 5 years of CCP implementation:

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

- Annually identify areas refugewide that consistently support foraging or staging shorebirds or terns and close areas that are subject to high levels of disturbance to all human use; a rapid-assessment method of identifying areas would be developed and implemented. This assessment will now include Nauset/South Beach and will inform potential closures.

Monitoring Elements

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

- Conduct post-breeding counts of American oystercatchers on the northern half of the refuge in conjunction with partner efforts, and report color-banded birds through the American Oystercatcher Working Group to better understand Monomoy NWR's importance during migration and staging.

- Resight and report banded shorebirds to *bandedbirds.org,* with a focus on red knots, during migration periods to contribute to studies on migration pathways, strategies, habitat use, and survival and to better understand Monomoy NWR's importance during migration.

- Rely on volunteers and refuge partners to annually conduct international shorebird surveys opportunistically during north and south migration refugewide to contribute to landscape data sets and identify new primary roosting and foraging sites as they occur on the refuge.

- Every 5 to 10 years, quantify migrating shorebird chronology and spatial distribution for 2 consecutive years according to Koch and Paton (2009) to monitor longer-term changes in shorebird use.

- Periodically monitor human disturbance levels in an effort to ensure that at least 90 percent of habitat being used by species of conservation concern is not subjected to frequent disturbance.

- Quantify flushing of feeding and resting shorebirds from human disturbance.

- Obtain aerial photography through collaboration with the Town of Chatham to monitor changes in intertidal habitat every year.

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

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

Rationale

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

Strategies

Continue to:

- Work with the Cape Cod Stranding Network to assist with rescues of stranded and entangled marine mammals, and help monitor injured or sick marine mammals.

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

Within 1 year of CCP implementation:

- Encourage, support, and actively participate in partner efforts to study marine mammals, including gray and harbor seals.

- Evaluate use of symbolic fencing for seal haulout sites and pupping sites that are subject to frequent human disturbance.

Monitoring Elements

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

- Monitor and report entangled and stranded marine mammals.

Objective B1.9 (Salt Marsh)

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

Rationale

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

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

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

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

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

Strategies

Continue to:

- Use temporary symbolic fencing to seasonally close most salt marsh habitat on North Monomoy Island from April to September to minimize trampling of vegetation and invertebrates, and minimize disturbance to nesting saltmarsh sparrows and American oystercatchers.

- Support partner efforts to investigate impacts of mercury on saltmarsh sparrows and natural processes that affect mercury speciation and bioavailability.

- Support partner efforts to investigate the hybridization of saltmarsh sparrows and how it impacts the population fitness of saltmarsh sparrows and Nelson's sparrows.

- Support partner efforts to investigate changes in tidal marsh bird populations on the refuge and in eastern Massachusetts by comparing current survey data to historical data.

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

Within 1 year of CCP implementation:

- Expand the areas of temporary symbolic fencing to include protection for salt marshes on Morris Island and South Monomoy Island.

- Participate in regional efforts to monitor the health and integrity of salt marsh habitat on the refuge. Focus management on reducing non-climate stressors to salt marshes.

- Install sediment elevation tables (SETs) in refuge salt marshes to evaluate the effects of various factors on salt marshes' ability to keep pace with sea level rise.

- Complete rapid assessments of vegetative composition on the North Monomoy Island salt marsh to evaluate suitability for sparrow nesting and allow for proactive development of habitat adaption efforts if needed.

- Determine presence and abundance of purple marsh crabs in all salt marshes on the refuge; if present, initiate studies to determine if herbivory is having an impact on salt marsh vegetation and health.

Monitoring Elements

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

Objective B1.10 (Freshwater Ponds and Marshes)

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

Rationale

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

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

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

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

Strategies

Within 1 year of CCP implementation:

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

Monitoring Elements

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

Objective B1.11 (Nearshore Marine Open Water)

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

Rationale

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

Strategies

Continue to:

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

- Maintain closure of the refuge to mussel harvesting to preserve food sources for red knots and American oystercatchers.

- Evaluate aquaculture requests in open water-submerged bottom areas (below mean low water) within the Declaration of Taking boundary for compatibility and benefits to refuge resources on a case-by-case basis.

- Participate in review and discussions with stakeholders regarding dredging of channels and the possible deposition of dredge materials surrounding Monomoy NWR, particularly impacts to priority wildlife and habitats.

- Support partner efforts to study wintering sea ducks using the waters surrounding the refuge, and monitor impacts of diseases affecting these populations.

- Support partner efforts to study shellfish and fin fish stocks and marine mammals, including seals and their principal predator, the great white shark.

- Support partner efforts to assess the distribution and genetic diversity of eelgrass across the region and test it against an experimental factorial design of potential stress parameters.

- Support partner efforts of the New England Aquarium and Mass Audubon to rescue stranded sea turtles and to collect for scientific research dead sea turtles recovered from refuge waters.

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

Within 1 year of CCP implementation:

- Prohibit bottom substrate-disturbing fishing activities such as mussel harvesting, scallop dragging, or any hydraulic dredging for shellfish within the Declaration of Taking refuge boundary in order to protect eelgrass beds and maintain productive benthic communities for wildlife.

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

- Support partner efforts to study potential impacts of offshore wind or tidal energy development to resources of concern.

- Encourage, support, and actively participate in efforts to study shellfish and fin fish stocks and marine mammals, including seals and their principal predator, the great white shark.

Within 5 years of CCP implementation:

- Work with partners to evaluate and map the current and historic extent of submerged aquatic vegetation (SAV), specifically eelgrass, within the Declaration of Taking to determine whether these species are stable, decreasing, or increasing, and to determine if active management of the resource is necessary.

- Collect baseline data of flora and fauna in the subtidal areas of the refuge to help determine priority species and develop a management plan to ensure conservation of these species.

- Evaluate need for "no anchoring zones" to minimize disturbance to eelgrass beds and implement as warranted.

- Evaluate the possibility of using dredge spoils to enhance beach and flats habitat on the refuge (e.g., Minimoy, flats west of Minimoy, and Morris Island Beach) outside of the wilderness area. If feasible, pursue NEPA analysis.

Monitoring Elements

- Monitor the impact of aquaculture activities initiated within refuge waters.

- Monitor the impacts of dredging projects on subtidal areas within the refuge boundary; this may involve pre-and post- dredging monitoring of substrates, SAVs, or benthic communities.

- Monitor the benefit to focal species of habitat created on the refuge using dredge material.

- Monitor avian health specific to common eider and other sea ducks by conducting surveillance during fall and winter to detect field mortality events, documenting observations of sick or dying birds, and identifying, collecting, and submitting dead birds for analysis at the National Wildlife Health Center in collaboration with the Region 5 Migratory Birds Office.

- Update bathymetry data refugewide every 5 to 10 years.

REFUGE GOAL 2:

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

Objective B2.1 (Access and Use)

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

Rationale

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

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

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

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

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

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

Strategies

Continue to:

- Open all of North Monomoy Island to the public from October to March. During the April to September nesting season (map 2.8) an east-west trail corridor bisecting North Monomoy Island is open to the public, as is the Broad Creek area to the south; in addition, the entire perimeter of North Monomoy Island below the mean high tide line is open for public circumnavigation around North Monomoy Island.

- Restrict travel on the refuge to foot traffic to maintain the wilderness character of North and South Monomoy Islands, as well as to protect sensitive nesting areas and wildlife habitat; this may include limiting access to dune areas to prevent erosion, as necessary.

- Allow motorized and non-motorized boating in refuge waters with landings prohibited in areas that are seasonally closed; map 2.7 shows recommended sites where the hazardous currents and shoals allow safe landing.

- Maintain and enforce closure of the refuge to operation and landings of motorized personal watercraft (e.g., wave runners, jet skis) on the refuge land and in refuge waters.

- Maintain and enforce closure of the refuge to kiteboarding operation within the Declaration of Taking-Marine Protected Area boundary.

- Use the existing rights-of-way on Tisquantum Road, Wikis Way, and Stage Island Road to access refuge properties.

- Phase out non-Service parking and dinghy storage at Stage Island Lot 7b.

- Assist in enforcement of the Marine Mammal Protection Act through regular communication and coordination with staff from partner agencies and organizations, including the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, and International Fund for Animal Welfare.

Within 1 year of CCP implementation:

- Utilize adaptive management, striving to keep Morris Island and large portions of South Monomoy (including Nauset/South Beach) open year round, and reopen seasonally closed areas after chicks fledge or after staging seasons for migratory birds such as roseate and common terns, piping plovers, red knots, and American oystercatchers to provide additional wildlife viewing and photography opportunities; temporarily close portions of the refuge only when necessary to protect wildlife and their habitat based on seasonal use by priority species.

- Improve visibility of the right-of-way trail access to the western portion of Morris Island refuge property off Tisquantum Road; improve signs so visitors can easily view the access point and understand that they have the right to use the path to access the refuge.

- Do not allow pets, including dogs on leash, on the entire refuge, including Morris Island and the part of Nauset/South Beach that is attached to South Monomoy Island.

- Work to acquire an additional lot adjacent to the Stage Island lot for refuge use only.

- Include parking requirements in all special use permits issued to commercial guides, photographers, and others.

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 would be free at other times.

- Replace the current motorized seal tour-ferry access system from the refuge headquarters on Morris Island with a competitive, multi-year concession, or special use permit holders if no concessionaire is identified. Provide two parking spaces for the concessionaire and shuttle vans. The concession would operate from refuge headquarters, but shuttle visitors from an off-refuge parking site to Morris Island and ferry visitors to North Monomoy Island and South Monomoy Island. It would also conduct interpretative natural and cultural history tours, arrange for refuge permitted fishing or waterfowl hunting guides, rent kayaks, and provide other visitor-related services. The concessionaire would 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. The concessionaire will replace the current special use permit issued for ferry service.

- All commercial wildlife watching tours, passenger ferry service, kayak or paddling tours, and hunting and fishing guides would need a refuge permit to operate within the refuge Declaration of Taking boundary, regardless of whether vessels or passengers make a refuge landfall.

Within 5 years of CCP implementation:

- Through local and regional partners, provide a local-area shuttle serving Morris Island refuge facilities (and other destinations in Chatham) from secure, satellite parking locations during the June 1 to September 15 peak visitor season.

- Work with municipal partners on the use of a town-owned or private parking facility that could serve as a satellite parking location for a shuttle service that would bring visitors to the refuge.

- Assist the Town of Chatham to relocate the fencing and improve the shoulder on the east side of the Morris Island Road causeway to better accommodate shuttle passage, parked cars, and emergency vehicles.

- Encourage the Town of Chatham to create a multi-use bicycle and pedestrian path on one side of the causeway and provide assistance as possible to help the town 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 refuge Morris Island facilities, including designated trails, satellite parking and shuttle stops, and the concessionaire's off-refuge facilities; this may involve erecting new signs within Service rights-of-way on land owned by others.

- 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, and on sites managed by local and regional partners.

- Complete a visitor services plan for the refuge incorporating strategies identified herein; 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; modify or restrict access, or adapt management strategies as warranted.

- Encourage paddling as a means of transportation to the Monomoy Wilderness portions of the refuge by collaborating with local and regional partners or the refuge concessionaire to provide kayaking launch facilities, rentals, instruction, and group outings to the Monomoy Wilderness.

- Explore the feasibility of improving the non-motorized watercraft launch site at the northern stairway and existing asphalt path, or along the Morris Island causeway; examine possibilities for constructing a waterfront access way meeting Americans with Disabilities Act requirements at the headquarters site or across the Tisquantum Road right-of-way.

- Extend an Americans with Disabilities Act-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, open this new facility, which could be shared space with partner groups, and transfer exhibits from the current refuge headquarters, which would primarily serve as administrative offices.

Monitoring Elements

- Estimate the number of visitors at the refuge engaged in wildlife-dependent priority and other nonpriority public use activities.

- Monitor available empty parking spaces and document traffic congestion at the Morris Island refuge administrative complex and nearby causeway throughout the year.

- Record the number of special use permits.

- 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 B2.2 (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 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.

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 would further increase opportunities for interpretation. In order to maintain the integrity of wilderness, no kiosks would be constructed on North Monomoy Island or South Monomoy. Information would be available through the use of technology, such as podcasts and handheld devices such as PDAs.

Strategies

Continue to:

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

- 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 tours and interpretive commercial 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 and wildlife day trip tours of the islands.

- Conduct seasonal interpretive programs at the refuge by refuge staff, interns, and volunteers, and provide roving interpreters on the Morris Island Trail; content would include wilderness area components.

- 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 would focus on a recommended viewing distance of at least 50 m to allow birds to remain undisturbed in their resting and foraging areas critical to successful migration.

Within 5 years of CCP implementation:

- Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted.

- 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 such as seals.

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 coordinates and information about the wilderness designation.

- 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 a self-guided interpretive brochure for a Powder Hole to Monomoy Point Lighthouse trail that interprets the unique natural and cultural history of the area, wildlife resources, and wilderness.
- 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 and stamp letterbox.
- Record the number of visitors to the visitor contact station on a daily basis.
- Record the number of refuge brochures/rack cards ordered on an annual basis.
- 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 B2.3 (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 National Wildlife Refuge System, National Wilderness Preservation System, 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 understand the importance of wildlife conservation, with a focus on migratory birds; understand the need for wilderness stewardship; identify the refuge's role in the National Wildlife Refuge and National Wilderness Preservation Systems in conserving Federal trust resources; explain the unique characteristics of the Monomoy Wilderness; and name at least one endangered species for which the refuge conducts management.

Rationale

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. Environmental education is identified in the Refuge Improvement

Act as a priority public use. 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 would 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 appears to be imperative now 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 refuge 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 for the refuge incorporating strategies identified herein; 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; modify or restrict access, or adapt management strategies as warranted.

- 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 would enhance or complement environmental education programs in the area (e.g., outer Cape).

- 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 to identify gaps remaining 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 that can be utilized on or offsite and incorporate the Massachusetts curriculum frameworks along with key refuge messages; these can be utilized by local and regional school districts based on the findings of a pilot study.

- 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 B2.4 (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.

Bill Thompson/USFWS

Lighthouse at Monomoy

This alternative expands upon alternative A by enhancing infrastructure and visitor services (i.e., concessionaire services) to increase wildlife observation and photography opportunities in a manner consistent with preserving wilderness character. We would 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 magical and 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 U.S. Fish and Wildlife 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. As production companies recognize the unique experience Monomoy refuge offers, their desire to capture that to share with the world places demands on refuge staff. Special use permits are required whenever the photographic images will or can be marketed (e.g., sale of copyrighted images, including videography). Videos must be wildlife and wilderness oriented.

Issuance of special use permits to allow commercial filming and photography 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 after sunset; prohibit touching, feeding, or harassing wildlife.
- Maintain the two viewing platforms on Morris Island (map 1.2).
- Allow photography in any area of the refuge open to the public.
- Host a youth or adult photography contest.

Within 1 year of CCP implementation:

- Allow commercial filming and photography on the refuge only when there is a direct benefit to the refuge or the Service. All allowed commercial filming and photography would operate under a special use permit issued by the refuge manager. Commercial photography would also have to support wilderness and be conducted in a manner consistent with protecting wilderness character.

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, ensure their members understand refuge regulations, and maintain a connection to one of the refuge's most important constituencies.

Within 5 years of CCP implementation:

- Complete a visitor services plan for the refuge; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted.
- Provide trails on refuge lands for wildlife observation; wilderness trails would not be maintained by refuge staff but would be clearly marked by satellite coordinates so visitors may use GPS-enabled devices to find the path, if necessary.
- Evaluate use of critter cam(s) so the public can observe nesting behavior online, which would 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; enhance existing boardwalk at the refuge headquarters to make it accessible under the Americans with Disabilities Act for improved observation opportunities at the overlook on Morris Island Trail.

- 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 special use permits 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 eBird Web site.

Objective B2.5 (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

The waters off of Monomoy NWR have a deserved reputation as a world-class surf fishery. Novice anglers, as well as experienced anglers visit Monomoy NWR every year. Many recreational anglers are also accompanied by commercial guides. Most fishing visits are for surf fishing, but some visitors also harvest lobsters, crab (not horseshoe crabs), and whelk.

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

Since fishing is a priority use, every effort would 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, dependent 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 special use permit. There are many benefits to anglers who are working with a commercial guide with the oversight of refuge staff, which is only possible if all commercial guides obtain a special use permit from the refuge. The special use permit would identify refuge rules, regulations, and closed areas. It would highlight habitats and species of concern that should be avoided by anglers

to reduce disturbance, and would explain wilderness so all activities conducted by anglers are consistent with preserving the wilderness character of refuge lands and waters. Refuge staff would establish a fair and equitable system for commercial fishing guides to operate on the refuge. The refuge expects that these guides would 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 would endeavor to promote fishing on the refuge by participating in local fishing tournaments, contracting with vendors to provide guided fishing tours for the general public, and distributing materials that describe local sport fish of interest and applicable fishing regulations. We would explore partnerships with local angler organizations and other groups to ensure 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 uncrowded 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 fishing in the open waters, above submerged lands, under State and Federal regulations. Included fishing activities are: demersal long line fishing; mid-water trawl fishing, hook and line/rod and reel fishing; lobster, crab, and whelk pot fishing; and hand-harvest of scallops.
- Allow anglers to fish on Morris Island 24 hours per day in accordance with all Federal and State fishing regulations.
- Allow freshwater fishing in the ponds on South Monomoy during daylight hours.

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 would include closed areas maps and any additional refuge-specific regulations.
- All commercial fishing guides would need a refuge permit to operate within the refuge DT boundary, regardless of whether vessels or passengers make a refuge landfall.

Within 3 years of CCP implementation:

- Replace the current motorized seal tour-ferry access system from the refuge headquarters on Morris Island with a competitive, multi-year concession, or special use permit holders if no concessionaire is identified; the concession would arrange for refuge-permitted fishing or waterfowl hunting 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 safely disposing of fish line.

Within 5 years of CCP implementation:

- Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted.
- Work with partners and coordinate with the State to develop a fishing brochure that informs anglers about refuge resources and seasonal closures and would be available on the refuge's Web site and at 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 special use permits 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 event.
- 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 B2.6 (Shellfishing) Allow refuge visitors to harvest subterranean shellfish (softshell clams, quahogs, and razor clams) using non-mechanized hand raking tools only and no artificial means of extraction (such as salt and chlorine), in accordance with Town of Chatham Shellfishing Rules and Regulations or additional refuge regulations.

Rationale

In alternative B, we would officially open the refuge to non-mechanized harvest of subterranean species (softshell clams, quahogs, and razor clams) and scallops (see objective B2.5.) To the best of our knowledge, razor clam harvesting is not currently occurring on the refuge. However, razor clams have historically been harvested on the refuge and may be again in the future, as regional conditions change.

We would not open the refuge to the harvest of mussels. Mussels are an important food source for many migratory birds and we would 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 candidate 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). Harvest techniques generally utilized for non-subterranean shellfish are so efficient that we are concerned that shellfish beds could be depleted. If additional information becomes available about the importance of subterranean shellfish species to priority wildlife species, we would reevaluate this objective.

Alternative B takes a more proactive approach to minimizing disturbance to migrating and staging birds on the intertidal flats. The rationale in alternative B, objective B1.7, 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 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.

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). Studies conducted at Monomoy refuge 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 in prep, Leavitt et al. 2010). However, if seasonal, dynamic closures are implemented, as discussed in alternative B, objective B1.7, they would apply to all users.

Shellfishing can also alter benthic communities or impose direct competition for shorebirds that feed on target organisms. For example, mechanical harvesting of cockles in South Wales resulted in their decline, and although shorebird foraging rates increased immediately following harvesting as birds took advantage of newly exposed prey, subsequent declines of bird activity lasted 50 days for Eurasian oystercatchers and 80 days for Eurasian curlews and various gull species (Ferns et al. 2000). Sediment disturbance associated with commercial harvest of bloodworms in the Bay of Fundy negatively impacted populations of mud snails, which is the primary prey of southward migrating semipalmated sandpipers (Shepherd and Boates 1999).

Softshell clams inhabit intertidal and shallow subtidal mudflats where shorebirds often forage (Leavitt and Peters 2005). While shorebirds reduce their foraging rates, flush more easily, and abandon areas with increased human presence (Burger 1981, Burger and Gochfeld 1991b, Lafferty 2001a, Thomas et al. 2003), the degree of shorebirds' response varies with different human activities (Burger 1981 and 1986, Pfister et al. 1992, Lafferty 2001b). 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 clam harvesters in coastal New England typically use short hand-rakes, 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, Levitt and Fraser 2004). Additionally, anecdotal observations of shorebirds congregating in recently shellfished areas at Monomoy refuge (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 been and 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 (Nol and Humphrey 1994). 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, in prep.). 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 would also start to enforce the existing 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 the harvest of softshell, quahog, and razor clams using non-mechanized, hand methods year-round following State and Town regulations.

Within 1 year of CCP implementation:

- Coordinate with the Mass Division of Marine Fisheries and the town of Chatham 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 or chlorine or other artificial means of extraction to harvest razor clams is transmitted to local clammers.
- Start to enforce the existing prohibition on the use of wheeled carts and other forms of mechanical transport in Monomoy Wilderness.
- Prohibit bottom substrate disturbing fishing activities such as mussel harvesting, scallop dragging, or any hydraulic dredging for shellfish within the Declaration of Taking refuge boundary.
- Coordinate with the Town of Chatham Shellfish Warden to ensure all permitted shellfishers using Monomoy refuge acknowledge being provided with information about the refuge purpose and mission, regulations, seasonal closures, and wilderness ethics and stewardship.

Within 3 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 or chlorine.

Monitoring Elements

- Record the number of annual resident and non-resident shellfish harvest permits issued by the Town of Chatham Shellfish Warden.
- Monitor harvest numbers to as an indicator of potential threats to softshell clam and quahog resource sustainability by tracking harvest pressure (numbers and take) to determine if it meets refuge compatibility.
- Formulate additional guidelines or regulations, if needed, that further protect species and habitats of concern and sensitive areas, preserve wilderness character, and conduct public guidance/review.
- Monitor impacts to wildlife, particularly staging shorebirds such as red knots, and nesting shorebirds such as American oystercatchers.

Objective B2.7 (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-Marine Protected Area boundary since the refuge was established. However, all areas included in the National Wildlife Refuge System

are closed to public access until and unless we open the area for a use or uses in accordance with the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee) and the Refuge Recreation Act of 1962 (16 U.S.C. § 460k-460k-4). Monomoy NWR has never been opened for fishing or waterfowl hunting by regulation, individual permit, or public notice as required by law.

Providing compatible wildlife-dependent recreation and educational activities on units of the National Wildlife Refuge System is a priority of the U.S. Fish and Wildlife Service. The National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. § 668dd et seq.) provides authority for the Service to manage the refuge and its wildlife populations. In addition, it declares that compatible wildlife-dependent public uses are legitimate and appropriate uses of the Refuge System and are to receive priority consideration in planning and management. There are six wildlife-dependent public uses: hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation. The 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. Increasing hunting opportunities on portions of the area administered by the refuge would allow management of waterfowl populations at acceptable levels, 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. Implementation of the proposed actions would be consistent and compatible with the Refuge Recreation Act, Refuge Administration Act, and the Monomoy NWR Comprehensive Conservation Plan.

Providing hunting and fishing opportunities addresses the mandates of Executive Order 12996 and the Refuge Improvement Act by providing the public with an opportunity to engage in wildlife-dependent recreation. 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.

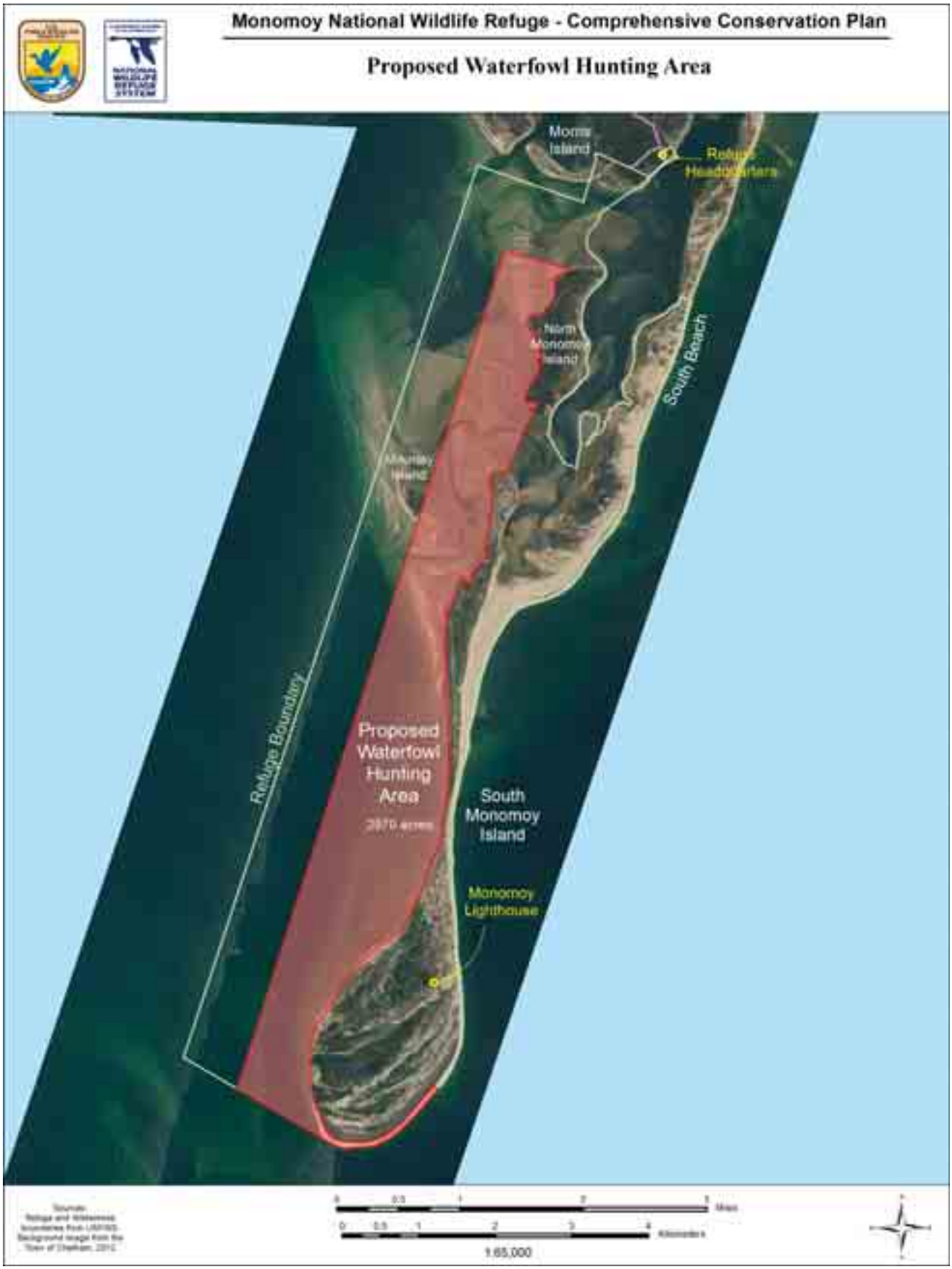
The refuge weighs a number of factors in opening an area to hunting or fishing, including safety considerations. The refuge manager may, upon annual review of the hunting program, impose further restrictions on hunting activity, recommend that the refuge be closed to hunting, or further liberalize hunting regulations within the limits of State and Federal regulations. Restrictions would 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 3.1.

Patrols by refuge law enforcement officers would enforce Federal and State hunting regulations. Enforcement patrols may also be conducted by Massachusetts Environmental Police officers. The frequency of patrols would 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 would 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 objective, and evaluate the hunt program; modify or restrict access, or adapt management strategies as warranted.


Monomoy National Wildlife Refuge - Comprehensive Conservation Plan
Proposed Waterfowl Hunting Area
Morris Island
Refuge Headquarters
North Monomoy Island
South Beach
Minister Island
Refuge Boundary
Proposed Waterfowl Hunting Area
South Monomoy Island
Monomoy Lighthouse
1:65,000

- Open a portion of Monomoy NWR to waterfowl hunting in accordance with Federal, State, and local hunting regulations. 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, including wilderness and non-wilderness areas, to apply for and receive a special use permit to conduct guiding on the refuge (50 CFR 27.97). The fee for this special use permit would 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 special use permits 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 U.S. Fish and Wildlife Service.**

Objective B3.1 (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 National Wilderness Preservation System.

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, and helps the public make informed decisions about the future of fish and wildlife resources and support the actions of the refuge.

This objective focuses on achieving such 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 recommend a more unified and strategic communications program that would 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 would 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, U.S. Coast Guard Heritage Museum, Provincetown Center for Coastal Studies, Woods Hole Oceanographic Institution, 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 purpose to local service and civic organizations and conservation partners throughout the region.

Within 1 year of CCP implementation:

- Promote an outreach campaign (already initiated by the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 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 and minimizing disturbance to marine mammals. The outreach message would focus on a recommended viewing distance of at least 150 feet to allow marine mammals undisturbed resting and foraging areas 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 would focus on a recommended viewing distance of at least 50 m to allow birds to remain undisturbed in their resting and foraging areas 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 B3.2 (Community Support)

Over the life of the plan, 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 would increase recognition of the refuge, the Refuge System, and the Service among neighbors, local leaders, conservation organizations, and elected officials. We would strive annually to increase outreach efforts toward the local citizenry. This publicity would 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 would serve as an important resource for refuge visitors and local community, providing educational and recreational opportunities and meeting and exhibit space for local conservation organizations.

At times, the refuge staff will make decisions that are not endorsed by the general public and the local community. However, management decisions are based on science and Service policy and regulations, regardless of their popularity with the public. It is important to maintain regular communication to inform and update the public about refuge actions. While not everyone will necessarily support our actions, we want to be sure that the reasons for our actions and decisions are explained. We hope to achieve informed consent, which ensures that because stakeholders understand our issues and actions, they do not oppose 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, 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 reorganized and reestablished itself in 2011, and is growing 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; ensure they understand the refuge mission and actively support refuge activities.
- Implement current Friends and volunteer policies according to Draft Friends Policy 633 FW 1-4 and National Wildlife Refuge System Volunteer and Partnership Enhancement Act of 1998 October 5.
- Maintain a volunteer database.
- Encourage establishing 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 to create a jointly staffed visitor contact facility in Chatham or Harwich that allows visitors to receive information on what nature-based opportunities are available in the local area, know where to go, and make whatever arrangements and contacts needed for their visit.

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

Objective B4.1 (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 endangered species recovery) and the Refuge System mission.

Rationale

Wilderness is a congressionally designated land use. As defined by the Wilderness Act, wilderness is untrammeled (free from human control), undeveloped, and natural, and offers outstanding opportunities for solitude and primitive recreation. The National Wildlife 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.

As in alternative A, refuge management activities in the Inward Point and Powder Hole inventory areas would remain largely unchanged from those employed since the 1970 designation of the adjoining Monomoy Wilderness. 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 would 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 as needed during the plan period for refuge administrative and management activities conducted within wilderness that are essential to fulfilling the purposes (migratory birds 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 non-wilderness areas to maintain or enhance their size, naturalness, and opportunities for solitude or primitive and unconfined recreation throughout the 15-year plan period, to the extent that it will not prevent fulfilling refuge establishment purposes or the Refuge System mission (610 FW).

- Use the appropriate response to unplanned wildfire ignitions that provides for public and firefighter safety while recognizing periodic fire as a natural process with long-term benefits to an enduring wilderness resource.

- Where fire exclusion or other 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 within the Monomoy Wilderness.

- Maintain wilderness boundary signs at three locations (two boat landings and on Nauset/South Beach).

- Implement management activities that involve temporary rather than permanent uses or site occupancy, that create no new surface disturbance, do not involve placement of permanent structures or installations (e.g., temporary symbolic fencing), or use motorized equipment or mechanized transport unless it is the minimum tool possible.

- Provide refuge staff with wilderness stewardship training appropriate for their positions.

- Review all refuge management activities proposed within the Monomoy Wilderness and the Inward Point and Powder Hole inventory areas through the 15-year plan period to ensure they are consistent with wilderness management; use the minimum requirements analysis process presented under Actions Common to All Alternatives.

- Assess current wilderness character (untrammeled, undeveloped, natural, outstanding opportunities for solitude or primitive and unconfined recreation, and other features/unique attributes) within the Monomoy Wilderness.

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; 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 Federal Aeronautics Administration (FAA) to increase pilot awareness of the 2,000-foot flight ceiling restriction over the Monomoy wilderness.

Within 5 years of CCP implementation:

- Explore opportunities with 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 and implement, if practicable, the minimum access pass program; use as a means of educating and informing the public about the wilderness-designated lands and waters on the refuge, refuge wildlife, and management actions, and appropriate use by visitors while in refuge wilderness; limit the number of people allowed at one time in an effort to maintain the solitude character of the Monomoy Wilderness.

- 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: **Protect cultural resources that exist on the refuge.**

Objective B5.1 (Archaeological Resources and Historical Structures)

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 on Monomoy NWR 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 National Register of Historic Places) to meet the historic preservation standards of the Secretary of the Department of the Interior.

Rationale

The Service has a legal responsibility, under section 106 of the National Historic Preservation Act, to consider the effects its actions may have on cultural resources, and to enforce all Federal cultural resource protection laws and regulations on refuge lands, including the preservation of structures listed on the National Register of Historic Places. 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.

Within this alternative, 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 National Historic Preservation Act prior to conducting any ground-disturbing activities on the refuge; compliance may entail any combination of State Historic Preservation Officer or Tribal Historic Preservation Officer consultation, literature survey, or field survey.

- Identify, evaluate, and conduct archaeological evaluation, with subsurface testing as necessary, for any project where ground-altering activity is proposed.

- Enforce all Federal cultural resource protection laws and regulations including the necessary provisions of Archaeological Resources Protection Act to protect cultural resources on the refuge.

- Conduct structural and basic maintenance on the Monomoy Point Light Station to comply with historic preservation standards.

- Develop and implement throughout the plan period a historic site management plan for the Monomoy Point Light Station structures and associated archaeological structures, following National Historic Preservation Act sections 106 and 110 and 36 CFR Part 800 collaborative procedures; the plan would 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 State Historic Preservation Officer 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.

- Update the 2010 minimum requirements analysis that addresses the need for periodic motorized equipment access through the Monomoy Wilderness to the Monomoy Point Light Station for the purposes of major repairs or refurbishment.

- 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 National Historic Preservation Act section 110, conduct proactive archaeological surveys to determine the limits and integrity of the Whitewash Village archaeological site group on South Monomoy, 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

- Maintain a log of all National Historic Preservation Act 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 Archaeological Resources Protection Act.
- 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 B6.1 (Staffing)

Over the next 15 years, fill seven additional permanent full-time positions and continue to employ seasonal and term biological staff and interns to implement the activities outlined in alternative B (see appendix G for staffing chart proposed under alternative B). 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 under this alternative to consistently complete the additional workload required to reach the expanded objectives proposed in alternative B. A 2008 national staffing model for the National Wildlife Refuge System indicated that Monomoy refuge, due to its location, size, number of visitors, and complexity of its biological program, should have a permanent staff of nine full-time employees. Funding levels have never been sufficient to 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, wilderness staff, interns, and volunteers.
- Work with organizations such as the Student Conservation Association and the Federal Pathways program to hire talented young college students for seasonal intern positions.
- Provide a safe environment at work that promotes diversity and inclusion.
- Seek grants and funding partnerships to support additional staff.
- Request additional staffing as funding becomes available.
- Provide relevant staff training opportunities to increase work skills and increase understanding of diversity and inclusion.

Within 15 years of CCP implementation:

- Change an existing General Biologist (GS-0401-09) to a Wildlife Refuge Specialist (GS-0401-09/11) position.
- 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 B6.2 (Facilities and Maintenance)

Over the life of the plan, ensure that offices, support facilities, and other infrastructure are sufficient for staff and volunteers; ensure the expanded programs and activities of staff and volunteers are provided for and maintained while sharing a headquarters site co-located with National Weather Service facilities.

Rationale

Adequate, properly functioning facilities are needed to support staff, volunteers, the visiting public, and the co-located National Weather Service upper air sounding operations. Current space is barely able to accommodate alternative A 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 would occur with increased staff.

The National Weather Service, an agency within the Department of Commerce's National Oceanic and Atmospheric Administration (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. A memorandum of understanding 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 National Weather Service. 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 National Weather Service operations.

The refuge administrative and National Weather Service 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 base, a result of subsequent erosion of the bluff. Expected sea level rise and the resulting geomorphological changes (Giese et al. 2010) 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 2.

The National Weather Service'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 the refuge and National Weather Service 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, 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. The lightkeeper's house at the light station serves as a summer camp for staff and volunteers, and as equipment storage from April to September. 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/visitor contact station, dormitory/maintenance buildings, and Monomoy Point Light Station to provide a safe working and living environment for refuge staff and volunteers.

- Work with the National Weather Service and maintain an memorandum of understanding with them for use of Service-owned land on Morris Island. Should the Weather Service at any point decide to relocate their existing operation, the refuge would look into re-utilizing the current Weather Service buildings and analyze space and site use at the Morris Island site.

- Maintain a fleet of three highway vehicles and three outboard motor boats that provide safe and efficient transport to North Monomoy Island, South Monomoy, Minimoy Island, and offsite locations for resource management and administrative work; replace boats and motors as necessary to maintain a functional fleet.

- Develop potential partnership with the town of Chatham or U.S. Coast Guard to establish new docks, covered boat storage, and maintenance with secure marine equipment storage and additional parking.

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 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 in this alternative as needed.

- Explore additional refuge staff housing opportunities within the local commuting area.

- Explore opportunities to acquire the waterfront Stage Island lot adjoining our current Lot 7b; add storage capability and expand parking for refuge staff.

Within 10 years of CCP implementation:

- Conduct a cost-benefit analysis to evaluate three options: establishing a stand-alone visitor contact station that supports refuge visitor services staff; renovating existing facilities (remodeling of current 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 acquiring a new headquarters site and funding to relocate the entire refuge operation, including visitor contact station and shuttle parking. This last would 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, and welcome area, and would include parking and 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 would also provide refuge information; this building would not support refuge visitor services staff.

Objective B6.3 (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 would themselves demonstrate renewable "green" energy measures, similar to those a residential homeowner, farmer, or small business owner might install, to show refuge visitors and public officials and move refuge operations and facilities toward carbon neutrality by 2020.

Rationale

The strategies that follow are part of a comprehensive effort to incorporate energy conservation technologies into the design of new and remodeled facilities on national wildlife refuges in the Northeast Region of the Fish and Wildlife Service, while simultaneously stimulating economic recovery. Guiding principles and other general information on implementing sustainable practices within the Refuge System can be found in Policy 565 FW 1.

The installation of wind turbines or photovoltaic arrays at the refuge aims to increase the proportion of electricity consumption derived from clean, renewable sources, while reducing the proportion derived from fossil fuel combustion and the associated greenhouse gas emissions, in an effort to create a smaller carbon footprint. Wind turbines or photovoltaic arrays at the refuge facilities would

utilize the available wind and sunlight to generate electrical power at those facilities while reducing power consumption from the utility grid. Installation of a photovoltaic array on South Monomoy would provide electrical power for heat, sanitation, water distribution, hot water, and lights to the Monomoy Point Light Station site without connecting to the utility grid.

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

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.

The solar panels, wind turbines, and other energy conservation technologies proposed would 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:

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

Within 1 year of CCP implementation:

- Reduce metered/potable water consumption by installing rainwater collection and distribution systems at refuge administrative facilities.

- Transition the fleet to use hybrid and electric alternative fuel vehicles and boat motors when feasible to meet the needs of managing the refuge.

Within 3 years of CCP implementation:

- Pursue improvements to preserve the Monomoy Point Light Station structures to extend maintenance intervals; make it more functional, including constructing internal walls and installing drywall to provide privacy for refuge staff stationed there when doing field work on South Monomoy.

- 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.

- Conduct a cost-benefit analysis to determine the most efficient source of alternative energy at the Monomoy Point Light Station and seek funding for installation.

Within 5 years of CCP implementation:

- Prepare a stand-alone NEPA analysis for the installation of a wind turbine to augment the solar thermal tube domestic hot water system installed in 2011 for the refuge headquarters complex on Morris Island.

- If project approved, seek funding to install the wind turbine.

Within 10 years of CCP implementation:

- Assuming approval and funding, install the wind turbine.

- Install an electric car charging station at the Morris Island parking lot.

Monitoring Elements

- Calculate the amount of electricity generated onsite through solar and wind production and as a ratio of electricity usage purchased from the commercial grid.

- Calculate the annual fossil fuel consumption (heat, vehicles, boats, and small engine equipment) for refuge operations.

- Calculate the annual metered/potable water use.

- Estimate 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.

Yianni Laskaris 2013

Newly hatched piping plover chicks

Alternative C. Natural Processes

In addition to actions common to all alternatives, alternative C proposes less frequent and intensive management, guided by a philosophy of allowing natural processes and succession of habitats to progress, consistent with preserving wilderness character, and to the extent that it does not compromise refuge purposes and goals. Generally, wildlife and habitat management, and inventories and monitoring efforts would be decreased from alternative A. We would manage the refuge visitor services programs with an emphasis on providing opportunities for wildlife-based recreation that use primitive means and provide solitude, and increased emphasis on non-motorized (paddling or walking) means for accessing the Monomoy Wilderness.

The Natural Processes alternative is summarized under alternative C in table 3.2, which compares the three management alternatives for Monomoy NWR.

Habitat and Population Management

Under this alternative, active habitat management would be decreased compared to those described under alternative A. We would focus on protecting existing habitat for federally listed species, but would reduce our focus on expanding these habitats by allowing natural succession to dominate.

Inventories and Monitoring

There would be decreased inventories and monitoring associated with the decrease in habitat management, and the focus would remain on federally listed species. Monitoring of other high priority species may continue, but efforts would generally be reduced.

Visitor Services

Under this alternative, interpretation opportunities would decline, as all commercial ferry services would be discontinued. A concessionaire system would be established under this alternative but participants would not be allowed to provide motorized transportation to the refuge. We would seek arrangement for non-motorized access to North Monomoy Island and South Monomoy either through a concessionaire or special use permit, as there is still a need to provide access for wildlife-dependent recreational uses on the refuge. Motorized boat access to the Monomoy Wilderness, including the tidal flats and beaches, would not be permitted. All visitor access would be by non-motorized means, such as walking, paddleboarding, or kayaking. Environmental education opportunities would be the same as in alternative A. Passive means for dissemination of public information would increase, as under alternative B. Wildlife observation and photography would be the same as in alternative B. Non-priority use opportunities would be managed as under alternative B. We would explore the feasibility of, and if warranted, institute a wilderness access permit, required for all visitors to North Monomoy Island and South Monomoy, including the intertidal flats and beaches.

Wilderness Management

We would manage the Monomoy Wilderness according to the provisions of the Wilderness Act and Service Wilderness Stewardship Policy (610 FW 1-3) to concurrently accomplish refuge (migratory birds and endangered species recovery) purposes and the Refuge System mission, while also preserving wilderness character and natural values for future generations. Refuge management strategies and techniques would be chosen to comply with wilderness stewardship principles and prevent degradation of wilderness character.

The Inward Point non-wilderness area includes the site of the former Monomoy Branting Club and seasonal camps. The Inward Point area is nearing but not yet free of visual evidence of permanent or human-made structures. While all the camps that were located in this area when excluded from the original wilderness designation have since been removed, utility poles, building foundations, and cisterns still are visible. The Powder Hole non-wilderness area includes the

sites of the former Whitewash Village fishing community, where little evidence remains today, and the former Monomoy Point Lifesaving Service and Coast Guard Stations. In addition, the Powder Hole area also includes the "cherry stem" access trail corridor and approximately 4-acre site of the existing Monomoy Point Light Station buildings, a National Register of Historic Places designated site.

Although these two areas were excluded from the wilderness designation in 1970, Congress intended the Secretary of the Interior to manage the entire area consistent with the concept of wilderness (House of Representatives, Report No. 91-1441) so they will eventually achieve wilderness character and be added to the Monomoy Wilderness. Neither area has yet achieved wilderness character due to the evidence of past human occupation that still remains. Therefore, these two non-wilderness areas are not yet recommended for further study during the plan period as wilderness study areas (WSAs). Significant progress toward achieving wilderness character has been made in both areas since 1970. Continuing to apply wilderness stewardship principles in both areas through the 15-year planning period will bring them still closer to achieving wilderness character, when they may once again be reviewed by the Service for suitability as additions to the National Wilderness Preservation System.

Our management of these areas would not change from how we currently manage them, with the exception that the refuge concessionaire would provide and facilitate non-motorized means to reach the Monomoy Wilderness, and cultural and historic site mitigation measures would be emphasized over structural repairs to the Monomoy Point Light Station structures. We would analyze all activities associated with cultural resource mitigation measures, using the minimum requirements analysis process to determine how to safely and practically conduct them using traditional skills and, if necessary, the minimum tool.

Cultural Resources

Systematic mitigation over time to reduce, avoid, or mitigate the adverse effects from natural weathering, erosion, and decay processes on the Monomoy Point Light Station structures and associated archaeological resources will be implemented following National Historic Preservation Act sections 106 and 110 and 36 CFR Part 800 collaborative procedures. This mitigation could include offsite preservation and interpretation that may require periodic mechanized or motorized transport and equipment use and access to the site through the Monomoy Wilderness.

Refuge Administration

There would be an increase in staffing compared to alternative A, but not to the extent proposed in alternative B. There would be some facility improvements, but to a lesser extent than envisioned under alternative B.

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

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 C1.1 (Dune Grasslands—Roseate and Common Terns)

Protect from disturbance and degradation 10 acres of nesting habitat for common terns and enhance and maintain 2 acres of prime nesting habitat for roseate terns. Maintain a minimum productivity of 1.0 chick per nesting pair over a 5-year period for both species of terns.

Rationale

In this alternative, we would focus on managing a smaller area for common terns than is currently being managed (10 acres versus 30 acres in alternative A),

but would still aim to provide 2 acres of high-quality habitat for roseate terns. Natural, rather than human processes, would dominate 20 acres of existing common tern habitat within the Monomoy refuge. The reduction in common tern nesting habitat may result in fewer nesting common terns, but the results of our efforts to maintain 2 acres of high-quality roseate tern nesting habitat are comparable to the current efforts for roseate terns under alternative A. All roseate terns nesting in the Northeast do so in conjunction with large, productive common tern colonies (Nisbet 1981), therefore, it is important to maintain some high-quality habitat for nesting common terns as well. Ten acres of quality habitat could still support thousands of nesting common tern pairs. We would maintain an active predator management program to enhance productivity of both species of terns. In contrast to alternatives A and B, the frequency and duration of our presence in and around the tern colony would likely be reduced, as we would no longer maintain a field camp.

Strategies

Upon CCP implementation:

- Use temporary symbolic fencing (see glossary) to seasonally close tern nesting areas from May through August to minimize human disturbance; if no nesting activity occurs within the closed area, posts may be removed beginning July 1.
- Patrol and enforce closed areas during the nesting season.
- Maintain periodic human presence through visits to the colony and surrounding areas generally 3 times per week from mid-May to early August.
- Use temporary portable blinds (similar to photo blinds) that are easily moved throughout the nesting areas to facilitate the collection of nesting data and predator management.
- Install temporary wooden chick shelters for roseate terns prior to nesting to increase chicks' ability to escape inclement weather and predators, increasing survival.
- In areas within the common and roseate tern nesting area, or within 100 m of the nesting areas, destroy all nest attempts by great black-backed and herring gulls by scattering nesting materials and removing eggs.
- Minimize impacts of avian and mammalian predators to nesting terns through non-lethal and lethal management as described in appendix J.
- In selected areas within the 10-acre nesting area, manipulate vegetation using mechanical methods, herbicide, and rotational prescribed burning to improve nesting habitat for terns and discourage nesting by competitor species, including laughing gulls.
- Coordinate with avian disease specialists at the National Wildlife Health Center in Madison, WI, to document, detect, and minimize the spread of avian diseases.
- Review 5-year reviews and recovery plan updates for roseate terns within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

Monitoring Elements

- Conduct complete nest counts refugewide for both species during the Massachusetts Statewide tern census window (currently June 5 to 20) and collect spatial data via a 60×60 m grid system to determine success of management in maintaining suitable habitat.
- Quantify productivity to determine success of management by recording clutch sizes, hatch success, and fledgling success for all nesting roseate terns and approximately 1 to 3 percent of all nesting common terns within the 10-acre nesting area.
- Trap banded roseate tern adults (as time allows), and band chicks to improve fledge success estimates, to document nesting site fidelity, contribute to metapopulation studies, and determine whether Monomoy NWR serves as a sink versus source population.
- Document changes in habitat within the grid system, especially before and after habitat management actions, but at least annually.
- Census laughing, herring, and great black-backed gulls in Area A to track population changes and distribution of predator and competitor species; collect spatial data via a 60×60 m grid for laughing gull nests.
- Monitor nesting attempts of herring and great black-backed gulls in and within 100 m of the tern nesting area.
- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings) and conduct nocturnal observations to improve understanding of predator impacts; quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.
- Conduct a complete census of all gulls on North Monomoy Island and South Monomoy every 10 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.
- Update a cover-type map refugewide every 10 to 15 years.

Objective C1.2 (Beach Shoreline and Dune Edges—Piping Plover)

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

Rationale

In this alternative, management actions would be the same as in alternative B for piping plover, except that we would not evaluate the appropriateness of using dredge material or other habitat alterations to accommodate sea level rise, and electric fencing would not be used. Actions implemented for piping plovers in this alternative would also benefit American oystercatchers and least terns, though there are not separate objectives for these species in this alternative.

Strategies

Continue to:

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

Within 1 year of CCP implementation:

- Use temporary symbolic fencing to seasonally close all suitable piping plover habitat regardless of the presence of pairs early in the season (March or April) and 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; once these criteria are met, fencing would be removed as staff time allows.
- 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.

Monitoring Elements

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

- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of nesting habitat.

- Update a cover-type map refugewide every 10 to 15 years.

Objective C1.3 (Beach—Northeastern Beach Tiger Beetle)

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

Rationale

This objective is the same as alternative A, objective A1.5. We would not actively pursue the use of the Monomoy NWR population as a donor site, but would support this work if led by partners. As in alternative A, we would also support priority research that would enhance recovery efforts.

Strategies

Continue to:

- Maintain vehicle closures on refuge lands to protect habitat and allow for continued population growth. Cooperate with the Town of Chatham, State of Massachusetts, U.S. Coast Guard, and other partners involved in emergency and public safety operations to protect tiger beetles and habitat when vehicle access is deemed essential to protect human life. This includes increased monitoring when vehicles are present to minimize habitat degradation and mortality by over-sand vehicles.

- Regularly inform and communicate with officials and the public about areas occupied by tiger beetles on the refuge, including Nauset/South Beach, to foster continued support for protection and monitoring of tiger beetles currently using these areas and allow for continued expansion of spatial distribution.

- Review 5-year reviews and recovery plan updates for northeastern beach tiger beetles within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.

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

Monitoring Elements

- Conduct site visits once in June and twice weekly in July and August to delineate habitat being used by adult beetles; during these visits, perform low intensity mark-resight efforts to estimate the population and calculate survival probability.

- Conduct larval activity site visits in the late September and early October peak period, to assess reproductive success and delineate larval habitat.

- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of spawning habitat.

- Update a cover-type map refugewide every 10 to 15 years.

Objective C1.4 (Intertidal—Migrating and Staging Birds, Horseshoe Crabs, and Marine Mammals)

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

Rationale
See alternative A, objective A1.7.

Strategies
Continue to:

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

Within 5 years of CCP implementation:

- Initiate an outreach campaign to provide information to all visitors about the importance of minimizing disturbance to migrating and staging birds; the outreach message would focus on a recommended viewing distance of at least 50 m to allow birds to remain undisturbed in their resting and foraging areas critical to successful migration.

- Annually identify areas refugewide that consistently support foraging or staging red knots or roseate terns, and seasonally close to all human use areas subject to high levels of disturbance.

Monitoring Elements

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

Objective C1.5 (Maritime Shrubland, Salt Marsh, Freshwater Ponds, and Nearshore Marine Waters—Biological Integrity, Diversity, and Environmental Health)

Promote biological integrity, diversity, and environmental health (BIDEH) to ensure that the historical, regional, and conservation roles of the refuge are preserved. This objective is broad in intent and may emerge in a variety of ways based on the specific history and role of Monomoy NWR.

Rationale

In alternative C, we do not implement habitat or species-specific objectives for species that are not federally listed. Therefore, objectives that were presented in alternative B for maritime shrubland, salt marsh, freshwater ponds, and nearshore marine water habitats are addressed in alternative C as one objective focused on BIDEH. While achieving our individual refuge purposes and the Service mission, it is important for refuge managers to preserve all habitats and species and to maintain a base level of conservation standards. Under this objective, the refuge would strive to continue to protect all the native species present on the refuge regardless of listing status. This objective serves as an umbrella objective to ensure that BIDEH is maintained on the refuge so the historical, regional, and conservation roles of the refuge are preserved.

BIDEH can be described at various landscape scales, from refuge to ecosystem, national, and international. Each landscape scale has a measure of BIDEH dependent on how the existing habitats, ecosystem processes, and wildlife populations have been altered in comparison to historic conditions. Levels of BIDEH vary among refuges, and often within refuges, over time. Individual refuges contribute to BIDEH at larger landscape scales, especially when they support populations and habitats that have been lost at an ecosystem,

national, or even international scale. In pursuit of refuge purposes, individual refuges may at times compromise elements of BIDEH at the refuge scale in support of those components at larger landscape scales. When evaluating the appropriate management direction for refuges, refuge managers consider their refuges' contribution to BIDEH at multiple landscape scales (policy 601 FW 3). Management, ranging from preservation to active manipulation of habitats and populations, is necessary to maintain BIDEH. We favor management that restores or mimics natural ecosystem processes or functions to achieve refuge purposes. Alternative C, objectives C1.1, C1.2, and C1.3, may have a larger focus on active management than this objective, but active management may still be implemented in this objective to maintain BIDEH in these habitats and promote native wildlife. BIDEH is defined by the Service in policy 601 FW 3, which can be viewed at *http://www.fws.gov/policy/601fw3.html*; accessed April 2013.

The refuge has never been officially open to the commercial harvest of fin fish, lobster, crab, whelk, aquaculture, or the removal of any shellfish other than by hand-harvest methods. Horseshoe crab harvesting had been previously allowed but was closed in 2002.

Within these habitats, priority species have been discussed in detail in the rationale sections of alternative A (objectives A1.3, A1.4, A1.6, A1.8, and A1.9) and alternative B (objectives B1.3, B1.4, B1.6, B1.10, B1.11, and B1.12). In alternative C, we would largely promote these species by providing healthy habitats relatively free from human disturbance. In some circumstances, species-specific strategies would still be implemented; those are listed below.

Strategies

Continue to:

- Allow nonnative rugosa rose to remain on the refuge in areas where wading birds nest.
- 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.
- Patrol and enforce closed areas.
- Maintain and enforce closure of the refuge to horseshoe crab harvesting.
- Maintain and enforce closure of the refuge to mussel harvesting to preserve food sources for red knots and American oystercatchers.
- Evaluate aquaculture requests in open water-submerged bottom areas (below mean low water) within the Declaration of Taking boundary for compatibility and benefits to refuge resources on a case-by-case basis.
- 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 study wintering sea ducks using the waters surrounding the refuge and monitor impacts of diseases effecting these populations.

- Support partner efforts to study shellfish and fin fish stocks, marine mammals including seals, and their principal predator, the great white shark.

- Support partner efforts to assess genetic diversity of eelgrass across the region and test it against an experimental factorial design of potential stress parameters.

- Support partner efforts of New England Aquarium and Mass Audubon to rescue stranded sea turtles and collect dead sea turtles recovered from refuge waters for scientific research.

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

Within 1 year of CCP implementation:

- Prohibit bottom substrate-disturbing fishing activities such as mussel harvesting, scallop dragging, or any hydraulic dredging for shellfish within the Declaration of Taking refuge boundary in order to protect eelgrass beds and maintain productive benthic communities for wildlife.

- Use temporary symbolic fencing to seasonally close portions of maritime shrublands with high densities of nesting wading birds and high seasonal public visitation from April to August and most salt marsh habitat on North Monomoy Island to minimize trampling of vegetation and invertebrates and disturbance to nesting saltmarsh sparrows and American oystercatchers from April to September.

- Install salt marsh elevation tables in refuge salt marshes to evaluate the effects of various factors on the salt marshes' ability to keep pace with sea level rise.

- Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to protect habitats from the effects of erosion and sea level rise (refer to alternative B, objective B1.1 rationale).

- Support partner efforts to study potential impacts of offshore wind or tidal energy development to resources of concern.

- Strengthen partnerships to manage lands adjacent to the refuge and throughout Cape Cod to enhance BIDEH and priority species across the landscape.

Within 5 years of CCP implementation:

- Control nonnative invasive plant species throughout maritime shrubland, salt marsh, and freshwater pond habitats using manual tools, herbicides, or prescribed fires to ensure less than 10 percent coverage refugewide.

- Work with partners to evaluate and map the current and historic extent of submerged aquatic vegetation, specifically eelgrass, within the Declaration of Taking to determine whether these species are stable, decreasing, or increasing and if active management of the resource is necessary.

- 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.

- 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.

Monitoring Elements

- 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.
- Conduct annual census of American oystercatchers as identified in alternative A, objective A1.3.
- Conduct annual census of least terns as identified in alternative A, objective A1.4.
- Partner with NOAA to conduct pupping counts and aerial surveys of haulout sites to track use by seals refugewide.
- Monitor and report entangled and stranded marine mammals.
- Analyze saltmarsh sparrow survey data from previous years to determine population trends and inform future management and inventory needs.
- Record the number of mosquito samples monitored on Morris Island for West Nile Virus or other arboviruses that pose a potential human health risk.
- Collect salt marsh elevation information from salt marsh elevation tables and evaluate the need for remediation.
- In future years, monitor growth and expansion of the marsh through coastal shoreline monitoring protocols currently being developed; in the meantime, monitor growth and expansion through onscreen digitizing of aerial photos combined with ground-truthing.
- Monitor American oystercatcher productivity throughout the nesting season by searching nesting areas at least 2 times per week beginning in early April to document nest locations, laying, hatching, nest failure or success, and overall productivity.
- Map locations and record abundance of invasive/nonnative species; monitor changes in species composition, and evaluate effectiveness of control techniques implemented.
- Record the number of enforcement actions taken against illegal harvesters of horseshoe crabs in refuge waters.
- Record the number of aquaculture activities initiated within refuge waters.
- Monitor the impacts of dredging projects on subtidal areas within the refuge boundary; this may involve pre-and post-dredging monitoring of substrates, submerged aquatic vegetatios, or benthic communities.

- Monitor avian health of common eider and other sea ducks by conducting surveillance during fall and winter to detect field mortality events, documenting observations of sick or dying birds, and identifying, collecting, and submitting dead birds for analysis at the National Wildlife Health Center in collaboration with the Region 5 Migratory Birds Office.

- Update bathymetry data refugewide every 10 to 15 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 promote stewardship of the wildlife and habitats of Monomoy NWR.**

Objective C2.1 (Access and Use)

With primary consideration to wildlife and wilderness character protection and public safety, allow public access to Morris Island, North Monomoy Island, South Monomoy, including Nauset/South Beach, and Minimoy Island while accommodating an anticipated minimum 25 percent visitation increase to the Monomoy NWR over the period. Ensure refuge visitors accessing the Monomoy Wilderness use non-motorized means, such as paddling or sailing.

Rationale

The majority of the land on Morris Island is privately owned, and access to refuge headquarters and the visitor contact station is provided via a right-of-way over private land as already summarized under alternative B.

The absence of both directional and informational signs can make Monomoy NWR difficult to locate. No signs off the highway or in Chatham direct or inform potential visitors about Monomoy NWR until just before the refuge entrance. A further complication is that the Morris Island parcel where the headquarters and visitor contact station is located lies beyond a gate identifying the roads of the Quitnesset neighborhood as private. The lack of adequate signs deters and discourages visitors and causes confused visitors to accidentally drive through private neighborhoods while trying to find the refuge facilities. Upon reaching the headquarters, visitors often arrive to a full parking lot and either leave without visiting the refuge or are compelled to park along the east side of the Morris Island Road causeway. The causeway is narrow and cars parked on the side impede traffic flow and can be a safety issue for pedestrians.

The U.S. Department of Transportation Volpe National Transportation Systems Center study, “Alternative Transportation Study: Monomoy National Wildlife Refuge” (May 2010), evaluated 21 (of 39 identified) transportation interventions addressing a variety of transportation safety and access issues at Monomoy NWR. These interventions improve multi-modal access, reduce traffic and parking congestion, improve traveler safety, enhance the visitor experience to Monomoy NWR and within Chatham, and develop and enhance partnerships with governmental and nongovernmental agencies. Alternative C strategies initiate several interventions recommended by the Volpe Center offering potential long-term relief from conditions currently limiting visitor access, specifically, finding the route through Chatham to reach Monomoy NWR. Implementation of the transportation plan would also assist the refuge in pursuing carbon neutrality by the year 2020 as proposed by the Service in its Visions document.

In this alternative, a concession would operate from refuge headquarters, but shuttle visitors from an off-refuge parking site to Morris Island and ferry visitors to North Monomoy Island and South Monomoy. Concessionaires would conduct interpretative natural and cultural history tours, arrange for refuge-permitted fishing or waterfowl hunting guides, rent kayaks, and provide other visitor related services. Two parking spaces would be provided for the concessionaire

and shuttle vans. The concessionaire would 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.

Currently there are no improved facilities for launching kayaks or small sailboats from the Morris Island portion of the refuge. The nearest undeveloped launch site is from the nearby Morris Island Road causeway. While there are several businesses that rent kayaks and paddle-boards in Chatham and surrounding communities, none are proximal to the refuge or the Monomoy Wilderness. Increasing the proportion of visitors accessing the Monomoy Wilderness via non-motorized transport decreases noise levels and noise disturbance of nesting, foraging, or resting migratory birds of conservation concern, while enhancing the opportunities for finding solitude within wilderness. Atmospheric carbon emissions from fossil-fuel consumption would also decrease.

An entrance fee would be collected under this alternative. Proceeds from the fee collection would be reinvested in the refuge to provide and maintain facilities for visitor use.

This alternative provides for compatible public use but is more conservation focused; it reduces potential disturbance to wildlife and its habitat to the maximum extent possible, while still allowing some public use of the refuge. The benefits to wildlife under this alternative are explained under goal 1.

As we proposed under alternative B, we would also close the refuge to dog walking within a year of the publication of this plan. We have found dog walking to disturb wildlife and other visitors and create unsanitary conditions; it is not considered one of the six priority uses on national wildlife refuges, and has not been found to be an appropriate use of the refuge.

Strategies

Continue to:

- Open all of North Monomoy Island to the public from October to March. During the April to September nesting season (map 2.8), an east-west trail corridor bisecting North Monomoy Island is open to the public as is the Broad Creek area to the south; in addition, the entire perimeter of North Monomoy Island below the mean high tide line is open for public circumnavigation around North Monomoy Island.

- Restrict travel on the refuge to foot traffic to maintain the wilderness character of North Monomoy Island and South Monomoy and protect sensitive nesting areas and wildlife habitat; this may include limiting access to dune areas to prevent erosion, as necessary.

- Maintain and enforce closure of the refuge to operation and landings of motorized personal watercraft (e.g., wave runners, jet skis) on the refuge land and in refuge waters.

- Maintain and enforce closure of the refuge to kiteboarding operation within the Declaration of Taking-Marine Protected Area boundary.

- Use the existing rights-of-way on Tisquantum Road, Wikis Way, and Stage Island Road to access refuge properties.

- Phase out non-Service parking and dinghy storage at Stage Island Lot 7b.

- Assist in enforcement of the Marine Mammal Protection Act through regular communication and coordination with staff from partner agencies and organizations, including the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, and International Fund for Animal Welfare.

Within 1 year of CCP implementation:

- Utilizing adaptive management, strive to keep Morris Island and large portions of South Monomoy Island (including Nauset/South Beach) open year-round, and re-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 in order to provide additional wildlife viewing and photography opportunities; temporarily close portions of the refuge only when necessary to protect wildlife and their habitat based on seasonal use by priority species.

- Do not allow motorized boats to land along the Monomoy Wilderness shoreline, including the tidal flats and beaches; allow paddling (kayak, canoe, rowed boats, paddle-boards) and sailing to continue.

- Improve visibility of the right-of-way trail access to the western portion of Morris Island refuge property off of Tisquantum Road; improve signs so visitors can easily view the access point and understand they have the right to use the path to access the refuge.

- Expand the ban on pets, including dogs on leash, to the entire refuge, including Morris Island and the part of Nauset/South Beach that is now part of South Monomoy Island.

- Work to acquire an additional parking area adjacent to the Stage Island lot for refuge use only; terminate all parking privileges for non-Service staff purposes within 60 days of CCP completion.

- Include parking requirements in all special use permits issued to commercial guides, photographers, and others.

Within 5 years of CCP implementation:

- Develop an entrance fee system that includes a 1-day entrance fee that would be charged per car or per group if arriving via foot or bicycle.

- Use funds from the Service's recreational fee program to maintain and improve visitor facilities and/or the hiring of temporary staff to provide enhanced visitor services.

- Replace the current motorized seal tour-ferry access system from the refuge headquarters on Morris Island with a competitive, multi-year concession, or special use permit holders if no concessionaire is identified. All commercial wildlife watching tours, passenger ferry service, kayak or paddling tours, and hunting and fishing guides would, within 2 years of CCP approval, need a refuge permit to operate within the refuge Declaration of Taking boundary, regardless of whether vessels or passengers make a refuge landfall.

- Through local and regional partners, provide a local-area shuttle serving Morris Island refuge facilities and other destinations in Chatham from secure, satellite parking locations during the June 1 to September 15 peak visitor season.

- Expand the shuttle beyond simple passenger transport to include transport of kayaks and gear and bicycles, in addition to people.
- Work with municipal partners on the use of a town-owned or private parking facility that could serve as a satellite parking location for a shuttle service that would bring visitors to the refuge.
- Assist the Town of Chatham to move the fencing and improve the shoulder on the east side of the Morris Island Road causeway to better accommodate shuttle passage, parked cars, and emergency vehicles.
- Encourage the Town of Chatham to create a multi-use bicycle and pedestrian path on one side of the causeway, and provide assistance as possible to help the town implement this project.
- Provide bicycle and pedestrian facilities and amenities through local and regional partners at 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 refuge Morris Island facilities, including designated trails, satellite parking and shuttle stops, and the concessionaire's off-refuge facilities; this may involve the erection of new signs within Service rights-of-way on land owned by others.
- 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, and sites managed by local and regional partners.
- Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted.
- Encourage paddling as a means of transportation to the Monomoy Wilderness portions of the refuge, particularly North Monomoy Island, by collaborating with local and regional partners or the refuge concessionaire to provide kayaking launch facilities, rentals, instruction, and group outings to the Monomoy Wilderness.
- Explore the feasibility of improving a non-motorized watercraft launch site at the northern stairway and existing asphalt path or along the Morris Island causeway; examine possibilities for constructing a waterfront access way meeting Americans with Disabilities Act requirements at the headquarters site or across the Tisquantum Road right-of-way.
- Extend an Americans with Disabilities Act-compliant boardwalk segment from the existing Morris Island Trail boardwalk to the Nauset/South Beach-Outermost Harbor overlook trail stops.

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 number of special use permits.
- 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 validated parking passes.

Objective C2.2 (Interpretation)

Within 5 years, refuge visitors would receive information regarding the Service, the Refuge System, the relationship of refuge habitats and management to endangered species recovery, biotic diversity, wilderness character and ethics, and natural coastal processes that shape the land itself and plant and animal communities. Interpretive opportunities would be offered primarily through virtual and self-guided means that would focus on key refuge messages such as migratory birds, listed species, and wilderness character.

Rationale

Under this alternative, interpretation would be primarily remote or virtual, and have increased emphasis on communicating the importance of preserving wilderness character and values such as naturalness and solitude. Issuing a wilderness access pass would carefully limit the number of visitors at one time to the Monomoy Wilderness. In limiting the number of visitors and providing a hands-off experience, visitors are more likely to focus on the wilderness characteristics of the refuge and encounter solitude, which would lead to an enhanced experience and understanding of the value of an enduring wilderness resource.

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 and wilderness preservation. Public understanding of the Service and its activities in the Commonwealth of Massachusetts is currently very 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.

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 would further increase opportunities for interpretation. Parking at the Morris Island visitor contact station is limited, and an alternative visitor contact facility located in Chatham would allow for increased interpretive opportunities. Access to most of the refuge is limited by boat. A concession system for non-motorized tours/outings would increase access and opportunities for interpretation. A safe, easily accessible and less congested visitor contact facility that provided adequate parking could serve as a location where shuttles run by partners or concessionaires bring visitors to the refuge. In order to maintain the integrity of wilderness, no kiosks would be constructed on North Monomoy Island or South Monomoy. Information will be available through the use of technology, such as podcasts and handheld devices such as PDAs.

Strategies

Continue to:

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

Within 1 year of CCP implementation:

- Improve informational materials at Morris Island kiosk to highlight the importance of the Monomoy Wilderness and the importance of the refuge to threatened and endangered species as a migration stopover site.
- Issue permits for interpretive commercial water-based tours and interpretive commercial land-based natural history and cultural history tours until a concessionaire contract is awarded.
- Work with a concessionaire or professional guide services to provide natural history and wildlife day trip tours of the islands.
- Conduct seasonal interpretive programs at the refuge by refuge staff, interns, and volunteers, and provide roving interpreters on the Morris Island Trail; content will include wilderness area components.
- 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, etc.
- 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.

Within 5 years of CCP implementation:

- Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted.

- 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, such as seals.

Within 7 years of CCP implementation:

- Use virtual technology to conduct interpretation such as text tours, podcasts, and virtual geocaching and letterboxing.

- Explore the option of creating a smartphone application with Monomoy Wilderness coordinates and information about the wilderness designation.

- Develop podcasts and other materials designed to provide portable interpretation to refuge visitors about refuge resources such as species of concern, migratory birds, and the Monomoy Wilderness.

- Develop a self-guided interpretive kayak trail and brochure.

- Increase the focus on the role of natural processes in shaping refuge habitats in refuge informational products and delivery.

- Work with the Arthur Carhart Wilderness Center to develop and provide materials that inform the public about wilderness areas.

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 that report use of geocaching trail and stamp letterbox.

- Record the number of visitors to the visitor contact station on a daily basis.

- Record the number of refuge brochures and rack cards ordered on an annual basis.

- Record the number of visitors who participate in concessionaire-led tours.

- Record the number of participants on tours guided by refuge staff and volunteers.

Objective C2.3 (Environmental Education)

Within 5 years of CCP approval, we would provide at least one curriculum-based onsite environmental education program for local and regional school districts to use that will focus on Monomoy NWR, Monomoy Wilderness, the Refuge System, National Wilderness Preservation System, species of conservation concern,

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USFWS

and natural ecological processes. Students who participate in the refuge's environmental education program would be able to understand the importance of wildlife conservation, with a focus on migratory birds; understand the need for wilderness stewardship; identify the Monomoy's role in the National Wildlife Refuge and National Wilderness Preservation Systems in conserving Federal trust resources; explain the unique characteristics of the Monomoy Wilderness; and 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*. Environmental education programs can promote understanding and appreciation of natural and cultural resources and their conservation on all lands and waters in the Refuge System. Generally, conducting environmental education involves more than facilitating field trips. It requires the refuge to develop a course of study designed to meet national and state curriculum-based academic standards. We believe that educating people about the significance of the refuge for birds and other wildlife would foster an appreciation of conservation and encourage them to make environmentally responsible decisions.

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

There are multiple efforts being made nationally and internationally to connect children with the outdoors and 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 but 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 appears to be imperative now more than ever for local organizations to facilitate and provide opportunities for children to explore and learn in the outdoors.

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

The refuge currently does not have a curriculum-based environmental education program, but occasionally accommodates requests to host school groups.

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 for the refuge incorporating strategies identified herein; 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; modify or restrict access, or adapt management strategies as warranted.

- Host one to two teacher workshops each year on threatened and endangered species, the value of Monomoy Wilderness, 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 and develop curricula and programs that would enhance or complement area environmental education programs, e.g., outer Cape region.

- Provide access to Children and Nature Network tool kits in English and Spanish.

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 currently not being served by other education organizations.

Within 10 years of CCP implementation:

- In coordination with partners and based on the findings of the pilot study, create at least one curriculum-based environmental education program that can be utilized by local and regional school districts onsite or offsite that incorporates the Massachusetts curriculum frameworks as well as key refuge messages.

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 teacher workshops and the number of attendees at each one.
- Record the number of times schools check out tool kits.

Objective C2.4 (Wildlife Observation and Photography)

Over the next 15 years, increase the number of wildlife observation and photography visits by 50 percent in a manner consistent with preserving wilderness, "taking nothing but photographs and leaving behind nothing but footprints."

Rationale

The refuge facilitates opportunities for wildlife observation and photography through self-guided nature trails and observation areas. We strive to provide safe, accessible wildlife observation and photography opportunities while protecting wildlife and their habitats at sensitive times in sensitive places on the refuge, and preserving wilderness character. Providing high-quality opportunities for visitors to engage in these activities on the refuge promotes visitor appreciation and support for refuge programs.

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.

This alternative expands upon alternative A by enhancing visitor services (e.g., special use permits for filming, rental of pop-up blinds) to increase wildlife observation and photography opportunities. We would promote the use of refuge-permitted guides to facilitate enhanced and increased opportunities for the public to observe and photograph wildlife on the refuge. Monomoy NWR is known worldwide for its magnificent and dynamic landscape, and it offers the chance to participate in premiere bird watching. Those who visit North or South Monomoy experience something magical and unique at the refuge, and find a sense of true escape and solitude in the wilderness. The refuge staff receives multiple requests for commercial filming and photography each year. As production companies recognize the unique experience Monomoy refuge offers, their desire to capture that to share with the world places demands on refuge staff.

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

its 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 can 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 variety of visitors; and observers who have minimal conflict with other priority wildlife-dependent recreational uses or refuge operations.

In 2009, the U.S. Fish and Wildlife 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.

In 2006, the Service published an additional report, compiled by Service economists, entitled *Banking on Nature 2006: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation.* According to the study, recreational use on national wildlife refuges generated almost $1.7 billion in total economic activity during fiscal year 2006. The study found that nearly 35 million people visited national wildlife refuges in 2006, supporting almost 27,000 private sector jobs and producing about $543 million in employment income. In addition, recreational spending on refuges generated nearly $185.3 million in tax revenue at the local, county, State and Federal level. The economic benefit is almost four times the amount appropriated to the Refuge System in fiscal year 2006. About 87 percent of refuge visitors travel from outside the local area.

Strategies

Continue to:

- Allow wildlife observation, which includes nature study, year-round on refuge lands open to public use from ½ hour before sunrise to ½ after sunset; prohibit touching, feeding, or harassing wildlife.

- Maintain the two viewing platforms on Morris Island (map 1.2).

- Allow commercial filming and photography on the refuge only when there is a direct benefit to the refuge or the Service; once determined compatible by the refuge manager, all allowed commercial filming and photography would operate under a special use permit.

- Allow photography in any area of the refuge open to the public.

- Host a youth or adult photography contest.

Within 5 years of CCP implementation:

- Complete a visitor services plan for the refuge incorporating strategies identified herein; 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; modify or restrict access, or adapt management strategies as warranted.

- Provide trails on refuge lands for wildlife observation; the wilderness trails would not be maintained by refuge staff, but would be clearly marked by satellite coordinates so visitors may use GPS-enabled devices to find the path, if necessary.

- Evaluate use of a critter cam(s) so the public can observe nesting behavior online, which would facilitate a connection to animals they may not be able to view in person.

- 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 develop photography tours with emphasis on the unique values and opportunities of the Monomoy Wilderness.

Within 7 years of CCP implementation:
- Evaluate and implement opportunities for universally accessible observation; enhance the existing boardwalk at the refuge headquarters to make it Americans with Disabilities Act-compliant for improved observation opportunities at the overlook on Morris Island Trail.

Monitoring Elements
- Record the number of visitors engaged in wildlife observation and photography annually.

- Record the number of special use permits 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 views to the critter-cam Web site.

Objective C2.5 (Fishing)

Provide opportunities for fishing in a manner consistent with preserving and promoting wilderness character, and ensure that 75 percent of visitors engaged in recreational fishing report that they had a high-quality experience.

Rationale
The waters off Monomoy NWR have a deserved reputation as a world-class fishery. Novice anglers as well as experienced anglers visit Monomoy NWR every year. Many recreational anglers are accompanied by commercial guides. As this is a commercial activity, it must be regulated on the refuge by use of a special use permit. There are many benefits to anglers who are working with a commercial guide with the oversight of refuge staff. This oversight is only possible if all commercial guides obtain a special use permit issued by the refuge manager. The special use permit would identify refuge rules, regulations, and closed areas, highlight habitats and species of concern that should be avoided by anglers to reduce disturbance, and would explain wilderness so all activities conducted by anglers are consistent with the wilderness character of refuge lands and waters. Refuge staff would establish a fair and equitable system for commercial fishing guides to operate on the refuge. The refuge expects these guides would help increase fishing opportunities on the refuge with an added level of safety, reduce conflicts with refuge wildlife, protect refuge sensitive refuge habitats, and ensure greater protection and appreciation of wilderness character.

Most fishing visits are for surf fishing, but some visitors also engage in the harvest of lobsters, crab (not horseshoe crabs), and whelk. Where fin fishing, lobster, crab, and whelk pot harvesting, and hand-harvest of scallops occur in the open waters lying above the submerged lands within the Declaration of Taking, we will work with the National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries to implement their regulations for these fisheries. These activities do not cause disturbance to the submerged lands.

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 uncrowded 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; and complements the wilderness characteristics of the refuge.

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 fishing in the open waters, above submerged lands, under State and Federal regulations. Included fishing activities are: demersal long line fishing; mid-water trawl fishing, hook and line/rod and reel fishing; lobster, crab, and whelk pot fishing; and, hand-harvest of scallops.

- Allow anglers to fish on Morris Island 24 hours per day in accordance with all Federal and State fishing regulations.

- Allow freshwater fishing in the ponds on South Monomoy during daylight hours.

Within 1 year of CCP implementation:

- 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 would include closed areas maps and any additional refuge-specific regulations.

Within 3 years of CCP implementation:

- Replace the current motorized seal tour-ferry access system from the refuge headquarters on Morris Island with a competitive, multi-year concession, or special use permit holders if no concessionaire is identified; the concession would arrange for refuge-permitted fishing or waterfowl hunting guides and provide a system to bring anglers and their guides to the refuge, along with providing other visitor-related services.

- Provide recreational anglers and their commercial guides with permits to operate, using non-motorized transport, in the waters within the Declaration of Taking through the refuge concessionaire agreement (as authorized sub-permittees) or special use permit.

- Establish a station at headquarters for recycling monofilament and safely disposing of fish line.

Within 5 years of CCP implementation:

- Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted.

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

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 the number of special use permits 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 offsite locations receiving information materials.
- Record the amount of monofilament collected from the recycling station.
- Have refuge law enforcement officers ensure that anglers possess the proper license requirements.

Objective C2.6 (Shellfishing)

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

Rationale
Same as alternative B, objective B2.6.

Strategies
Continue to:
- Allow the harvest of subterranean shellfish using non-mechanized, hand methods on intertidal habitats year-round, following State and Town regulations.

Within 1 year of CCP implementation:
- Coordinate with the Mass Division of Marine Fisheries and the Town of Chatham Shellfish Warden to review annual use, obtain harvest records, and promote and ensure the sustainability of the shellfish resource on the refuge.
- Start to enforce the existing prohibition on the use of wheeled carts and other forms of mechanical transport in Monomoy Wilderness.
- Require the use of only non-mechanized, hand-operated harvesting equipment; prohibit all motorized and chemical means for extracting shellfish from the sediment.
- Prohibit bottom substrate-disturbing fishing activities such as mussel harvesting, scallop dragging, or any hydraulic dredging for shellfish within the Declaration of Taking refuge boundary.
- Coordinate with the Town of Chatham Shellfish Warden to ensure all permitted shellfishers using Monomoy refuge acknowledge being provided with information about the refuge purpose and mission, regulations, seasonal closures, and wilderness ethics and stewardship.

Within 3 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 or chlorine.

Monitoring Elements

- Record the number of annual resident and non-resident shellfish harvest permits issued by the Town of Chatham Shellfish Warden.
- Monitor harvest numbers as an indicator of potential threats to softshell clam and quahog resource sustainability by tracking harvest pressure (numbers and take) to determine if it meets refuge compatibility.
- Formulate additional guidelines or regulations, if needed, that further protect species and habitats of concern and sensitive areas, preserve wilderness character, and conduct public guidance/review.
- Monitor impacts to wildlife, particularly staging shorebirds such as red knots and nesting shorebirds such as American oystercatchers.

Objective C2.7 (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

Providing compatible wildlife-dependent recreation and educational activities on units of the Refuge System is a Service priority. The National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. § 668dd et seq.) provides authority for the Service to manage the refuge and its wildlife populations. In addition it declares that compatible wildlife-dependent public uses are legitimate and appropriate uses of the refuge System that are to receive priority consideration in planning and management. There are six wildlife-dependent public uses: hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation. The 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. Increasing hunting opportunities on portions of the area administered by the refuge would allow management of waterfowl populations at acceptable levels, provide more wildlife-dependent recreational opportunities for the public, and promote a better understanding and appreciation of refuge habitats and their associated fish and wildlife resources. Implementation of the proposed actions would be consistent and compatible with the Refuge Recreation Act, Refuge Administration Act, and the Monomoy NWR Comprehensive Conservation Plan.

Hunting at Monomoy refuge and the surrounding area 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. The open water area known as the Declaration of Taking that surrounds the Monomoy refuge has been long recognized for its high-quality waterfowl hunting opportunities. The Service has not regulated this use under past or current management practices.

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 would occur if hunting becomes inconsistent with other higher priority refuge programs or endangers refuge resources or public safety.

Patrols by refuge law enforcement officers would accomplish enforcement of Federal and State hunting regulations. Massachusetts Environmental Police Officers may also conduct enforcement patrols. The frequency of patrols would 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 would 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 objective, and evaluate the hunt program; modify or restrict access, or adapt management strategies as warranted.

- Open a portion of Monomoy NWR to waterfowl hunting in accordance with Federal, State, and local hunting regulations. There will be no fee for individual permits but there will be a minimal processing fee charged by the third-party vendor that issues the hunt permits.

- Require all commercial guides providing guiding services within North Monomoy Island and South Monomoy, including wilderness and non-wilderness areas, to apply for and receive a special use permit to conduct guiding on the refuge (50 CFR 27.97); the fee for this special use permit would not be less than $100 or more than $500 with all monies, minus administration costs, to enhance the hunting program and the hunters' experience.

- Prohibit motorized boat landing in wilderness and the use of decoys on the shoreline to maintain and enhance the wilderness experience.

Monitoring Elements

- Record the number of special use permits issued.

- Record the number of each species harvested.

- Record the number of individual waterfowl 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 U.S. Fish and Wildlife Service.**

Objective C3.1 (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 three offsite opportunities annually within the local community or the Cape Cod region, so residents and visitors can learn about the Monomoy NWR coastal barrier ecosystem, the Monomoy Wilderness, and the role of the Refuge System in protecting and managing those enduring resources.

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 National Outreach Strategy). 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, and helps the public find opportunities to be outdoors, make informed decisions about the future of fish and wildlife resources, and, hopefully, support the actions of the refuge. A Presidential

initiative known as America's Great Outdoors (*www.americasgreatoutdoors.gov*; accessed August 2012) strives to help people connect, or reconnect, with the outdoors through jobs and service, recreation, and education. Effective communication strategies will help us connect people not only to the refuge and its wilderness but also to other nearby conservation areas and organizations.

This objective focuses on achieving such 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 challenges and take advantage of its strengths, the strategies under this objective recommend 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 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. We would 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, U.S. Coast Guard Heritage Museum, Provincetown Center for Coastal Studies, Woods Hole Oceanographic Institution, 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 online.
- Give presentations about refuge management actions and wildlife at venues such as the Cape Cod Natural History Conference.
- Occasionally participate in local festivals and parades.
- Work with the Friends group and volunteers to increase refuge activities and funding opportunities.

Within 1 year of CCP implementation:

- Speak about the refuge and its purpose to local service and civic organizations and conservation partners regionwide, upon invitation only.
- Promote an outreach campaign (already initiated by the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 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 and minimizing disturbance to marine mammals; the outreach message would focus on a recommended viewing distance of at least 150 feet to allow marine mammals undisturbed resting and foraging areas critical to 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.

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.

Monitoring Elements

- Record the number of press contacts and press releases made annually.

- Record the number of attendees and participants at onsite and 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 C3.2 (Community Support)

Over the life of the plan, for the aim of having the public understand our purpose and management activities, develop new and enhance existing partnerships, support the Friends group and volunteers, and provide other forms of support to improve refuge communications and effectiveness and improve our ability to achieve the refuge mission by increasing volunteer hours and the number of partnerships by 50 percent.

Rationale

A primary purpose of these partnerships would be to collaborate on promoting and educating about what it means to visit a wilderness area, and the important role it plays in preserving the quality of life on the Cape Cod region. Refuge Friends groups play a vital role in supporting the mission of the refuge, providing volunteers and community support. Until fairly recently, the Friends of Monomoy were an important part of the refuge by providing some financial support for interpretation and habitat management projects on the refuge. In 2011, the Friends of Monomoy reorganized and reestablished itself, and is growing 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. This is a tremendous asset to a station that only has three permanent staff. Additional volunteer support would be necessary.

Community partnerships can also provide support for refuge programs and activities. Without the dynamic partnerships and relationships within the local community and beyond, the refuge staff would not be able to provide the level of outreach and education that we hope to achieve. The refuge is a public resource,

therefore, community involvement can help create a sense of ownership and deepen individuals' connection to it.

Strategies
Continue to:
- Recruit, train, and guide volunteer efforts on the refuge.
- Maintain a productive relationship with the Friends of Monomoy group that understands the refuge mission and actively supports refuge activities.
- Implement current Friends and volunteer policies according to Draft Friends Policy 633 FW 1-4 and National Wildlife Refuge System Volunteer and Partnership Enhancement Act of 1998 October 5.
- Maintain a volunteer database.
- Encourage the establishing 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.
- Work with partners to promote and educate what it means to visit a wilderness area and the important role it plays in preserving the quality of life in the Cape Cod region.

Monitoring Elements
- Record the number of volunteers and volunteer hours contributed annually.
- Track number of members of the Friends group.
- Record the number of partnerships with Monomoy NWR.
- Record the number of volunteer position descriptions created.
- Record the number of events and number of participants at each event.

REFUGE GOAL 4: **Ensure the spirit and character of the Monomoy Wilderness are preserved.**

Objective C4.1 (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 endangered species recovery) and the Refuge System mission.

Rationale
Wilderness is a congressionally designated land use. As defined by the Wilderness Act, wilderness is untrammeled (free from human control), undeveloped, and natural, and offers outstanding opportunities for solitude and primitive recreation. The National Wildlife Refuge System manages refuge wilderness to secure an enduring resource of wilderness and to 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 or permanent human habitation, and its natural conditions are preserved. Visitors to the Monomoy Wilderness would 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.

Systematic actions over time to reduce, avoid, or mitigate the adverse effects on the structures and associated archaeological resources from natural weathering, erosion, and decay will be implemented following National Historic Preservation Act sections 106 and 110 and 36 CFR Part 800. We would analyze all activities associated with light station structure mitigation measures, and determine through use of the minimum requirements decision guide process how to safely and practically conduct those periodic historic mitigation operations using traditional skills and, when necessary, the minimum tool.

As mentioned under Conducting Resource Management and Public Use Activities Consistent with Wilderness Principles, we will complete minimum requirements analyses as needed during the plan period for refuge administrative and management activities conducted within wilderness essential to fulfilling the purposes of the refuge. Each management activity would be evaluated via the minimum requirements decision guide process, which is a process to identify, analyze, and select management actions that are the minimum necessary for wilderness administration. The minimum requirements decision guide process provides the foundation for the more comprehensive wilderness stewardship plan.

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 non-wilderness areas to maintain or enhance their size, naturalness, and opportunities for solitude or primitive and unconfined recreation throughout the 15-year plan period, to the extent that it will not prevent fulfilling refuge establishment purposes or the Refuge System mission (610 FW).

- Use the appropriate response to unplanned wildfire ignitions that provides for public and firefighter safety, while recognizing periodic fire as a natural process with long-term benefits to an enduring wilderness resource.

- Implement management activities that involve temporary rather than permanent uses or site occupancy, that create no new surface disturbance, do not involve placement of permanent structures or installations (e.g., temporary symbolic fencing), or use motorized equipment or mechanized transport, unless it is the minimum tool possible.

- Provide refuge staff with wilderness stewardship training appropriate for their positions.

- Review all refuge management activities proposed within the Monomoy Wilderness and the Inward Point and Powder Hole inventory areas, and ensure they are consistent with wilderness management using the minimum requirements analysis process presented under Actions Common to All Alternatives.

- Assess current wilderness character (untrammeled; undeveloped; natural; outstanding opportunities for solitude or primitive and unconfined recreation; and other features/unique attributes) within the Monomoy Wilderness and implement the wilderness monitoring component of a wilderness stewardship plan for the Monomoy Wilderness.

Within 1 year of CCP implementation:

- Decrease the use of boats to transport refuge staff to North Monomoy Island and South Monomoy by requiring staff and volunteers to paddle or hike to their work locations when feasible.

- Remove all signs within the Monomoy Wilderness and utilize the kiosk on Morris Island to inform visitors about the Monomoy Wilderness, e.g., allowed uses, boundary, etc.

Within 3 years of CCP implementation:

- Complete a wilderness stewardship plan for the Monomoy Wilderness incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and evaluate visitor experiences; limit or restrict access through use of a wilderness access pass, or adapt management strategies as warranted.

- 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 and implement, if practicable, the minimum access pass program; use as a means of educating and informing the public about the wilderness-designated lands and waters on the refuge, refuge wildlife and management actions, and appropriate use by visitors while in refuge wilderness; limit the number of people allowed at one time in an effort to maintain the solitude character of the Monomoy Wilderness.

- Explore the option of creating a smartphone application with Monomoy Wilderness coordinates and information about the wilderness designation.

- Work with regional airports and the Federal Aeronautic Administration to increase pilot awareness of the 2,000-foot flight ceiling restriction over the Monomoy wilderness.

Monitoring Elements

- Maintain a listing of completed minimum requirements analyses for the refuge, and documentation of the annual minimum requirements analysis review process.

- Record the number of refuge wilderness access passes issued and other special use permits.

- Record compliance with wilderness access pass requirements and number of warnings and notices of violation issued.

- 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: **Protect cultural resources that exist on the refuge.**

Objective C5.1 (Archaeological Resources and Historical Structures)

Identify, evaluate, and preserve all significant 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 on Monomoy NWR threatened by coastal erosion. Protect and preserve significant archaeological resources threatened by proposed ground-disturbing activities or sea level rise damage, or subject to potential artifact looting.

Manage the Monomoy Point Light Station (listed on the National Register of Historic Places) to meet the historic preservation standards of the Secretary of the Department of the Interior to the extent that is prudent and feasible, given the long-term threat to the structures posed by erosion and climate change.

Rationale

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

The Service is obligated to preserve the Monomoy Point Light Station to the extent feasible, but long-term in-situ preservation of the structures at the site would no longer be a priority under alternative C. We would conduct basic maintenance on the structures to keep the light station intact for as long as possible. However, the natural processes of erosion and decay would, over time, result in the destruction of the light station structures at the site. Prior to that eventuality, a program would be implemented to provide for mitigation of these foreseeable adverse effects on the National Historic Register sites and National Register-eligible structures and associated archaeological resources following National Historic Preservation Act sections 106 and 110 and 36 CFR Part 800 collaborative procedures. This could include the relocation of light station structures that may require periodic mechanized or motorized transport and equipment use and access to the worksites along a temporary overland trail or road through the Monomoy Wilderness. The mitigation program would be developed in consultation with the State Historic Preservation Officer and in accordance with the cultural resource provisions of the National Historic Preservation Act and the Wilderness Act. For example, additional analysis and documentation of historic architecture could be completed, and more comprehensive archaeological investigations could be performed. An interpretive display at a mainland location could be based upon historic documents, photographs, maps, and artifacts from the site.

Strategies

Continue to:

- Comply with the National Historic Preservation Act section 106 prior to conducting any ground disturbing activities on the refuge; compliance may entail any combination of State Historic Preservation Officer consultation, literature survey, or field survey.

- Enforce all Federal cultural resource protection laws and regulations including the necessary provisions of Archaeological Resources Protection Act to protect cultural resources on the refuge.

- Develop and implement throughout the plan period a historic site management plan for the Monomoy Point Light Station structures and associated archaeological structures, following National Historic Preservation Act sections 106 and 110 and 36 CFR Part 800 collaborative procedures; the plan would 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 collaboratively with the State Historic Preservation Officer 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.

- Identify, evaluate, or survey cultural resources on the refuge on a project-specific basis.

Within 5 years of CCP implementation:

- Establish a protocol with the Massachusetts Board of Underwater Archaeological Resources for examination and assessment of historic shipwreck remains that may appear.

Within 10 years of CCP implementation:

- Develop a mitigation plan for the Monomoy Point Light Station to implement an interpretive program of exhibits, documentary research, archaeological investigation, and possible relocation of structures, prior to the destruction of this National Register site by natural forces.

Monitoring Elements

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

- Enforce Federal cultural resource protection laws and regulations by patrolling refuge lands for violations, and investigating any violations that are detected in accordance with the Archaeological Resources Protection Act.

- Monitor erosion damage 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 C6.1 (Staffing)

Over the next 15 years, fill six additional permanent full-time positions to implement the activities outlined in alternative C (see appendix G for proposed staffing chart under alternative C). Provide a diverse and inclusive workplace through annual training, support, and awareness.

Rationale

The refuge must still carry out its affirmative responsibilities to protect refuge resources and preserve wilderness character. This requires an increase in staff, as the work of the refuge cannot be done with just three permanent employees.

We base the addition of six new staff members on the 2008 national staffing model for the National Wildlife Refuge System, which indicated that Monomoy refuge, due to its location, size, number of visitors, and complexity of its biological program, should have a permanent staff of nine full-time employees. The composition of these positions varies from alternative B in that the concentration of the work will be different. Additionally, due to increased travel time refuge staff will spend paddling and hiking to assigned field work locations under alternative C, a substantially larger seasonal workforce is needed than under alternatives A and B.

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 committed to creating and maintaining a diverse and inclusive workplace. An inclusive workplace is one where all employees feel they are part of a team with open communication, 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, and wilderness staff, interns, and volunteers.
- Work with organizations such as the Student Conservation Association and the Federal Pathways program to hire talented young college students for seasonal intern positions.
- Provide a safe work environment 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 understanding of diversity and inclusion.

Within 15 years of CCP implementation:

- Fill one Visitor Services Specialist position.
- Fill one Maintenance Worker/Boat Operator position.
- Fill one Administrative Assistant position.
- Fill two Park Ranger-Law Enforcement positions.
- Fill one Refuge Operations Specialist position.

Monitoring Elements

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

Objective C6.2 (Facilities and Maintenance)

Over the life of the plan, provide adequate, safe, and energy-efficient infrastructure and equipment to safely support refuge staff, interns, and volunteers, while sharing a headquarters site with National Weather Service facilities.

Rationale

Adequate, properly functioning facilities are needed to support staff, volunteers, the visiting public, and the co-located National Weather Service upper air sounding operations. Current space is barely able to accommodate alternative A staffing plus co-location of visitor contact station and staff offices during the peak (April-October) field and visitation seasons. This peak season also coincides with very high seasonal rental rates. The Cape Cod and Islands region has very high housing costs, and affordable seasonal rental rates in the outer Cape are in very short supply. Refuge-provided housing will remain essential for recruiting the best qualified candidates by offsetting housing costs. Relocating the majority of refuge functions currently based at Morris Island to an alternate waterfront site with more useable space in the local community in new and expanded facilities specifically designed and constructed to support all refuge functions would help alleviate the overcrowding that would occur with increased staff and the site limitations of this small, built-out parcel. Considering the increased focus on providing more virtual opportunities for visitors to experience the refuge and Monomoy Wilderness, we would explore opportunities to partner with others to purchase or construct offsite a new visitor contact station, administrative offices, and residential housing facilities. We would continue to use the lighthouse keeper's house at the Monomoy Point Light Station as a summer camp for staff and volunteers and equipment storage from April to September, but only basic maintenance will be done to maintain the structures. Long-term preservation would not occur under this alternative.

USFWS

Morris Island trail

The National Weather Service, an agency within the Department of Commerce's National Oceanic and Atmospheric Administration, has been co-located with the refuge at the Morris Island administrative complex since 1971; this joint

tenancy is expected to continue at least through the plan period. A memorandum of understanding 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 National Weather Service. Weather Service personnel launch radiosonde-equipped weather balloons at least twice daily, recording upper atmospheric conditions that are entered into computer forecast models from which daily weather forecast products are derived. Any facility/infrastructure modifications at the Morris Island site could impact these Weather Service operations.

The refuge administrative and National Weather Service 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 along this bluff. As recently as the mid-1950s, the historic Chatham Life Saving 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 at mid-slope and at the base, exposed by subsequent erosion of the bluff. Expected sea level rise and the resulting geomorphological changes (Giese et al. 2010) project over several decades a progressive westward migration of what is now Nauset/South Beach across Outermost Harbor and reconnecting to Morris Island. When the westward protective barrier beach migration is complete, the Morris Island bluff would once again be exposed to undiminished coastal storm wave energy and very rapid rates of erosion.

The National Weather Service's white-domed upper air sounding building and the 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 annually from June to August. Any further reduction in useable space on this small lot without a corresponding reduction in use will create unsafe conditions for visitors and staff, 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 the refuge and National Weather Service 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 will avoid a crisis when the options are fewer and solutions costlier.

Strategies

Continue to:

- Maintain the headquarters and visitor contact station, dormitory and maintenance buildings, and Monomoy Point Light Station to provide a safe working and living environment for refuge staff and volunteers.

- Work with the National Weather Service and maintain an memorandum of understanding with them for use of Service-owned land on Morris Island. Should the National Weather Service at any point decide to relocate their existing operation, the refuge would look into re-utilizing the current National Weather Service buildings and space and site use at the Morris Island site.

- Maintain a fleet of three highway vehicles and three outboard motor boats that provide safe and efficient transport to North Monomoy Island, South Monomoy, Minimoy Island, and offsite locations for resource management and administrative work; replace boats and motors as necessary to maintain a functional fleet.

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 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 in this alternative, as needed.

- Explore additional refuge staff housing opportunities within the local commuting area.

- Explore opportunities to acquire the waterfront Stage Island lot adjoining our current Lot 7b; add storage capability and expand parking for refuge staff.

- Explore opportunities to partner with the Town of Chatham or U.S. Coast Guard to establish new docks, covered boat storage, and maintenance with secure marine equipment storage and additional parking.

Within 10 years of CCP implementation:

- Explore the acquisition of an alternative headquarters site, which would include parking and shuttle to Morris Island, where the entire refuge operation can be relocated, including the visitor contact station; this would include exploring possibilities to co-locate with partners.

Objective C6.3 (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. Refuge facilities would demonstrate renewable "green" energy measures similar to those a residential homeowner, farmer, or small business owner might install, and achieve a Gold LEEDS rating.

Rationale

The strategies that follow are part of a comprehensive effort to incorporate energy conservation technologies into the design of new and remodeled facilities on national wildlife refuges in the Northeast Region of the Fish and Wildlife Service, while simultaneously stimulating economic recovery. Guiding principles and other general information on implementing sustainable practices within the Refuge System can be found in Policy 565 FW 1.

The installation of wind turbines or photovoltaic arrays at the refuge aims to increase the proportion of electricity consumption derived from clean, renewable sources, while reducing the proportion derived from fossil fuel combustion and the associated greenhouse gas emissions, in effort to create a smaller carbon footprint. Wind turbines or photovoltaic arrays at the refuge headquarters would utilize the available wind and sunlight to generate electrical power at those facilities while reducing power consumption from the utility grid.

A solar-thermal domestic hot water system was added to the shop/dorm building in 2011, and additional thermal insulation was added to the headquarters attic. As new or replacement vehicles and boat motors are purchased, converting to more fuel efficient technologies such as gas-electric hybrids or flex (bio) fuel capable models would reduce fossil fuel consumption and associated atmospheric carbon emissions. Driving or using motorboat less and walking, bicycling, or paddling more while accomplishing the refuge purposes will also reduce fossil fuel consumption.

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 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.

The solar panels, wind turbine generators, and other energy conservation technologies proposed would provide public demonstrations of methods for reducing dependence on nonrenewable energy sources. Established public visitation at the headquarters site 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:

- Conduct bird and bat surveys at the site of the proposed wind turbine for Morris Island to determine what species are currently using the area.
- Train staff and volunteers in 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 that reduce fossil fuel consumption and associated carbon emissions by refuge visitors, such as local passenger shuttles with satellite parking, improved highway signs, and improved facilities for pedestrians, bicyclists, and kayakers.

Within 5 years of CCP implementation:

- Reduce metered/potable water consumption by installing rainwater collection and distribution systems at refuge administrative facilities. Transition the fleet to use hybrid and electric alternative fuel vehicles and boat motors when feasible to meet the needs of managing the refuge.
- Prepare a stand-alone NEPA analysis for the installation of a wind turbine to augment the solar thermal tube domestic hot water system installed in 2011 for the refuge headquarters complex on Morris Island.
- If project approved, seek funding to install the wind turbine.

Within 10 years of CCP implementation:

- Assuming approval and funding, install the wind turbine.

Monitoring Elements

- Calculate the amount of electricity generated on-site through solar and wind production and as a ratio of electricity usage purchased from the commercial grid.
- Calculate the annual fossil fuel consumption (heat, vehicles, boats and small engine equipment) for refuge operations.
- Calculate the annual metered (potable) water use.
- Estimate 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 and the amount of waste that is recycled.

Table 3.2 below compares and contrasts what distinguishes the three management alternatives evaluated in detail in this draft CCP/EIS. It provides highlights of the management actions that are presented in detail in chapter 3. We recommend readers consult chapter 3, including the sections titled "Actions Common to All Alternatives" and "Actions Common to Alternatives B and C" to understand the full range of what is proposed, and our rationale, under each alternative.

Table 3.2. Summary Comparison of Management Actions by Alternative.

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Dune Grasslands (Roseate and Common Terns)	Objective A1.1: Continue to protect from disturbance and degradation 30 acres of nesting habitat for common terns and enhance and maintain 2 acres of prime nesting habitat for roseate terns within this area. Maintain a minimum productivity of 1.0 chick per nesting pair over a 5-year period for both species of terns. ——— *Continue to:* Use temporary symbolic fencing (see glossary) to seasonally close tern nesting areas from May through August to minimize human disturbance; if no nesting activity occurs within the closed area, posts may be removed beginning July 1 Patrol and enforce closed areas during the nesting season Establish and staff a temporary field camp from early May until mid-August to maintain human presence 24 hours per day for the purpose of providing predator management and to facilitate data collection Erect temporary, hard-sided blinds to facilitate the identification of possible limiting factors including diet composition and impacts of kleptoparasitism, and to further facilitate nesting studies and predator management Install temporary wooden chick shelters prior to nesting to increase chicks' ability to escape inclement weather and predators, 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	Objective B1.1: 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. ——— *In addition to objective A1.1:* *Within 1 year of CCP implementation:* Evaluate potential for establishing new tern habitat and attracting birds to areas of the refuge not currently used, including further installation of sound systems and decoys Strengthen partnerships to manage lands adjacent to the refuge to create a larger area of continuous protection for terns *Within 5 years of CCP implementation:* Control nonnative invasive plant species throughout dune grasslands using manual tools, herbicides, or prescribed fires to ensure less than 10 percent coverage refugewide, with a control emphasis in tern nesting areas Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to protect habitats from the effects of erosion and sea level rise	Objective C1.1: Protect from disturbance and degradation 10 acres of nesting habitat for common terns and enhance and maintain 2 acres of prime nesting habitat for roseate terns. Maintain a minimum productivity of 1.0 chick per nesting pair over a 5-year period for both species of terns. ——— *In addition to objective A1.1, strategies 1, 2, 8, and 10 to 12:* *Upon CCP implementation:* Maintain periodic human presence through visits to the colony and surrounding areas generally 3 times per week from mid-May to early August Use temporary portable blinds (similar to photo blinds) that are easily moved throughout the nesting areas to facilitate the collection of nesting data and predator management Install temporary wooden chick shelters for roseate terns prior to nesting to increase chicks' ability to escape inclement weather and predators, and thus increase survival In areas within the common and roseate tern nesting area, or within 100 m of the nesting areas, destroy all nest attempts by great black-backed and herring gulls by scattering nesting materials and removing eggs In selected areas within the 10-acre nesting area, manipulate vegetation using mechanical methods, herbicide, and rotational prescribed burning to improve nesting habitat for terns and discourage nesting by competitor species, including laughing gulls

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Dune Grasslands (Roseate and Common Terns) (cont.)	Minimize impacts of avian and mammalian predators to nesting terns through non-lethal and lethal management as described in appendix J In selected areas, manipulate vegetation using mechanical methods, herbicide, and rotational prescribed burning to improve habitat for terns and discourage nesting by competitor species, including laughing gulls Coordinate with avian disease specialists at the National Wildlife Health Center in Madison, WI, to document, detect, and minimize the spread of avian diseases Review 5-year reviews and recovery plan updates for roseate terns within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc. Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and will inform future management		

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Beach Shoreline and Dune Edges (Piping Plover)	Objective A1.2: Continue to protect from disturbance and degradation all high-quality nesting habitat and nearby foraging habitat for piping plovers on the refuge. Maintain a minimum productivity of at least 1.24 chicks fledged per pair annually and an average of 1.5 chicks fledged per pair over a 5-year period. ——— *Continue to:* Use temporary symbolic fencing to seasonally close all suitable piping plover habitat that is located in areas that are vulnerable to human disturbance regardless of the presence of pairs by April 1; this may happen earlier if weather allows Use temporary symbolic fencing to seasonally close additional areas that contain breeding piping plovers (May) as nesting or courtship behaviors are observed; maintain these areas as closed until at least July 1 if no nesting has occurred or until all chicks have fledged (fencing would be removed as staff time allows once these criteria are met) Patrol and enforce closed areas during the nesting season Use temporary predator exclosures on piping plover nests that are located in sparsely vegetated areas with nothing obstructing the view of the bird or inhibiting the bird's ability to detect predators Minimize impacts of avian and mammalian predators to nesting plovers through non-lethal and lethal management as described in appendix J	Objective B1.2: 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. ——— *In addition to objective A1.2, strategies 3 to 6, 8, and 9:* *Within 1 year of CCP implementation:* Use temporary symbolic fencing to seasonally close all suitable piping plover habitat regardless of the presence of pairs early in the season (March or April) and to seasonally close additional areas that contain breeding piping plovers (May through July) as nesting or courtship behaviors are observed; maintain these areas as closed until July 1 if no nesting has occurred or until chicks have fledged within the closed areas (fencing would be removed as staff time allows once these criteria are met) Participate in partner-based, high priority, landscape-level piping plover research, which may include resighting banded adults, collecting unhatched eggs for DNA analysis, or evaluating habitat availability as a limiting factor Use temporary solar-powered electric fence in suitable nesting habitat to protect piping plover nests from mammalian predators	Objective C1.2: Continue to protect from disturbance and degradation all high-quality nesting habitat and nearby foraging habitat for piping plovers on the refuge. Maintain a minimum productivity of at least 1.24 chicks fledged per pair annually and an average of 1.5 chicks fledged per pair over a 5-year period. ——— *In addition to objective A1.2, strategies 3 to 6, 8, and 9:* *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 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 or within the closed areas (fencing would be removed as staff time allows once these criteria are met) Participate in partner-based, high priority, landscape-level piping plover research, which may include resighting banded adults, collecting unhatched eggs for DNA analysis, or evaluating habitat availability as a limiting factor

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Beach Shoreline and Dune Edges (Piping Plover) (cont.)	Strengthen partnerships to manage lands adjacent to the refuge to ensure the success and survival of piping plovers in the surrounding area and to create a larger area of continuous protection Participate in partner-based, high priority, landscape-level piping plover research, which may include resighting banded adults or collecting unhatched eggs for DNA analysis Review 5-year reviews and recovery plan updates for piping plovers within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc. Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and will inform future management	Experiment with the use of temporary non-electrified fencing to reduce mammalian depredation *Within 5 years of CCP implementation:* Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to protect habitats from the effects of erosion and sea level rise	

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Beach Shoreline, Dune Edges, and High Salt Marsh (American Oystercatcher)	Objective A1.3: Continue to protect from disturbance and degradation all high-quality nesting habitat and nearby foraging habitat for nesting pairs of American oystercatchers. Maintain a mean productivity of at least 0.40 chicks fledged per nesting pair consistent with current research. ——— *Continue to:* Use temporary symbolic fencing to seasonally close all suitable American oystercatcher habitat that is located in areas vulnerable to human disturbance regardless of the presence of pairs early in the season (April); this may happen earlier if weather allows Use temporary symbolic fencing to seasonally close additional areas that contain breeding American oystercatchers (May) as nesting or courtship behaviors are observed. Maintain these areas as closed until August 1 (if the areas remain unused), or until all chicks have fledged Patrol and enforce closed areas during the nesting season Participate in landscape-level color-banding effort through the American Oystercatcher Working Group to improve productivity estimates on the refuge, and contribute to a range-wide understanding of survival, movement, and dispersal, which are critical to understanding and predicting population trends at multiple spatial scales	Objective B1.3: 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 consistent with current research. ——— *In addition to objective A1.3, strategies 3 and 5 to 10:* *Within 1 year of CCP implementation:* Use temporary symbolic fencing to seasonally close all suitable American oystercatcher habitat regardless of the presence of pairs early in the season (March or April); maintain these areas as closed until August 1 (if the areas remain unused), or until all chicks have fledged Increase refuge participation in landscape-level color-banding efforts through the American Oystercatcher Working Group to improve productivity estimates on the refuge, and contribute to a range-wide understanding of survival, movement, and dispersal, which are critical to understanding and predicting population trends at multiple spatial scales *Within 5 years of CCP implementation:* Evaluate appropriateness of artificially incubating eggs to increase hatching success of American oystercatchers and minimize loss to predators	Not specifically addressed under alternative C

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Beach Shoreline, Dune Edges, and High Salt Marsh (American Oystercatcher) (cont.)	Use temporary solar-powered electric fence in suitable nesting habitat to protect American oystercatchers from mammalian predators Experiment with the use of temporary non-electrified fencing to reduce mammalian depredation Explore the effectiveness of temporary nesting platforms for American oystercatchers to reduce nest loss due to overwash Minimize impacts of avian and mammalian predators to nesting American oystercatchers through non-lethal and lethal management as described in appendix J Strengthen partnerships with Mass Audubon's Coastal Waterbird Program and the Town of Chatham to manage lands adjacent to the refuge to ensure the success and survival of American oystercatchers in the surrounding area and to create a larger area of continuous protection Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and will inform future management		

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Beach Shoreline and Dune Edges (Least Tern)	Objective A1.4: Continue to protect nesting least terns from disturbance. _____ *Continue to:* Patrol and enforce closed areas during the nesting season Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and will inform future management	Objective B1.4: 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. _____ *In addition to objective A1.4:* *Within 1 year of CCP implementation:* Use temporary symbolic fencing to close all suitable least tern nesting habitat in May, and additional areas as nesting behaviors are observed; maintain these areas as closed until August (when chicks have fledged), or until they are no longer being used by breeding birds Use lethal predator management to protect nesting least terns if the population reaches or exceeds 10 percent of the State population *Within 5 years of CCP implementation:* Use temporary solar-powered electric fence in suitable nesting habitat to protect least terns from mammalian predators Use temporary chick shelters to provide chicks with shade and protection from avian and mammalian predators; chick shelter design would be modified from other successful designs to address the most common predators on Monomoy refuge	Not specifically addressed under alternative C

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Beach (Northeastern Beach Tiger Beetle)	Objective A1.5: Continue to protect from disturbance and degradation areas currently occupied by northeastern beach tiger beetle adults or larvae with sufficient protected habitat for expansion and genetic interchange (to be determined by future research). Maintain a peak count of at least 500 adults. ——— *Continue to:* Maintain vehicle closures on refuge lands to protect habitat and allow for continued population growth. Cooperate with the Town of Chatham, Commonwealth of Massachusetts, U.S. Coast Guard, and other partners involved in emergency and public safety operations to protect tiger beetles and habitat when vehicle access is deemed essential to protect human life. This includes increased monitoring when vehicles are present to minimize habitat degradation and mortality by OSVs. Regularly inform and communicate with officials and the public about areas occupied by tiger beetles on the refuge, including Nauset/South Beach, to foster continued support for protection and monitoring of tiger beetles currently using these areas and allow for continued expansion of spatial distribution Review 5-year reviews and recovery plan updates for northeastern beach tiger beetles within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc. Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and will inform future management	Objective B1.5: Continue to protect areas currently occupied by northeastern beach tiger beetle adults or larvae from disturbance and degradation with sufficient protected habitat for expansion and genetic interchange (to be determined by future research). Continue to maintain a peak count of at least 500 adults. Enhance recovery opportunities and meet recovery objectives by serving as a donor site/source population for other sites in the Northeast. ——— *In addition to objective A1.5:* *Within 5 years of CCP implementation:* Facilitate and expand research opportunities on the refuge to fill data gaps that will promote tiger beetle recovery including, but not limited to, genetic work to determine differences between beetle populations in Massachusetts and Chesapeake Bay Work with the New England Ecological Services Field Office staff to determine other potential areas for translocation on the refuge or other viable sites in New England or New Jersey for population augmentation or introduction Work with the New England Ecological Services Field Office to utilize Monomoy refuge as a donor population for newly identified sites, while ensuring that the Monomoy population is not impacted	Objective C1.3: Continue to protect from disturbance and degradation areas currently occupied by northeastern beach tiger beetle adults or larvae with sufficient protected habitat for expansion and genetic interchange (to be determined by future research). Maintain a peak count of at least 500 adults. ——— *Same as objective A1.5.*

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Maritime Shrubland (Black-crowned Night-heron, Snowy Egrets, and Neotropical Migrant Songbirds)	Objective A1.6: Continue to minimize human disturbance to shrubland habitat generally consisting of northern bayberry and rugosa rose approximately 3 feet tall, which is used by nesting wading birds including black-crowned night-herons and snowy egrets. ——— *Continue to:* Allow nonnative rugosa rose to remain on the refuge in areas where wading birds nest Use temporary symbolic fencing to seasonally close nesting areas in portions of the refuge with high seasonal public visitation to provide disturbance-free nesting opportunities for wading birds Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and will inform future management	Objective B1.6: Protect existing native maritime shrubland and evaluate use by migrating landbirds of conservation concern. If large patches of maritime shrubland are regionally important, maintain native species composition (including bayberry, beach plum, etc.) with less than 5 percent invasive plants. Continue to minimize human disturbance to shrubland habitat generally consisting of northern bayberry and the nonnative rugosa rose approximately 3 feet tall, which is used by nesting wading birds, including black-crowned night-herons and snowy egrets. ——— *In addition to objective A1.6:* *Within 5 years of CCP implementation:* Implement standard buffer distances for seasonal closures based on findings at other sites, and modify to be more restrictive at Monomoy refuge if buffers are not sufficient Evaluate regional importance of maritime shrubland on Monomoy refuge to migrating landbirds, and, if appropriate, periodically evaluate habitat conditions (including species composition, nonnative plant presence, and community structure) Utilize biological, mechanical, chemical, and fire management to reduce nonnative species in maritime shrublands deemed important for migrating landbirds	Not specifically addressed under alternative C; see habitat discussion under Objective C1.5

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Intertidal (Migrating and Staging Birds, Horseshoe Crabs, and Marine Mammals)	Objective A1.7: Passively oversee up to 2,500 acres of intertidal habitat refugewide to benefit migrating and staging birds, particularly species of conservation concern, including black-bellied plover, piping plover, American oystercatcher, ruddy turnstone, red knot, sanderling, semipalmated sandpiper, dunlin, short-billed dowitcher, roseate tern, and common tern. Continue to prohibit harvest of horseshoe crabs and minimize human disturbance to gray and harbor seals that also rely on these intertidal areas *Continue to:* Use temporary symbolic fencing to maintain seasonal closures in portions of intertidal mudflats (that are generally established for nesting species) to reduce disturbance to staging and migrating birds Work with partners to determine the relative importance of tern staging sites on Cape Cod, identify problematic disturbances, and develop solutions to minimize disturbances Work with partners to document the importance of Monomoy refuge to migrating red knots and contribute to research that will inform species' recovery Maintain and enforce closure of the refuge to horseshoe crab harvesting Work with partners to study movement and embayment site fidelity of horseshoe crabs by tagging 500 crabs annually Participate in State and regional efforts to document changes in populations of horseshoe crabs by conducting spawning surveys on Morris Island, North Monomoy Island, and South Monomoy	Objective B1.7: Adaptively manage the refuge's approximately 2,500 acres of intertidal habitat to protect staging and migrating birds, particularly species of conservation concern, including black-bellied plover, piping plover, American oystercatcher, ruddy turnstone, red knot, sanderling, semipalmated sandpiper, dunlin, shortbilled dowitcher, roseate tern, and common tern, so at least 90 percent of habitat being used annually by species of conservation concern is not subjected to frequent disturbances. Also manage this intertidal habitat to benefit juvenile and spawning horseshoe crabs and allow no harvest of horseshoe crabs within the refuge boundary. *In addition to objective A1.7, strategies 2 to 6 and 8 to 10:* *Within 1 year of CCP completion:* Continue to use temporary symbolic fencing to implement seasonal closures to public use to protect wildlife. There may be a small expansion to these closed areas which may occur along the western salt marsh edge of North Monomoy Island, around the barrier beach and salt marsh edge of Minimoy Island, and around the north end of South Monomoy. Habitat will be assessed on Nauset/South Beach. Use the Atlantic Flyway Shorebird Conservation Business Strategy as a guiding document for establishing priority research and conservation efforts.	Objective C1.4: Passively oversee 2,500 acres of intertidal habitat refugewide to benefit migrating and staging birds, particularly species of conservation concern such as black-bellied plover, piping plover, American oystercatcher, ruddy turnstone, red knot, sanderling, semipalmated sandpiper, dunlin, short-billed dowitcher, roseate tern, and common tern. Continue to prohibit harvest of horseshoe crabs and minimize human disturbance to gray and harbor seals that also rely on these intertidal areas. *In addition to objective A1.7:* *Within 5 years of CCP implementation:* Initiate an outreach campaign to provide information to all visitors about the importance of minimizing disturbance to migrating and staging birds; the outreach message would focus on a recommended viewing distance of at least 50 m to allow birds to remain undisturbed in their resting and foraging areas which are critical to successful migration Annually identify areas (refugewide) that consistently support foraging or staging red knots or roseate terns, and seasonally close areas subject to high levels of disturbance to all human use

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Intertidal (Migrating and Staging Birds, Horseshoe Crabs, and Marine Mammals) (cont.)	Work with the Cape Cod Stranding Network to assist with rescues of stranded and entangled marine mammals, and help monitor injured or sick marine mammals Maintain and enforce closure of the refuge to mussel harvesting to preserve food source for red knots and American oystercatchers Review 5-year reviews and recovery plan updates for roseate terns or other listed species present in this habitat type within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc. Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and will inform future management	*Within 5 years of CCP completion:* Initiate an outreach campaign to provide information to all visitors about the importance of minimizing disturbance to migrating and staging birds; the outreach message would focus on a recommended viewing distance of at least 50 m to allow birds to remain undisturbed in their resting and foraging areas which are critical to successful migration Annually identify areas (refugewide) that consistently support foraging or staging shorebirds or terns and close areas that are subject to high levels of disturbance to all human use; a rapid-assessment method of identifying areas would be developed and implemented 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	
Beach Berm, Intertidal, and Nearshore Marine Waters (Marine Mammals)	See objective A1.7	Objective B1.8: Protect and support healthy seal populations on the refuge and ensure compliance with Marine Mammal Protection Act seal guidelines. _____ *In addition to objective A1.7, strategies 7 and 10:* *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	Not specifically addressed under alternative C; see habitat discussion under Objective C1.5

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Maritime Shrubland, Salt Marsh, Freshwater Ponds, and Nearshore Marine Waters (Biological Integrity, Diversity, and Environmental Health)	Under alternative A, biological integrity, diversity, and environmental health for these habitats are addressed under other habitat and species objectives under goal 1	Under alternative B, biological integrity, diversity, and environmental health for these habitats are addressed under other habitat and species objectives under goal 1	Objective C1.5: Promote biological integrity, diversity, and environmental health (BIDEH) to ensure that the historical, regional, and conservation roles of the refuge are preserved. This objective is broad in intent and may emerge in a variety of ways based on the specific history and role of Monomoy NWR. *Continue to:* Allow nonnative rugosa rose to remain on the refuge in areas where wading birds nest 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 Patrol and enforce closed areas Maintain and enforce closure of the refuge to horseshoe crab harvesting Maintain and enforce closure of the refuge to mussel harvesting to preserve food source for red knots and American oystercatchers Evaluate aquaculture requests in open water-submerged bottom areas (below MLW) within the Declaration of Taking boundary for compatibility and benefits to refuge resources on a case-by-case basis 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 study wintering sea ducks using the waters surrounding the refuge and monitor impacts of diseases effecting these populations

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Maritime Shrubland, Salt Marsh, Freshwater Ponds, and Nearshore Marine Waters (Biological Integrity, Diversity, and Environmental Health) (cont.)			Support partner efforts to study shellfish and fin fish stocks, marine mammals including seals and their principal predator, the great white shark Support partner efforts to assess 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 research relevant to these habitat types and priority species when research has conservation implications and will inform future management *Within 1 year of CCP implementation:* Prohibit bottom substrate-disturbing fishing activities such as mussel harvesting, scallop dragging, or any hydraulic dredging for shellfish within the Declaration of Taking refuge boundary in order to protect eelgrass beds and maintain productive benthic communities for wildlife. Use temporary symbolic fencing to seasonally close: (1) portions of maritime shrublands with high densities of nesting wading birds and high seasonal public visitation from April to August; (2) most salt marsh habitat on North Monomoy Island to minimize trampling of vegetation and invertebrates and disturbance to nesting saltmarsh sparrows and American oystercatchers from April to September

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Maritime Shrubland, Salt Marsh, Freshwater Ponds, and Nearshore Marine Waters (Biological Integrity, Diversity, and Environmental Health) (cont.)			Install sediment elevation tables (SET) in refuge salt marshes to evaluate the effects of various factors on salt marshes' ability to keep pace with sea level rise Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to protect habitats from the effects of erosion and sea level rise (refer to alternative B, objective B1.1 rationale) Support partner efforts to study potential impacts of offshore wind or tidal energy development to resources of concern Strengthen partnerships to manage lands adjacent to the refuge and throughout Cape Cod to enhance BIDEH and priority species across the landscape *Within 5 years of CCP implementation:* Control nonnative invasive plant species throughout maritime shrubland, salt marsh, and freshwater pond habitats using manual tools, herbicides, or prescribed fires to ensure less than 10 percent coverage refugewide Work with partners to evaluate and map the current and historic extent of SAVs, 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 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 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

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Salt Marsh	Objective A1.8: Continue to protect coastal salt marsh habitat through seasonal closures on North Monomoy Island to protect the quality and natural function of the marsh and provide important nesting habitat for saltmarsh sparrows and American oystercatchers. ——— *Continue to:* Use temporary symbolic fencing to seasonally close most salt marsh habitat on North Monomoy Island from April to September to minimize trampling of vegetation and invertebrates, and minimize disturbance to nesting saltmarsh sparrows and American oystercatchers Support partner efforts to investigate impacts of mercury on saltmarsh sparrows and natural processes that affect mercury speciation and bioavailability Support partner efforts to investigate the hybridization of saltmarsh sparrows and how it impacts the population fitness of saltmarsh sparrows and Nelson's sparrows Support partner efforts to investigate changes in tidal marshbird populations in the refuge and eastern Massachusetts by comparing current surveys to historical data Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and will inform future management	Objective B1.9: 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 provide nesting habitat for saltmarsh sparrow, American oystercatchers, foraging areas for wading birds, roosting areas for shorebirds, and nursery habitat for horseshoe crabs. ——— *In addition to objective A1.8, strategies 1 to 5:* *Within 1 year of CCP implementation:* Expand the areas of temporary symbolic fencing to include protection for salt marshes on Morris Island and South Monomoy Island Participate in regional efforts to monitor the health and integrity of salt marsh habitat on the refuge. Focus management on reducing non-climate stressors to salt marshes Install sediment elevation tables (SET) in refuge salt marshes to evaluate the effects of various factors on salt marshes' ability to keep pace with sea level rise Complete rapid assessment of vegetative composition in 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	Not specifically addressed under alternative C; see habitat discussion under Objective C1.5

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Freshwater Ponds and Marshes	Not specifically addressed under alternative A	Objective B1.10: 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. ——— *Within 1 year of CCP implementation:* Analyze 2 years of acoustic bat monitoring data to quantify importance of Monomoy refuge to migrating bats and determine if future monitoring is warranted Control nonnative invasive plant species, especially common reed, throughout freshwater habitats using manual tools, herbicides, or prescribed fires to ensure less than 10 percent coverage refugewide Submit samples of common reed from stands that haven't been previously tested to determine if they are native Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and will inform future management	Not specifically addressed under alternative C; see habitat discussion under Objective C1.5

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Nearshore Marine Open Water	Objective A1.9: Oversee uses on 2,000 acres of nearshore marine open water, submerged aquatic vegetation beds and subtidal bottoms to conserve natural and cultural heritage and assure sustainable productivity of marine resources to benefit federal trust resources including: migrating, staging and wintering birds such as eiders, scoters, long-tailed duck, brant, bufflehead, loons, grebes, mergansers, northern gannet, terns, and gulls; marine mammals; horseshoe crabs; interjurisdictional fish; and sea turtles. ——— *Continue to:* Maintain and enforce closure of the refuge to horseshoe crab harvesting Reinstall permanent markers visually delineating the Declaration of Taking boundary in open waters based on Regional Surveyor's coordinates; commercial GPS software vendors will be provided digital map layers for incorporation into their software products Maintain closure of the refuge to mussel harvesting to preserve food source for red knots and American oystercatchers Evaluate aquaculture requests in open water-submerged bottom areas (below MLW) within the Declaration of Taking for compatibility and benefits to refuge resources on a case-by-case basis Participate in review and discussions with stakeholders regarding dredging of channels and deposition of dredge materials surrounding Monomoy NWR and impacts to priority wildlife and habitats Support partner efforts to study wintering sea ducks using the waters surrounding the refuge and monitor impacts of diseases affecting these populations	Objective B1.11: Protect, manage, and restore 2,000 acres of nearshore marine open water, submerged aquatic vegetation beds and subtidal bottoms to conserve natural and cultural heritage and assure sustainable productivity of marine resources to benefit federal trust resources including: migrating, staging and wintering birds such as eiders, scoters, long-tailed duck, brant, bufflehead, loons, grebes, mergansers, northern gannet, terns, and gulls; marine mammals; horseshoe crabs; interjurisdictional fish; and sea turtles. ——— *In addition to objective A1.9, strategies 1to 10:* *Within 1 year of CCP implementation:* Prohibit bottom substrate-disturbing fishing activities such as mussel harvesting, scallop dragging, or any hydraulic dredging for shellfish within the Declaration of Taking refuge boundary in order to protect eelgrass beds and maintain productive benthic communities for wildlife. Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to protect habitats from the effects of erosion and sea level rise Support partner efforts to study potential impacts of offshore wind or tidal energy development to resources of concern Encourage, support, and actively participate in efforts to study shellfish and fin fish stocks, marine mammals including seals and their principal predator, the great white shark	Not specifically addressed under alternative C; see habitat discussion under Objective C1.5

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 1: Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.			
Responds to Issues: How will the refuge manage priority wildlife species and other biological resources? How will the refuge conduct predator management?			
Nearshore Marine Open Water (cont.)	Support partner efforts to study shellfish and fin fish stocks, marine mammals including seals and their principal predator, the great white shark Support partner efforts to assess distribution and genetic diversity of eelgrass across the region and test it against an experimental factorial design of potential stress parameters Support partner efforts (New England Aquarium and Mass Audubon) to rescue stranded sea turtles and to collect dead sea turtles recovered from refuge waters for scientific research Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and will inform future management	*Within 5 years of CCP implementation:* Work with partners to evaluate and map the current and historic extent of submerged aquatic vegetation (SAVs), specifically eelgrass, within the Declaration of Taking to determine whether these species are stable, decreasing, or increasing and to determine if active management of the resource is necessary Collect baseline data of flora and fauna in the subtidal areas of the refuge to help determine priority species and develop a management plan to ensure conservation of these species Evaluate need for "no-anchoring zones" to minimize disturbance to eelgrass beds and implement as warranted Evaluate the possibility of using dredge spoils to enhance beach and flats habitat on the refuge (e.g., Minimoy, flats west of Minimoy, and Morris Island Beach) outside of the wilderness area. If feasible, pursue NEPA analysis.	

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
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.			
Responds to Issues: What types of recreational opportunities will be provided on the refuge? How will public uses be managed? How will the refuge address access and parking?			
Access and Use	Objective A2.1: Allow public access to Morris Island, North Monomoy Island, South Monomoy, Minimoy Island, and the Declaration of Taking area to the extent that it will not adversely impact Federal trust resources or wilderness character, while maintaining closures that reduce disturbance to wildlife from visitors and protect suitable nesting habitat for species of concern. The exact location and timing of the closures is flexible to respond to the presence of wildlife. Visitors may participate in any compatible public use on the refuge in areas that are open to the public. ——— *Continue to:* Provide parking at the refuge headquarters on Morris Island for beach and trail access Provide 30 parking spaces free of charge at refuge headquarters on Morris Island. Issue special use permits to two boat operators who provide access to North Monomoy and South Monomoy and allow boat access to North Monomoy and South Monomoy Utilizing adaptive management strive to keep Morris Island and large portions of South Monomoy Island open year-round, and re-open seasonally closed areas after chick fledging or staging seasons for migratory birds such as roseate and common terns, piping plovers, red knots, and American oystercatcher in order to provide additional wildlife viewing and photography opportunities; temporarily close portions of the refuge only when necessary to protect wildlife and their habitat based on seasonal use of priority species Open all of North Monomoy Island to the public from October to March. During the April to September nesting season (map 2.8) an east-west trail corridor bisecting North Monomoy Island is open to the public as well as the Broad Creek area to the south; in addition the entire perimeter of North Monomoy Island below the mean high tide line is open for public circumnavigation around North Monomoy Island Restrict travel on the refuge to foot traffic to maintain the wilderness character of North Monomoy Island and South Monomoy, as well as to protect sensitive nesting areas and wildlife habitat; this may include limiting access to dune areas to prevent erosion as necessary	Objective B2.1: With primary consideration to wildlife protection, character of the Monomoy Wilderness, and public safety, continue to allow public access to Morris Island, North Monomoy Island, South Monomoy Island (including Nauset/South Beach), and Minimoy Island while implementing a concessionaire system that accommodates an anticipated visitor increase of 25 percent. Maintain seasonal closures that reduce disturbance to wildlife from visitors and protect suitable nesting habitat for species of concern. The exact location and timing of the closures is flexible to respond to the presence of wildlife. Visitors may participate in any compatible public use on the refuge in areas that are open to the public. ——— *In addition to objective A2.1, strategies 4 to 10, and 14:* *Within 1 year of CCP implementation:* Utilizing adaptive management, strive to keep Morris Island and large portions of South Monomoy Island, including Nauset/South Beach, open year-round, and re-open seasonally closed areas after chick fledging or staging seasons for migratory birds such as roseate and common terns, piping plovers, red knots, and American oystercatcher in order to provide additional wildlife viewing and photography opportunities; temporarily close portions of the refuge only when necessary to protect wildlife and their habitat based on seasonal use of priority species 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 they have the right to use the path to access the refuge Do not allow pets, including dogs on leash, on the entire refuge, including Morris Island and the part of Nauset/South Beach that is attached to South Monomoy Island	Objective C2.1: With primary consideration to wildlife and wilderness character protection and public safety, allow public access to Morris Island, North Monomoy Island, South Monomoy Island (including Nauset/South Beach), and Minimoy Island while accommodating an anticipated minimum 25 percent visitation increase to the Monomoy NWR over the period. Ensure refuge visitors who access the Monomoy Wilderness use nonmotorized means, such as paddling or sail boats to get there. ——— *In addition to objective A2.1, strategies 4 to 5, 7 to 10, and 14:* *Within 1 year of CCP implementation:* Utilizing adaptive management, strive to keep Morris Island and large portions of South Monomoy Island, including Nauset/South Beach, open year-round, and re-open seasonally closed areas after chick fledging or staging seasons for migratory birds such as roseate and common terns, piping plovers, red knots, and American oystercatcher in order to provide additional wildlife viewing and photography opportunities. temporarily close portions of the refuge only when necessary to protect wildlife and their habitat based on seasonal use of priority species Do not allow motorized boats to land along the Monomoy Wilderness shoreline, including the tidal flats and beaches; allow paddling (kayak, canoe, rowed boats, paddle-boards) and sailing to continue 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 they have the right to use the path to access the refuge Expand the ban on pets, including dogs on leash, to include the entire refuge, including Morris Island and the part of Nauset/South Beach that is now part of South Monomoy Island

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
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.			
Responds to Issues: What types of recreational opportunities will be provided on the refuge? How will public uses be managed? How will the refuge address access and parking?			
Access and Use (cont.)	Allow motorized and non-motorized boating in refuge waters with landings prohibited in areas that are seasonally closed; map 2.7 shows recommended sites where the hazardous currents and shoals allow safe landing Maintain and enforce closure of the refuge to operation and landings of motorized personal watercraft (e.g., wave runners, jet skis) on the refuge land and in refuge waters Maintain and enforce closure of the refuge to kiteboarding operation within the Declaration of Taking-Marine Protected Area boundary Use the existing rights-of-way on Tisquantum Road, Wikis Way, and Stage Island Road to access refuge properties Phase out non-Service parking and dinghy storage at Stage Island Lot 7b	Work to acquire additional lot adjacent to the Stage Island lot for refuge use only Include parking requirements in all special use permits issued to commercial guides, photographers, and others *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 would be free at other times	Work to acquire additional parking area adjacent to the Stage Island lot for refuge use only; terminate all parking privileges for non-Service staff purposes within 60 days of CCP completion Include parking requirements in all special use permits issued to commercial guides, photographers and others *Within 5 years of CCP implementation:* Develop an entrance fee system that includes a 1-day entrance fee that would be charged per car or per group if arriving via foot or bicycle. Use funds from the Service's Recreational Fee Program to maintain and improve visitor facilities and/or the hiring of temporary staff to provide enhanced visitor services.

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
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.			
Responds to Issues: What types of recreational opportunities will be provided on the refuge? How will public uses be managed? How will the refuge address access and parking?			
Access and Use (cont.)	Grant up to two special use permits to ferry operations with drop-offs to North Monomoy Island and South Monomoy Island Allow one ferry company to base their operations out of the Morris Island parking lot with exclusive use of refuge facilities and lands Explore funding opportunities with partners to provide shuttle service to the refuge from offsite satellite parking area(s) and improve shoulder parking along the causeway Assist in enforcement of the Marine Mammal Protection Act through regular communication and coordination with staff from partner agencies and organizations including National Marine Fisheries Service, National Oceanic and Atmospheric Administration, and International Fund for Animal Welfare	Replace the current motorized seal tour-ferry access system from the refuge headquarters on Morris Island with a competitive, multi-year concession, or special use permit holders if no concessionaire is identified. The concession would operate from refuge headquarters, but shuttle visitors from an off-refuge parking site to Morris Island and ferry visitors to North Monomoy Island and South Monomoy Island, conduct interpretative natural and cultural history tours, arrange for refuge permitted fishing or waterfowl hunting guides, rent kayaks, and provide other visitor related services. Provide two parking spaces for the concessionaire and shuttle vans. The concessionaire would be encouraged to manage guide services that facilitate hiking, paddling, or sailing, and encourage visitors to engage in in non-motorized boating in order to promote a wilderness experience. All commercial wildlife watching tours, passenger ferry service, kayak or paddling tours, and hunting and fishing guides would need a refuge permit to operate within the refuge, regardless of whether vessels or passengers make a refuge landfall *Within 5 years of CCP implementation:* Through local and regional partners, provide a local-area shuttle serving Morris Island refuge facilities (and other destinations in Chatham) from secure, satellite parking locations during the June 1 to September 15 peak visitor season Work with municipal partners on the use of a town-owned or private parking facility that could serve as a satellite parking locations for a shuttle service that would bring visitors to the refuge Assist the Town of Chatham to relocate the fencing and improve the shoulder on the east side of the Morris Island Road causeway to better accommodate shuttle passage, parked cars, and emergency vehicles	Replace the current motorized seal tour-ferry access system from the refuge headquarters on Morris Island with a competitive, multi-year concession, or special use permit holders if no concessionaire is identified. All commercial wildlife watching tours, passenger ferry service, kayak or paddling tours, and hunting and fishing guides would, within 2 years of CCP approval, need a refuge permit to operate within the refuge Declaration of Taking boundary, regardless of whether vessels or passengers make a refuge landfall Through local and regional partners, provide a local-area shuttle serving Morris Island refuge facilities (and other destinations in Chatham) from secure, satellite parking locations during the June 1 to September 15 peak visitor season Expand shuttle beyond simple passenger transport, to include transport of kayaks and gear and bicycles in addition to people Work with municipal partners on the use of a town-owned or private parking facility that could serve as a satellite parking locations for a shuttle service that would bring visitors to the refuge Assist the Town of Chatham to relocate the fencing and improve the shoulder on the east side of the Morris Island Road causeway to better accommodate shuttle passage, parked cars, and emergency vehicles Encourage the Town of Chatham to create a multi-use bicycle and pedestrian path on one side of the causeway and provide assistance as possible to help the town implement this project Provide bicycle and pedestrian facilities and amenities through local and regional partners at refuge headquarters, Chatham area shuttle stops, and other high priority downtown locations

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Responds to Issues: What types of recreational opportunities will be provided on the refuge? How will public uses be managed? How will the refuge address access and parking?			
Access and Use (cont.)		Encourage the Town of Chatham to create a multi-use bicycle and pedestrian path on one side of the causeway and provide assistance as possible to help the town 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 refuge Morris Island facilities including designated trails, satellite parking and shuttle stops and concessionaire's off-refuge facilities; this may involve the erection of new signs within Service right-of-way on land owned by others 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, and sites managed by local and regional partners	Through local and regional partners, improve motor vehicle, bicycle, and pedestrian route directional signs to refuge Morris Island facilities including designated trails, satellite parking and shuttle stops and concessionaire's off-refuge facilities; this may involve the erection of new signs within Service rights-of-way on land owned by others 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, and sites managed by local and regional partners Complete a Visitor Services Plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and to evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted

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Responds to Issues: What types of recreational opportunities will be provided on the refuge? How will public uses be managed? How will the refuge address access and parking?			
Access and Use (cont.)		Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objectives, and to evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted Encourage paddling as a means of transportation to the Monomoy Wilderness portions of the refuge by collaborating with local and regional partners or the refuge concessionaire to provide kayaking launch facilities, rentals, instruction, and group outings to the Monomoy Wilderness Explore feasibility of improving non-motorized watercraft launch site at northern stairway and existing asphalt path or along the Morris Island causeway; examine possibilities for constructing a waterfront access way meeting ADA requirements at the headquarters site or across the Tisquantum Road right-of-way 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, open this new facility, which could be shared space with partner groups, and transfer exhibits from the current refuge headquarters, which would primarily serve as administrative offices in the future.	Encourage paddling as a means of transportation to the Monomoy Wilderness portions of the refuge, particularly North Monomoy Island, by collaborating with local and regional partners or the refuge concessionaire to provide kayaking launch facilities, rentals, instruction, and group outings to the Monomoy Wilderness Explore feasibility of improving non-motorized watercraft launch site at northern stairway and existing asphalt path or along the Morris Island causeway; examine possibilities for constructing a waterfront access way meeting ADA requirements at the headquarters site or across the Tisquantum Road right-of-way Extend an ADA-compliant boardwalk segment from the existing Morris Island Trail boardwalk to the Nauset/South Beach-Outermost Harbor overlook trail stops

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Interpretation	Objective A2.2: Maintain the interpretation opportunities available on Morris Island and provide interpretive materials that inform visitors about the purpose and mission of the refuge, Refuge System, the Monomoy Wilderness, the unique natural resources of the refuge and its importance to the recovery and management of migratory birds. *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; open 7 days a week during summer months when the refuge hires interns Inform the public about the refuge and Refuge System, its purpose and mission, and its resources using brochures, rack cards, interpretative panels on trails, and the refuge Web site Update refuge literature and daily/seasonal information (e.g., flood warning, high tide info, etc.) in a timely manner as conditions and access change based on bird nesting and seal haulout occurrences Provide refuge visitors with wilderness ethics and stewardship information and Monomoy Wilderness information through the visitor contact station, Web site, social media, printed materials, and community outreach activities Maintain the interpretive panels along the Morris Island Trail Install seven new or replacement interpretive panels along Morris Island Trail Develop temporary, portable exhibits designed to describe Monomoy's biotic diversity including wildlife, plants, fish, natural processes, its wilderness character and their management at Monomoy refuge	Objective B2.2: Ensure that at least 75 percent of refuge visitors would 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, and enduring wilderness resource, and coastal resource stewardship of the outer Cape region. *In addition to objective A2.2, strategies 1 to 9 and 11:* *Within 1 year of CCP implementation:* Improve informational materials at Morris Island kiosk to highlight the importance of the Monomoy Wilderness and the importance of the refuge to threatened and endangered species as a migration stopover site Issue permits for interpretive commercial water-based tours and interpretive commercial 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 and wildlife tours of the islands consisting of day trips on various natural history and resource topics Conduct seasonal interpretive programs at the refuge by refuge staff, interns, and volunteers, and provide roving interpreters on the Morris Island Trail; content would include wilderness area components 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, etc.)	Objective C2.2: Within 5 years, refuge visitors would receive information regarding the Service, the Refuge System, the relationship of refuge habitats and management to endangered species recovery, biotic diversity, wilderness character and ethics, and natural coastal processes that shape the land itself and plant and animal communities. Interpretive opportunities would be offered primarily through virtual and self-guided means which would focus on key refuge messages such as migratory birds, listed species, and wilderness character. *In addition to objective A2.2, strategies 1 to 5, 7, 8, and 11:* *Within 1 year of CCP implementation:* Improve informational materials at Morris Island kiosk to highlight the importance of the Monomoy Wilderness and the importance of the refuge to threatened and endangered species as a migration stopover site Issue permits for interpretive commercial water-based tours and interpretive commercial 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 and wildlife tours of the islands consisting of day trips on various natural history and resource topics Conduct seasonal interpretive programs at the refuge by refuge staff, interns, and volunteers, and provide roving interpreters on the Morris Island Trail; content will include wilderness area components 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, etc.)

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Responds to Issues: What types of recreational opportunities will be provided on the refuge? How will public uses be managed? How will the refuge address access and parking?			
Interpretation (cont.)	Provide an informational kiosk on Morris Island that contains signs and literature that orient visitors to the refuge and inform them of public use regulations Issue permits for interpretive commercial water-based tours and interpretive commercial land-based tours Conduct seasonal interpretive programs by refuge staff, interns, and volunteers and provide roving interpreters on the Morris Island Trail Issue press releases to inform the public about refuge activities and accomplishments	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 importance to maintain bird and wildlife buffers and of 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 would focus on a recommended viewing distance of at least 50 m to allow birds to remain undisturbed in their resting and foraging areas which are critical to successful migration *Within 5 years of CCP implementation:* Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and to evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted	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 *Within 5 years of CCP implementation:* Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and to evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted

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Interpretation (cont.)		Create and disseminate fact sheets about key refuge resources (e.g., endangered and threatened species, barrier island ecosystem, salt marsh habitat, etc.), refuge management (e.g., predator management, seasonal closures, etc.), Monomoy Wilderness, and watchable wildlife (e.g., seals, etc.) *Within 7 years of CCP implementation:* Use virtual technology to conduct interpretation such as text tours, podcasts, and virtual geocaching and letterboxing Explore the option of creating a smartphone application (or other future technology) with Monomoy Wilderness coordinates and information about the wilderness designation Develop podcasts and other materials designed to provide portable interpretation to refuge visitors about refuge resources (e.g., species of concern, migratory birds, etc.) 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 self-guided interpretive brochure for a Powder Hole to Monomoy Point Lighthouse trail that interprets the unique natural and cultural history of the area, wildlife resources and wilderness Develop seasonal paddling tours/routes using podcasts to describe refuge wildlife, habitats, and management actions	Create and disseminate fact sheets about key refuge resources (e.g., endangered and threatened species, barrier island ecosystem, salt marsh habitat, etc.), refuge management (e.g., predator management, seasonal closures, etc.), Monomoy Wilderness, and watchable wildlife (e.g., seals, etc.) *Within 7 years of CCP implementation:* Use virtual technology to conduct interpretation such as text tours, podcasts, and virtual geocaching and letterboxing Explore the option of creating a smartphone application with Monomoy Wilderness coordinates and information about the wilderness designation Develop podcasts and other materials designed to provide portable interpretation to refuge visitors about refuge resources (e.g., species of concern, migratory birds, etc.) and the Monomoy Wilderness Develop a self-guided interpretive kayak trail and brochure Increase the focus on the role of natural processes in shaping refuge habitats in refuge informational products and delivery Work with Arthur Carhart Wilderness Center to develop and provide materials that inform the public about wilderness areas *Within 10 years of CCP implementation:* Develop seasonal paddling tours/routes using podcasts to describe refuge wildlife, habitats, and management actions

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Environmental Education	Objective A2.3: Over the next 15 years, continue to maintain the existing level of environmental education, as requested and in coordination with refuge partners. ——— *Continue to:* Host school field trips as requested, as timing and resources allow	Objective B2.3: 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 National Wildlife Refuge System, and National Wilderness Preservation Systems, 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 National Wildlife Refuge and National Wilderness Preservation Systems in conserving Federal trust resources; (4) explain the unique characteristics of the Monomoy Wilderness; and 5) name at least one endangered species the refuge conducts management for. ——— *In addition to objective A2.3:* *Within 5 years of CCP implementation:* Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objectives, and to evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted 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, and develop curriculum and programs that would enhance or compliment area environmental education programs (e.g., outer Cape) Provide access to Children and Nature Network tool kits in English and Spanish	Objective C2.3: Within 5 years of CCP approval, we would provide at least one curriculum-based onsite environmental education program for local and regional school districts to use that will focus on Monomoy NWR, Monomoy Wilderness, the Refuge System, and National Wilderness Preservation Systems, species of conservation concern, and natural (ecological) processes. 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 Monomoy's role in the National Wildlife Refuge and National Wilderness Preservation Systems in conserving Federal trust resources; (4) explain the unique characteristics of the Monomoy Wilderness; and 5) name at least one endangered species the refuge conducts management for. ——— *In addition to objective A2.3:* *Within 5 years of CCP implementation:* Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objectives, and to evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted Host one to two teacher workshops each year on threatened and endangered species, the value of Monomoy Wilderness, 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 curriculum and programs that would enhance or compliment area environmental education programs (e.g., outer Cape region) Provide access to Children and Nature Network tool kits in English and Spanish

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Environmental Education (cont.)		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 group currently not 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 that can be utilized on or offsite that incorporate the Massachusetts curriculum frameworks as well as key refuge messages that can be utilized by local and regional school districts based on findings of pilot study Expand efforts to coordinate with area environmental educators to integrate refuge programs with local environmental education programs	*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 group currently not being served by other education organizations *Within 10 years of CCP implementation:* Create at least one curriculum-based environmental education program in coordination with partners that can be utilized on or offsite that incorporate the Massachusetts curriculum frameworks as well as key refuge messages that can be utilized by local and regional school districts based on findings of pilot study

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Wildlife Observation & Photography	Objective A2.4: Over the life of the plan, continue to provide visitors with the opportunity to engage in wildlife observation and photography on the refuge by maintaining the refuge's existing boardwalk and overlook on the Morris Island Trail, and continued coordination with ferry vendors to provide access to North Monomoy Island and South Monomoy. ——— *Continue to:* Allow wildlife observation, which includes nature study, year-round on refuge lands open to public use from ½ hour before sunrise to ½ after sunset; prohibit touching, feeding, or harassing wildlife Maintain the two viewing platforms on Morris Island (map 1.2) Allow commercial filming and photography on the refuge only when there is a direct benefit to the refuge or the Service; all allowed commercial filming and photography would operate under a special use permit once determined compatible by the refuge manager. Allow photography in any area of the refuge open to the public Host a youth or adult photography contest	Objective B2.4: 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. ——— *In addition to objective A2.4, strategies 1, 2, 4, and 5:* *Within 1 year of CCP implementation:* Allow commercial filming and photography on the refuge only when there is a direct benefit to the refuge or the Service. All allowed commercial filming and photography would operate under a special use permit issued by the refuge manager. Commercial photography would also have to support wilderness and be conducted in a manner consistent with protecting wilderness character. *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, to ensure that members understand refuge regulations, and to maintain a connection to one of the most important refuge constituencies *Within 5 years of CCP implementation:* Complete a visitor services plan for the refuge; establish thresholds of acceptable change to resources resulting from public use; and develop monitoring strategies to measure change, measure achievement of objective, and evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted Provide trails on refuge lands for wildlife observation; the wilderness trails would not be maintained by refuge staff but would be clearly marked by satellite coordinates so that visitors may use the GPS-enabled devices to find the path, if necessary	Objective C2.4: Over the next 15 years, increase the number of wildlife observation and photography visits by 50 percent in a manner consistent with preserving wilderness, taking "nothing but photographs" and leaving behind "nothing but footprints." ——— *In addition to objective A2.4, strategies 1 to 5:* *Within 5 years of CCP implementation:* Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objectives, and to evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted Provide trails on refuge lands for wildlife observation; the wilderness trails would not be maintained by refuge staff but would be clearly marked by satellite coordinates so that visitors may use the GPS-enabled devices to find the path, if necessary Evaluate use of critter cam(s) so public can observe nesting behavior online which would facilitate a connection to animals they may not be able to view in person 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 develop photography tour with emphasis on the unique values and opportunities of the Monomoy Wilderness *Within 7 years of CCP implementation:* Evaluate and implement opportunities for universally accessible observation; enhance existing boardwalk at the refuge headquarters to make it ADA accessible for improved observation opportunities at the overlook on Morris Island Trail

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Wildlife Observation & Photography (cont.)		Evaluate use of critter cam(s) so public can observe nesting behavior online which would 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 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; enhance existing boardwalk at the refuge headquarters to make it ADA accessible for improved observation opportunities at the overlook on Morris Island Trail Install an additional viewing platform or photography blind on Morris Island	

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Fin Fishing, Lobstering, and Crabbing	Objective A2.5: Continue to provide high-quality fishing opportunities to refuge visitors within areas otherwise open to public use. ——— *Continue to:* Allow fin fishing from all refuge lands otherwise open to public use, from ½ hour before sunrise to ½ hour after sunset, in accordance with Massachusetts and Federal regulations, including possessing a saltwater or freshwater fishing license recognized by the Commonwealth of Massachusetts. Allow fishing in the open waters, above submerged lands, under State and Federal regulations. Included fishing activities are: demersal long line fishing; mid-water trawl fishing, hook and line/rod and reel fishing; lobster, crab, and whelk pot fishing; and hand-harvest of scallops. Allow anglers to fish on Morris Island 24 hours per day in accordance with all Federal and State fishing regulations Allow freshwater fishing in the ponds on South Monomoy during daylight hours Allow commercial fishing guides to conduct fin fishing on the refuge in areas that are open to fishing in accordance with State seasons	Objective B2.5: Provide opportunities for fishing, and strive to ensure that 50 percent of visitors engaged in recreational fishing report having a high-quality experience. ——— *In addition to objective A2.5, strategies 1 to 4:* *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 refuge's Web site, at Morris Island kiosk, and distribute to local fishing organizations, guides and shops, which would include "closed areas" maps and any additional refuge-specific regulations All commercial fishing guides would need a refuge permit to operate within the refuge Declaration of Taking boundary, regardless of whether vessels or passengers make a refuge landfall *Within 3 years of CCP implementation:* Replace the current motorized seal tour-ferry access system from the refuge headquarters on Morris Island with a competitive, multi-year concession, or special use permit holders if no concessionaire is identified; the concession would arrange for refuge permitted fishing or waterfowl hunting guides and provide a means system to bring anglers and their guides to the refuge along with providing other visitor related services Establish station at headquarters for recycling monofilament and safely disposing of fish line	Objective C2.5: Provide opportunities for fishing in a manner consistent with preserving and promoting wilderness character, and ensure that 75 percent of visitors engaged in recreational fishing report that they had a high-quality experience. ——— *In addition to objective A2.5, strategies 1 to 4:* *Within 1 year of CCP implementation:* Provide seasonal information (e.g., conditions, species, fish runs) on refuge's Web site, at Morris Island kiosk, and distribute to local fishing organizations, guides and shops, which would include "closed areas" maps and any additional refuge-specific regulations *Within 3 years of CCP implementation* Replace the current motorized seal tour-ferry access system from the refuge headquarters on Morris Island with a competitive, multi-year concession or special use permit holders if no concessionaire is identified. The concession would arrange for refuge permitted fishing or waterfowl hunting guides and provide a means system to bring anglers and their guides to the refuge along with providing other visitor related services Provide recreational anglers and their commercial guides permits to operate, using non-motorized transport in the waters within the Declaration of Taking through the refuge concessionaire agreement (as authorized sub-permittees) or special use permit

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Fin Fishing, Lobstering, and Crabbing (cont.)		*Within 5 years of CCP implementation:* Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and to evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted Work with partners and coordinate with the State to develop a fishing brochure that informs anglers about refuge resources and seasonal closures that would be available on the refuge's Web site and at 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	Establish station at headquarters for recycling monofilament and safely disposing of fish line *Within 5 years of CCP implementation:* Complete a visitor services plan for the refuge incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and to evaluate visitor experiences; modify or restrict access, or adapt management strategies as warranted Work with partners and coordinate with the State to develop a fishing brochure that informs anglers about refuge resources and seasonal closures that would be available on the refuge's Web site and at Morris Island kiosk *Within 10 years of CCP implementation:* Evaluate the fishing program; modify or restrict access, or adapt management strategies as warranted

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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.			
Responds to Issues: What types of recreational opportunities will be provided on the refuge? How will public uses be managed? How will the refuge address access and parking?			
Shellfishing	Objective A2.6: Continue to allow Town of Chatham residents and refuge visitors to shellfish using non-mechanized hand raking tools only, and in accordance with Town of Chatham Shellfish Rules and Regulations. ——— *Continue to:* Allow clamming using non-mechanized, hand methods on the majority of intertidal habitats year round (following State and Town regulations) Coordinate with the Town of Chatham Shellfish Warden as needed to discuss shellfish resource management and harvest levels and harvest regulations and enforcement	Objective B2.6: Allow refuge visitors to harvest subterranean shellfish (softshell clams, quahogs, and razor clams) using non-mechanized hand raking tools only and no artificial means of extraction (such as salt and chlorine), in accordance with Town of Chatham Shellfishing Rules and Regulations or additional refuge regulations. ——— *In addition to objective A2.6, strategy 1:* *Within 1 year of CCP implementation:* Coordinate with the Mass Division of Marine Fisheries and the Town of Chatham Shellfish Warden to review annual use, obtain harvest records, promote and ensure the sustainability of the shellfish resource on the refuge Ensure information about the refuge's prohibition on the use of salt or chlorine or other artificial means of extraction to harvest razor clams is transmitted to local clammers Start to enforce the existing prohibition on the use of wheeled carts and other forms of mechanical transport in Monomoy Wilderness Close the refuge to the harvest of mussels Prohibit bottom substrate disturbing fishing activities such as mussel harvesting, scallop dragging, or any hydraulic dredging for shellfish within the Declaration of Taking refuge boundary Coordinate with Town of Chatham Shellfish Warden to ensure all permitted shellfishers using Monomoy refuge acknowledge being provided with information about the refuge purpose and mission, regulations, seasonal closures, and wilderness ethics and stewardship *Within 3 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 or chlorine	Objective C2.6: Allow refuge visitors to harvest subterranean shellfish (softshell clams, quahogs, and razor clams) using non-mechanized hand raking tools only and no chemical means of extraction (such as salt and chlorine), in accordance with Town of Chatham Rules and Regulations or additional refuge regulations. ——— *In addition to objective A2.6, strategy 1:* *Within 1 year of CCP implementation:* Coordinate with Mass Division of Marine Fisheries and the Town of Chatham Shellfish Warden to review annual use, obtain harvest records, promote and ensure the sustainability of the shellfish resource on the refuge Start to enforce the existing prohibition on the use of wheeled carts and other forms of mechanical transport in Monomoy Wilderness. Require use of only non-mechanized, hand operated harvesting equipment; prohibit all motorized and chemical means for extracting shellfish from the sediment Prohibit the harvest of mussels Prohibit bottom substrate disturbing fishing activities such as mussel harvesting, scallop dragging, or any hydraulic dredging for shellfish within the Declaration of Taking refuge boundary Coordinate with Town of Chatham Shellfish Warden to ensure all permitted shellfishers using Monomoy refuge acknowledge being provided with information about the refuge purpose and mission, regulations, seasonal closures, and wilderness ethics and stewardship *Within 3 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 or chlorine

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
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.			
Responds to Issues: What types of recreational opportunities will be provided on the refuge? How will public uses be managed? How will the refuge address access and parking?			
Waterfowl Hunting	Waterfowl hunting not currently allowed	Objective B2.7: 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. ——— *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 objective, and to evaluate the hunt program; modify or restrict access, or adapt management strategies as warranted Open a portion of Monomoy NWR to waterfowl hunting in accordance with Federal, State, and local hunting regulations. 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, South Monomoy, including wilderness and non-wilderness areas to apply for and receive a special use permit to conduct guiding on the refuge (50 CFR 27.97). The fee for this SUP would not be less than $100 or more than $500 with all monies minus administration costs, to enhance the hunting program and the hunters' experience.	Objective C2.7: 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. ——— *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 objective, and to evaluate the hunt program; modify or restrict access, or adapt management strategies as warranted Open a portion of Monomoy NWR to waterfowl hunting in accordance with Federal, State, and local hunting regulations. 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 guides providing guiding services within North Monomoy Island, South Monomoy, including wilderness and non-wilderness areas to apply for and receive a special use permit to conduct guiding on the refuge (50 CFR 27.97); the fee for this SUP would not be less than $100 or more than $500 with all monies minus administration costs, to enhance the hunting program and the hunters' experience In an effort to maintain and enhance the wilderness experience, motorized boat landing in wilderness and the use of decoys on the shoreline would be prohibited

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 3: Communicate and collaborate with local communities, Federal and state agencies, and conservation organizations to promote natural resource conservation and to support the goals of the refuge and the mission of the U.S. Fish and Wildlife Service.			
Responds to Issues: How will the refuge convey its messages to the public? How will the refuge foster relationships with the local community and partners?			
Public Outreach	Objective A3.1: Continue to conduct outreach to residents and visitors to the Cape Cod region about the refuge and refuge activities, via the visitor contact station, social networking sites, and refuge Web site. ——— *Continue to:* Update and print brochures and rack cards and make them available to the Chamber of Commerce and tourist attractions Use Internet resources to inform the public about the refuge, its mission, and management actions Issue press releases to inform the public about refuge activities, respond to media inquiries, and publish our accomplishments online Give presentations about refuge management actions and wildlife at venues such as the Cape Cod Natural History Conference Occasionally participate in local festivals and parades Work with Friends group and volunteers to increase refuge activities and funding opportunities Speak about the refuge and its purpose to local service and civic organizations, and regionwide conservation partners Educate visitors and boaters to maintain a 150-foot minimum distance from seals in accordance with the Northeast Seal Watching Guidelines and Marine Mammal Protection Act	Objective B3.1: Over the next 10 years, expand public information dissemination efforts with a target of annually reaching 100,000 people, and participate in at least 5 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, Refuge System, and National Wilderness Preservation System. ——— *In addition to objective A3.1, strategies 1 to 7:* *Within 1 year of CCP implementation:* Promote an outreach campaign (already initiated by National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 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 and minimizing disturbance to marine mammals. The outreach message would focus on a recommended viewing distance of at least 150 feet to allow marine mammals undisturbed resting and foraging areas which are critical to 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 Federal-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	Objective C3.1: Over the next 10 years, expand public information dissemination efforts with a target of annually reaching 100,000 people, and participate in at least 3 offsite opportunities annually within the local community or the Cape Cod region, so residents and visitors can learn about the Monomoy NWR coastal barrier ecosystem, the Monomoy Wilderness, and the role of the Refuge System in protecting and managing those enduring resources. ——— *In addition to objective A3.1, strategies 1 to 6:* *Within 1 year of CCP implementation:* Speak about the refuge and its purpose, *upon invitation only*, to local service and civic organizations, and regionwide conservation partners Promote an outreach campaign (already initiated by National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 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 and minimizing disturbance to marine mammals; the outreach message would focus on a recommended viewing distance of at least 150 feet to allow marine mammals undisturbed resting and foraging areas which are critical to 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

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 3: Communicate and collaborate with local communities, Federal and state agencies, and conservation organizations to promote natural resource conservation and to support the goals of the refuge and the mission of the U.S. Fish and Wildlife Service.			
Responds to Issues: How will the refuge convey its messages to the public? How will the refuge foster relationships with the local community and partners?			
Public Outreach (cont.)		Initiate an outreach campaign to provide information to all visitors about the importance of minimizing disturbance to migrating and staging birds. The outreach message would focus on a recommended viewing distance of at least 50 m to allow birds to remain undisturbed in their resting and foraging areas which are critical to successful migration. *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	Provide and maintain refuge informational displays at other frequently visited refuge partner locations *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
Community Support	Objective A3.2: Increase community support by fostering further growth of the Friends of Monomoy and increase volunteer hours by 150 hours a year for the next 10 years. *Continue to:* Recruit, train, and guide volunteer efforts on the refuge Maintain a productive relationship with the Friends of Monomoy NWR group that understands the refuge mission and actively supports refuge activities Implement current Friends and volunteer policies according to Draft Friends Policy 633 FW 1-4 and National Wildlife Refuge System Volunteer and Partnership Enhancement Act of 1998 October 5 Maintain a volunteer database Encourage establishing a local chapter of the American Lighthouse Foundation to support future maintenance and conduct interpretation at the historic Monomoy Point Light Station	Objective B3.2: Over the life of the plan, support the Friends group, increase refuge partnerships, volunteers, and other forms of support to improve refuge communications and effectiveness and have the public understand our purpose and management activities by increasing volunteer hours and the number of partnerships by 50 percent. *In addition to objective A3.2:* *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 to create a jointly staffed visitor contact facility in Chatham or Harwich that allows visitors to: (1) receive information on what nature-based opportunities are available in the local area; (2) know where to go; and (3) make whatever arrangements and contacts needed for their visit	Objective C3.2: Over the life of the plan, develop new and enhance existing partnerships, support a reinvigorated Friends group, increase refuge partnerships, volunteers, and other forms of support to improve refuge communications and effectiveness, improve our ability to achieve the refuge mission, and have the public understand our purpose and management activities by increasing volunteer hours and the number of partnerships by 50 percent. *In addition to objective A3.2:* *Within 2 years of CCP implementation:* Develop and implement volunteer position descriptions to increase volunteer opportunities Work with partners to promote and educate about what it means to visit a wilderness area and the important role it plays in preserving the quality of life in the Cape Cod region

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 4: Ensure that the spirit and character of the Monomoy Wilderness are preserved.			
Responds to Issues: How will the refuge manage its wilderness resources in keeping with the Wilderness Act? Will there be a change in the areas designated as wilderness?			
Wilderness Implementation and Designation	Objective A4.1: Manage the Monomoy Wilderness to preserve wilderness character and values, in a manner consistent with refuge establishment purposes (migratory birds and endangered species recovery) and the Refuge System mission. ——— *Continue to:* Manage the existing Monomoy Wilderness for naturalness, wildness, and outstanding opportunities for solitude or primitive and unconfined recreation by conducting refuge management operations and visitor uses in a manner that protects wilderness character Continue managing the Inward Point and Powder Hole inventory areas to maintain or enhance their size, naturalness, and opportunities for solitude or primitive and unconfined recreation throughout the 15-year plan period, to the extent that it will not prevent fulfilling refuge establishment purposes or the Refuge System mission (610 FW) Use the appropriate response to unplanned wildfire ignitions that provides for public and firefighter safety while recognizing periodic fire as a natural process with long-term benefits to an enduring wilderness resource Where fire exclusion or other man-caused alterations of natural coastal processes have led to unnatural wildland fuel and vegetation conditions, apply prescribed fire to restore a more natural fire regime or migratory bird or endangered/threatened species habitat conditions within the Monomoy Wilderness Maintain wilderness boundary signs at three locations (two boat landings and on Nauset/South Beach) Implement management activities that involve temporary rather than permanent uses or site occupancy which create no new surface disturbance, do not involve placement of permanent structures or installations (e.g., temporary symbolic fencing) or use of motorized equipment or mechanized transport unless it is the minimum tool possible	Objective B4.1: Manage the Monomoy Wilderness to enhance its wilderness character and values, in a manner consistent with refuge establishment purposes (migratory birds and endangered species recovery) and the Refuge System mission. ——— *In addition to objective A4.1, strategies 1 to 6:* *Continue to:* *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 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 to evaluate visitor experiences Work with the Federal Aeronautical Adminstration to increase pilot awareness of the 2,000-foot flight ceiling restriction over Monomoy wilderness. *Within 5 years of CCP implementation:* Explore opportunities with 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	Objective C4.1: : Manage the Monomoy Wilderness to enhance its wilderness character and values, in a manner consistent with refuge establishment purposes (migratory birds and endangered species recovery) and the Refuge System mission. ——— *In addition to objective A4.1, strategies 1 to 3 and 6 :* *Continue to:* Assess current wilderness character (untrammeled; undeveloped; natural; outstanding opportunities for solitude or primitive and unconfined recreation; and other features/ unique attributes) within the Monomoy Wilderness and implement the wilderness monitoring component of a wilderness stewardship plan for the Monomoy Wilderness *Within 1 year of CCP implementation:* Decrease the use of boats to transport refuge staff to North Monomoy Island and South Monomoy by requiring staff and volunteers to paddle or hike to their work locations when feasible Remove all signs within the Monomoy Wilderness and utilize the kiosk on Morris Island to inform visitors about the Monomoy Wilderness (e.g., allowed uses, boundary, etc.) *Within 3 years of CCP implementation:* Complete a wilderness stewardship plan for the Monomoy Wilderness incorporating strategies identified herein; establish thresholds of acceptable change to resources resulting from public use; develop monitoring strategies to measure change, measure achievement of objective, and to evaluate visitor experiences; limit or restrict access through use of a wilderness access pass or adapt management strategies as warranted Explore opportunities with 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

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 4: Ensure that the spirit and character of the Monomoy Wilderness are preserved.			
Responds to Issues: How will the refuge manage its wilderness resources in keeping with the Wilderness Act? Will there be a change in the areas designated as wilderness?			
Wilderness Implementation and Designation (cont.)	Provide refuge staff with wilderness stewardship training appropriate for their position Review all activities proposed within the Monomoy Wilderness and the Inward Point and Powder Hole inventory areas, and ensure they are consistent with wilderness management using the Minimum Requirements Analysis process presented under Actions Common to All Alternatives Review and implement actions recommended in the Wilderness Character Report (untrammeled; undeveloped; natural; outstanding opportunities for solitude or primitive and unconfined recreation; and other features/unique attributes) within the Monomoy Wilderness	Explore the feasibility of a wilderness access pass and implement if practicable the minimum access pass program as a means of educating and informing the public about the wilderness-designated lands and waters on the refuge, refuge wildlife and management actions, and appropriate use by visitors while in refuge wilderness, as well as limiting the number of people allowed at one time in an effort to maintain the solitude character of the Monomoy Wilderness Explore the option of creating a smartphone application with Monomoy Wilderness coordinates and information about the wilderness designation	Explore the feasibility of a wilderness access pass and implement if practicable the minimum access pass program as a means of educating and informing the public about the wilderness-designated lands and waters on the refuge, refuge wildlife and management actions, and appropriate use by visitors while in refuge wilderness, as well as limiting the number of people allowed at one time in an effort to maintain the solitude character of the Monomoy Wilderness Explore the option of creating a smartphone application with Monomoy Wilderness coordinates and information about the wilderness designation Work with the Federal Aeronautical Administration to increase pilot awareness of the 2,000-foot flight ceiling restriction over Monomoy wilderness.
Refuge Goal 5: Protect cultural resources that exist in the refuge.			
Responds to Issues: How will the refuge manage its cultural resources? What will happen to the light station?			
Archaeological Resources and Historic Structures	Objective A5.1: Protect and preserve archaeological, Native American, and historical resources on Monomoy NWR from ground-disturbing activities or processes, and artifact looting. Maintain the Monomoy Point Light Station (listed on the National Register of Historic Places) to meet the historic preservation standards of the Secretary of the Department of the Interior. *Continue to:* Comply with section 106 of NHPA prior to conducting any ground disturbing activities on the refuge. Compliance may entail any combination of SHPO/THPO 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	Objective B5.1: 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 on Monomoy NWR that are threatened by coastal erosion. Protect and preserve significant archaeological resources that are threatened by proposed ground-disturbing activities, or are subject to potential artifact looting. Maintain the Monomoy Point Light Station (listed on the National Register of Historic Places) to meet the historic preservation standards of the Secretary of the Department of the Interior. *In addition to objective A5.1, strategies 1 to 5:* *Within 1 year of CCP implementation:* Develop a MOA collaboratively with the State Historic Preservation Officer and Advisory Council on Historic Preservation which 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	Objective C5.1: 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 on Monomoy NWR that are threatened by coastal erosion. Protect and preserve significant archaeological resources that are threatened by proposed ground disturbing activities or sea level rise damage, or are subject to potential artifact looting. Manage the Monomoy Point Light Station (listed on the National Register of Historic Places) to meet the historic preservation standards of the Secretary of the Department of the Interior, to the extent that is prudent and feasible given the long-term threat to the structures posed by erosion and climate change. *In addition to objective A5.1, strategies 1, 3, and 5:* *Within 1 year of CCP implementation:* Develop a MOA collaboratively with the State Historic Preservation Officer and Advisory Council on Historic Preservation which 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 Identify, evaluate, or survey cultural resources on the refuge, on a project-specific basis

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
Refuge Goal 5: Protect cultural resources that exist in the refuge.			
Responds to Issues: How will the refuge manage its cultural resources? What will happen to the light station?			
Archaeological Resources and Historic Structures (cont.)	Develop and implement throughout the plan period, 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 provides for systematic mitigation over time of the adverse effects from natural weathering, erosion and decay processes	Update the 2010 MRA that addresses the need for periodic motorized equipment access through the Monomoy Wilderness to the Monomoy Point Light Station for the purposes of major repairs or refurbishment 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 which includes periodic monitoring of known archaeological sites In accordance with NHPA (section 110), conduct pro-active archaeological surveys to determine the limits and integrity of the Whitewash Village archaeological site group on South Monomoy, and to 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 (interpretive signs, day and virtual tours, etc.) to support the interest of the public in this nationally significant historic resource	*Within 5 years of CCP implementation:* Establish a protocol with the Massachusetts Board of Underwater Archaeological Resources for examination and assessment of historic shipwreck remains that may appear *Within 10 years of CCP implementation:* Develop a mitigation plan for the Monomoy Point Light Station, to implement an interpretive program of exhibits, documentary research, archaeological investigation, and possible relocation of structures, prior to the destruction of this National Register site by natural forces

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
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.			
Responds to Issues: how will the refuge continue to staff the refuge? What types of facility and infrastructure changes will be made, if any?			
Staffing	Objective A6.1: Maintain current staffing levels at three full time employees (refuge manager and two biologists), and continue to employ seasonal and term biological staff and interns (see appendix G for current staffing chart). Provide a diverse and inclusive workplace through annual training, support, and awareness. *Continue to:* Recruit and employ seasonal and term biological, visitor services, and wilderness staff, interns, and volunteers Work with organizations such as the Student Conservation Association and the Federal Pathways program to hire talented young college students for seasonal intern positions Provide a safe environment at work that promotes diversity and inclusion Seek grants and funding partnerships to support additional staff Request additional staffing as funding becomes available Provide relevant staff training opportunities to increase work skills and to increase understanding of diversity and inclusion	Objective B6.1: Over the next 15 years, fill seven additional permanent full-time positions and continue to employ seasonal and term biological staff and interns to implement the activities outlined in alternative B (see appendix G for staffing chart proposed under alternative B). Provide a diverse and inclusive workplace through annual training, support, and awareness. *In addition to objective A6.1:* *Within 15 years of CCP implementation:* Change an existing General Biologist (GS-0401-09) to a Wildlife Refuge Specialist (GS-0401-09/11) position 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	Objective C6.1: Over the next 15 years, fill six additional permanent full-time positions to implement the activities outlined in alternative C (see appendix G for proposed staffing chart under alternative C). Provide a diverse and inclusive workplace through annual training, support, and awareness. *In addition to objective A6.1:* *Within 15 years of CCP implementation:* Fill one Visitor Services Specialist position Fill one Maintenance Worker/Boat Operator position Fill one Administrative Assistant position Fill two Park Ranger-Law Enforcement positions Fill one Refuge Operations Specialist position

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
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.			
Responds to Issues: how will the refuge continue to staff the refuge? What types of facility and infrastructure changes will be made, if any?			
Facilities & Maintenance	Objective A6.2: Provide adequate, safe, and energy-efficient infrastructure and equipment to safely support refuge staff, interns, and volunteers, while sharing a headquarters site with co-located National Weather Service facilities. ——— *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 and maintain an MOU with them for use of Service-owned land on Morris Island. Should the NWS at any point decide to relocate their existing operation, the refuge would look into re-utilizing the current NWS buildings and space/site use at the Morris Island site Maintain a fleet of three highway vehicles and three outboard motor boats that provide safe and efficient transport to North Monomoy Island, South Monomoy, Minimoy Island, and offsite locations for resource management and administrative work; replace boats and motors as necessary to maintain a functional fleet Develop potential partnership with town of Chatham or U.S. Coast Guard and establish new dockage and covered boat storage and maintenance with secure marine equipment storage and additional parking	Objective B6.2: Over the life of the plan, ensure office, support facilities, and other infrastructure sufficient to support staff and volunteers and the expanded programs they provide and activities they undertake are provided and maintained, while sharing a headquarters site with co-located National Weather Service facilities. ——— *In addition to objective A6.2:* *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 armoring and 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 in this alternative as needed Explore additional refuge staff housing opportunities within the local commuting area Explore opportunities to acquire the waterfront Stage Island lot adjoining our current Lot 7b; add storage capability and expand parking for refuge staff	Objective C6.2: Over the life of the plan, provide adequate, safe, and energy-efficient infrastructure and equipment to safely support refuge staff, interns, and volunteers, while sharing a headquarters site with co-located National Weather Service facilities. ——— *In addition to objective A6.2, strategies 1 to 3:* *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 armoring and 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 in this alternative as needed Explore additional refuge staff housing opportunities within the local commuting area

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
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.			
Responds to Issues: how will the refuge continue to staff the refuge? What types of facility and infrastructure changes will be made, if any?			
Facilities & Maintenance (cont.)		*Within 10 years of CCP implementation:* Conduct a cost-benefit analysis to evaluate (1) establishment of a stand-alone visitor contact station that supports refuge visitor services staff, (2) renovation of existing facilities through remodeling of current headquarters/visitor contact station and dormitory/maintenance building to provide additional office and living space with or without the establishment of a separate visitor contact station, or (3) acquisition of a new headquarters site and funding to relocate the entire refuge operation (including visitor contact station) and shuttle parking. This would 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, and welcome area, which would include parking and 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 with their efforts to establish store in downtown Chatham or Harwich that would also provide refuge information; this building would not support refuge visitor services staff	Explore opportunities to acquire the waterfront Stage Island lot adjoining our current Lot 7b; add storage capability and expand parking for refuge staff Explore opportunities to partner with Town of Chatham or U.S. Coast Guard and establish new dockage and covered boat storage and maintenance with secure marine equipment storage and additional parking *Within 10 years of CCP implementation:* Explore the acquisition of alternative headquarters site, which would include parking and shuttle to Morris Island, where entire refuge operation can be relocated (including visitor contact station); this would include exploration of possibilities to co-locate with partners

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
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.			
Responds to Issues: how will the refuge continue to staff the refuge? What types of facility and infrastructure changes will be made, if any?			
Energy Efficiency	Objective A6.3: 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. *Continue to:* Seek renewable energy project assistance through the Federal Energy Management Program to conduct a feasibility study to determine the technical performance of solar panels at the Monomoy Point Light Station Evaluate the possibility of installing a wind turbine at the Morris Island contact station Conduct bird and bat surveys at the site of the proposed wind turbine for Morris Island to determine what species are currently using the area Train staff and volunteers about water and energy conservation, purchase materials made with post-consumer content or with built in solar panels for charging cell phones and other electrical devices in the field, and recycle and reuse materials Maintain recycling and compost bins at refuge facilities Work with local and regional partners seeking funding for alternative transportation measures that reduce fossil fuel consumption and associated carbon emissions by refuge visitors, 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	Objective B6.3: 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 the associated greenhouse gas emissions (a smaller carbon footprint) at refuge headquarters. Reduce metered, potable (treated) water consumption at refuge facilities. Refuge facilities would themselves demonstrate renewable "green" energy measures similar in type to that which a residential homeowner, farmer, or small business owner might install for refuge visitors and public officials and move refuge operations and facilities toward carbon neutrality by 2020. *In addition to objective A6.3, strategies 1 to 7:* *Within 1 year of CCP implementation:* Reduce metered/potable water consumption by installing rainwater collection and distribution systems at refuge administrative facilities Transition fleet to use hybrid and electric alternative fuel vehicles and boat motors when feasible to suit the needs of managing the refuge	Objective C6.3: 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. Refuge facilities would demonstrate renewable "green" energy measures similar to that which a residential homeowner, farmer, or small business owner might install by achieving a Gold LEEDS rating. *In addition to objective A6.3, strategies 2 to 6:* *Within 5 years of CCP implementation:* Reduce metered/potable water consumption by installing rainwater collection and distribution systems at refuge administrative facilities Transition fleet to use hybrid and electric alternative fuel vehicles and boat motors when feasible to suit the needs of managing the refuge Prepare a stand-alone NEPA analysis for the installation of a wind turbine to augment the solar thermal tube domestic hot water system installed in 2011 for the refuge headquarters complex on Morris Island *Within 10 years of CCP implementation:* Install a wind turbine to augment the solar thermal tube domestic hot water system installed in 2011 for the refuge headquarters complex on Morris Island

Refuge Resource or Program	Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses	Alternative C: Natural Processes
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.			
Responds to Issues: how will the refuge continue to staff the refuge? What types of facility and infrastructure changes will be made, if any?			
Energy Efficiency (cont.)		*Within 3 years of CCP implementation:* Conduct a cost-benefit analysis to determine the most efficient source of alternative energy at the Monomoy Point Light Station and seek funding for installation Pursue improvements to preserve the Monomoy Point Light Station structures to extend maintenance intervals, and make it more functional, including the construction of internal walls and the installation of drywall to provide privacy to refuge staff stationed there when doing field work on South Monomoy Use the CLIR (Climate Leadership in Refuges) tool to calculate refuge greenhouse gas emissions, and develop and implement actions to reduce the release of these gases from refuge operations *Within 5 years of CCP implementation:* Prepare a stand-alone NEPA analysis for the installation of a wind turbine to augment the solar thermal tube domestic hot water system installed in 2011 for the refuge headquarters complex on Morris Island *Within 10 years of CCP implementation:* Install a wind turbine to augment the solar thermal tube domestic hot water system installed in 2011 for the refuge headquarters complex on Morris Island Install electric car charging station at Morris Island parking lot	

Chapter 4

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Seal

Environmental Consequences

- Introduction
- Effects on Air Quality
- Effects on Climate Change
- Effects on Water Quality
- Effects on Soils
- Effects on Federal Threatened and Endangered Species
- Effects on Vegetation and Habitats
- Effects on Birds
- Effects on Other Native Wildlife
- Effects on Wilderness Recommendations and Designation
- Effects on Public Uses and Access
- Effects on Socioeconomic Resources
- Effects on Cultural, Historical, and Archaeological Resources
- Cumulative Impacts
- Relationship Between Short-term Uses of the Human Environment and Enhancement of Long-term Productivity
- Unavoidable Adverse Effects
- Potential Irreversible and Irretrievable Commitments of Resources
- Environmental Justice

Introduction

This chapter describes the foreseeable environmental consequences we predict if the refuge management alternatives presented in chapter 3 are implemented. Specifically, we predict the beneficial and adverse effects of implementing the management actions and strategies for each of the alternatives:

- Alternative A–Current Management (which serves as a baseline for comparing against the other two alternatives)
- Alternative B–Enhanced Management of Habitat and Public Uses (Service-preferred)
- Alternative C–Natural Processes Management

In this chapter, we describe the direct, indirect, short-term, and cumulative effects likely to occur over the 15-year life span of this CCP. Longer-term cumulative impacts are also included, but beyond certain timeframes (5 to 10 years), we are less certain about the impact of our actions and therefore provide more approximate descriptions of environmental consequences. Where detailed information is available, we present a scientific and analytic comparison of the alternatives and their anticipated impacts and effects on the environment. In the event that detailed information is unavailable, we base those comparisons on our best professional judgment and experience. At the end of this chapter, table 4.8 summarizes the effects predicted for each alternative and provides a side-by-side comparison. Our discussion also relates the predicted impacts of the alternatives to the refuge goals and to the key issues identified in chapter 1.

The Council for Environmental Quality (CEQ) and Service regulations on implementing NEPA require that we assess the significance of the effects of all alternatives based on their context, duration, and intensity. The context of our impact analysis ranges from site-specific to regional and landscape-scale, depending on how widely the effect of an action can be observed. Certain actions (such as removal of invasive plant species) may have effects only in a local context, while others (such as participation in regional partnerships) may have a much broader impact. However, it is important to note that even local actions may have cumulative effects that reach beyond their local context, when combined with other actions. For example, invasive plant control on a local scale, when combined with other control efforts across that landscape, could result in combined, significant reductions in the overall abundance and distribution of invasive species. Although the refuge makes up only a small percentage of the larger ecoregion, we developed the three management alternatives to contribute toward regional conservation goals. Our proposed conservation objectives and strategies for species and habitats are consistent with regional, State, and Service landscape-level plans identified in chapter 1, including the North Atlantic Landscape Conservation Cooperative (NALCC), Massachusetts Comprehensive Wildlife Conservation Strategy (MA CWCS), and the many other plans relevant to this area.

We based our evaluation of the intensity of the effects from implementing the alternatives on these factors:

- The expected degree or percent of change in the resource from current conditions.
- The frequency and duration of the effect.
- The sensitivity of the resource to such an effect, or its natural resiliency to recover from such an effect.

- The potential for implementing effective preventive or mitigating measures to lessen the effect.

Effects range in duration from short-term (a matter of days or weeks, as with noise produced by construction) to effectively permanent (e.g., new infrastructure).

Certain types of proposed projects are not fully evaluated in this chapter. These include aspects of management that are common to all alternatives and do not individually or cumulatively have a significant effect on the quality of the human environment. The following would qualify under the Service's list of categorical exclusions (categorical exclusions are classes of actions that do not individually or cumulatively have a significant effect on the human environment, and are specifically detailed in 516 DM 8.5(B) and 43 C.F.R. sections 46.210 and 46.215), if individually proposed:

- Environmental education and interpretive programs (unless major construction is involved or significant increase in visitation is expected).
- Non-invasive research, monitoring, and inventory of biological resources.
- Operations and maintenance of existing infrastructure and facilities (unless major renovation is involved).
- Certain minor, routine, recurring, management activities and improvements.
- Small construction projects (e.g., kiosk, interpretive signs, boardwalks).
- Native vegetation planting and invasive plant control.
- Minor changes in amounts and types of public use.
- Issuance of new or revised management plans when only minor changes are planned.
- Law enforcement activities.

We describe in chapter 3, in Additional NEPA Analysis, those future management decisions that may require more detailed analysis before a choice is made. We analyze the impacts of available choices in this document to the extent possible, but more detailed analysis would inform the final decision in each case.

None of the alternatives recommend further detailed study for wilderness for any of the non-wilderness portions of Monomoy NWR during the 15-year plan period. In all alternatives, we will continue managing the existing Monomoy wilderness, and the Inward Point and Powder Hole (currently non-wilderness) exclusions as well as the Nauset/South Beach area that is now part of South Monomoy Island. We will manage these areas to maintain their size, naturalness, and outstanding opportunities for solitude or primitive and unconfined recreation, to the extent it will not prevent us from fulfilling and carrying out refuge establishing purposes and the Refuge System mission, in accord with Service wilderness stewardship policy (610 FW).

Effects on Air Quality

Chapter 2, Affected Environment, presents the status of air quality in Massachusetts. Poor air quality has adverse impacts on the refuge and other natural areas. Overall air quality in the refuge landscape is currently good. There are no current criteria pollutant exceedances, with the exception of moderate levels of ozone that exceeded safe health levels in the recent past. Air quality

monitoring records for the station in Fairhaven, MA, (MA DEP 2012) indicate that it exceeded the 8-hour ozone standard of 0.075 ppm on 4 days in 2011.

We evaluated the management actions proposed in each alternative for their potential to help improve air quality locally, in the region, and globally. The benefits we considered included:

- Maintaining natural vegetative cover on the refuge's 7,604 acres.
- Requiring that all new facilities and upgrades to existing facilities be energy-efficient.
- Limiting public uses to those that are appropriate, compatible, and wildlife-oriented activities.
- Adopting energy efficient practices to reduce the refuge's contribution to emissions and meet the Service's carbon-neutral goal by 2020.

Collectively, these management actions would help reduce the potential for additional sources of emissions in the surrounding landscape. The potential adverse effects of the management alternatives that were evaluated include increases in:

- Vehicle and equipment emissions associated with visitor use.
- Particulates from using prescribed fire as a management tool.

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Air pollutants contributed by vehicle emissions are a significant concern in Massachusetts. The State is addressing this problem through programs to reduce automobile emissions. While our visitors' vehicles directly contribute air pollutants, they are not the principle cause of reduced air quality. Based on findings from the USGS National Wildlife Refuge Visitor Survey Results: 2010/2011 (Sexton et al. 2011), the majority of refuge visitors (75 percent) were nonlocal and for most local visitors, Monomoy NWR was the primary purpose or sole destination of their trip (65 percent). Local visitors traveled an average of 17 miles to get to the refuge, while nonlocal visitors traveled an average of 330 miles (Sexton et al. 2011). However, their contribution to poor air quality is negligible compared to that of urban and industrial centers within a 200-mile radius.

The refuge positively impacts air quality primarily through the protection of natural lands. Natural vegetated areas such as salt marshes help to offset pollution levels by acting as filters. Unfortunately, the benefit of this natural filtration has never been quantified for refuge lands.

Impacts on Air Quality Common to All Alternatives

Benefits

Regional air quality should not be adversely affected by refuge management activities regardless of which alternative is selected. None of the alternatives would violate EPA standards and all three would comply with the Clean Air Act. Since most of the impacts to regional air quality originate from sources off the refuge, management actions on the refuges would have negligible effect on regional air quality. No major stationary or mobile sources of air pollution are present on the refuge, nor would any be created under any of the alternatives. Refuge land management would help reduce any future direct and cumulative impacts by maintaining natural vegetative cover on refuge lands, requiring

that all upgrades to existing facilities or all new facilities be energy efficient, and limiting public uses to those that are appropriate, compatible, and wildlife-oriented activities. Collectively, these management actions reduce the potential for additional anthropogenic sources of emissions in the surrounding landscape.

The refuge will pursue opportunities to purchase hybrid or alternative fueled vehicles to reduce air emissions from its operations. Morris Island is the only place on the refuge that vehicles can access; it offers limited space for parking and driving. We would attempt to keep the use of vehicles on the refuge to a minimum by restricting travel on the refuge (with the exception of Morris Island) to foot traffic to preserve wilderness character. We would also evaluate opportunities to implement recommendations from a Volpe National Transportation Systems Center study to reduce the number of vehicles coming to the refuge on a daily basis, such as alternative fuel shuttles from a satellite parking area. Establishing a satellite parking location and shuttle bus service would likely decrease the amount of vehicle traffic to the refuge and may result in a negligible reduction in emissions in the immediate vicinity of the refuge. At this time, the refuge has not actively monitored the number of motorboats within the Declaration of Taking. We would expect to see less motorboat use in the Southway as it becomes shallower, but this could be offset by increased use in the shallows on the west side. It is also possible that there may be less motorboat use if the waterway between Morris Island and North Monomoy Island continues to silt in, becoming shallower over time. Alternatively, if the Morris Island channel is maintained and the breach on Nauset/South Beach remains open, there could be an increase in the amount of motorboat use on and around the northern end of the refuge.

Adverse Impacts

In all the alternatives, we would use the herbicides approved by the Service such as, but not limited to, glyphosate to control invasive plants. Glyphosate is a non-volatile compound we would apply only with ground equipment, backpack sprayers, or to individual plants, thereby virtually eliminating the likelihood of any measurable airborne particulates. We will take all precautions with respect to wind conditions, time of day, and proper equipment to ensure that only target plants are exposed to the chemical.

The primary management action common to all alternatives that may affect air quality is prescribed fires. When a prescribed burn is used for refuge vegetation management, some localized and temporary impacts on air quality may result. Although this action is proposed under all alternatives, its use varies among the three and, therefore, air quality impacts would vary and differ by alternative.

Under each alternative, the refuge would continue to use motorized equipment to support maintenance operations and general habitat and wildlife management activities. Equipment would include cars and trucks, motorboats, weed eaters, lawn mowers, etc., that use gasoline. Emissions associated with these sources are expected to have minimal impacts on regional air quality. Table 4.1 provides a summary of criteria pollutants (PM2.5, PM10, CO, CO_2, NO_X, SO_2, and VOC) from the refuge's boat and vehicle use in 2012 and Barnstable County's stationary point source emissions from year 2005. The refuge contributes approximately 19,845.7 lbs/year in boat emissions and 15,387.74 lbs/year in vehicle emissions (based on 2012 boat hours and vehicle mileage). Based on 2005 data, mobile sources in Barnstable County contributed approximately 43,029.76 tons per year (94,864,382.3 lbs/year) in emissions. Monomoy refuge mobile operations contribute about 0.037 percent compared with the regional output of criteria pollutants in Barnstable County.

Table 4.1. Monomoy NWR and Barnstable County Emissions.

Source	Emission per Year (lbs/year)
Monomoy NWR Boat Fleet (2012 hours)	19,845.7
Monomoy NWR Vehicle Fleet (2012 mileage)	15,387.74
Total Monomoy NWR Emissions	35,233.4
Barnstable County (2005)	94,864,382.3
Percentage	0.037 percent

Source: MassDEP Clean Air Act Emissions Inventories, http://www.mass.gov/dep/air/priorities/aqdata.htm; accessed April 2013.

Figure 4.1 shows the relative distance and direction of the six nearest (Clean Air Act) Class I air sheds to Monomoy NWR. Based on their distances from Monomoy NWR, we do expect no visibility impairment of the Class I air sheds from the limited and infrequent prescribed fire and herbicide use on Monomoy.

Figure 4.1. Class 1 Airsheds of the Northeastern U.S.

The potential air quality impacts from prescribed fire on human health and public welfare range from occupational exposure of smoke on firefighters to public health, soiling of materials (economic losses), public nuisance, and highway safety impacts from reduced visibility. Sandberg et al. (2002) provide a comprehensive overview of current knowledge about the effects of fires in wildland fuels, including prescribed fires on air quality.

The major pollutant of concern in smoke from fire is fine particulate matter, both PM10 and PM2.5 (Sandberg et al. 2002). Studies indicate that 90 percent of all smoke particles emitted during wildland burning are PM10[1], and 90 percent of PM10 is PM2.5 (Ward and Hardy 1991). Particulates can reduce visibility or cause negative effects to the health of people with respiratory or cardiovascular illnesses (Hardy et al. 2001). Several population subgroups are more sensitive to fine particulates than is the general population. Asthmatics are especially susceptible to PM exposure. Children are more likely to have decreased

[1] The PM10 and PM2.5 standard includes particles with a diameter of 10 micrometers or less and 2.5 micrometers or less, respectively.

pulmonary function, while increased mortality has been reported in the elderly and in individuals with cardiopulmonary disease.

Globally, biomass fires (especially in tropical forests) are a significant contributor of carbon dioxide and other greenhouse gases in the atmosphere. Fires are also an important mechanism in the redistribution of ecosystems in response to climate stress, which, in turn, affects the atmosphere-biosphere carbon balance (Sandberg et al. 2002).

Although the long-term health effects from occupational smoke exposure remain unknown, evidence to date suggests that brief, intense smoke exposures can exceed short-term exposure limits in peak exposure situations, such as for firefighters holding firelines downwind of an active prescribed burn. Work shift-average exposure only occasionally exceeds recommended instantaneous exposure limits set by the American Conference of Governmental Industrial Hygienists (ACGIH), and rarely exceeds Occupational Safety and Health Administration (OSHA) time weighted average (TWA) limits (Reinhardt and Ottmar 2000; Reinhardt et al. 2000). Overexposure increases to 10 percent of the time if the exposure limits are adjusted for hard breathing, extended hours, and high elevations, factors common to wildland firefighting that intensify the effects of many of the health hazards of smoke (Betchley and others 1995; Materna et al. 1992; Reinhardt and Ottmar 2000; Reinhardt et al. 2000).

Smoke exposure is a hazard only a small portion of the time, but is predictable and therefore manageable. Fireline practices such as crew rotation, awareness training, and carbon monoxide monitoring can mitigate the hazard, allowing firefighters to focus on fire management by lessening the distraction, discomfort, and health impacts of smoke exposure (Reinhardt and Ottmar 2000). The long-term health effects of occupational smoke exposure to wildland firefighters are unknown in spite of anecdotal evidence that suggests a greater incidence of cardiopulmonary disease and death compared to the general population (Sandberg et al. 2002).

The deposition of smoke particles on the surface of buildings, automobiles, clothing, and other objects reduces aesthetic appeal and damages a variety of objects and building structures (Baedecker and others 1991). Smoke may also discolor artificial surfaces such as building bricks or stucco, requiring cleaning or repainting. Increasing the frequency of cleaning, washing, or repainting soiled surfaces becomes an economic burden and can reduce the useful life of soiled material (Maler and Wyzga 1976). Soiling from smoke also changes reflectance of opaque materials and reduces light transmission through windows and other transparent materials (Beloin and Haynie 1975). When fine smoke particles (less than 2.5μm) infiltrate indoor environments, soiling of fabrics, painted interior walls, and works of art may occur.

Nuisance smoke is the amount of smoke in the ambient air that interferes with a right or privilege common to members of the public, including the use or enjoyment of public or private resources (EPA 1990). Nuisance smoke complaints are linked to loss of visibility, odors, and ash fallout that soils buildings, cars, laundry, and other objects. Acrolein (and possibly formaldehyde) in smoke at distances of 1 mile from the fireline can cause eye and nose irritation, exacerbating public nuisance conditions (Sandberg and Dost 1990). Population centers, homes, and businesses on the mainland are well over a mile distant from prescribed burn units proposed for Monomoy and therefore unlikely to be exposed to irritating effects of acrolein or formaldehyde even with unexpected wind direction shifts. A small number of individuals in boats or walking within

1 mile or less of prescribed burn operations on Monomoy NWR could, however, experience the irritating effects of such exposure.

Perhaps the most significant nuisance effect of prescribed fire smoke is local visibility reduction in areas impacted by the plume. People go to places they deem as special and picturesque such as Monomoy NWR, Cape Cod National Seashore, and Chatham village to enjoy colorful scenic vistas of natural landscapes that depend upon clear, clean air. Visitor enjoyment and satisfaction is adversely impacted by reduced visibility (Sandberg et al. 2002). Smoke can impede driver ability to see the roadway and result in loss of life and property damage at concentrations far below National Ambient Air Quality Standards (NAAQS). During the daytime, smoke becomes a problem when it drifts into areas of human habitation. At night, smoke can become entrapped near the ground and, in combination with fog, create visibility reductions that cause roadway accidents. The potential exists for limited smoke intrusions into boat channels and possibly onto the public roads from prescribed fires conducted on the refuge.

Fires are known to emit the pollutants that are precursors for ozone (O_3) formation, such as volatile organic compounds and a minor amount of NO_X. Ground-level O_3 is a criteria (NAAQS) pollutant with a history of non-attainment of the NAAQS standard during warm months (e.g., days above 90˚F) and, therefore, important in eastern Massachusetts. Emissions from fires in wildland fuels (especially NO_X) subjected to sunlight and warm temperatures, either in the original plume or as a result of the plume mixing with the regional atmosphere, combined with nitrate and, indirectly, sulfate aerosol formation, contribute to ozone formation, visibility impairment, and increased PM2.5 concentrations (Sandberg et al. 2002). Stith et al. (1981) mapped ozone mixing ratios in an isolated, fresh, biomass-burning plume. At the source, or near the bottom, of the horizontally drifting plume, they measured low or negative changes in ozone values, which they attributed to titration by NO and low ultraviolet (UV) intensity. Near the top of the plume, 10 km downwind, and in smoke less than 1 hour old, they measured change in ozone values as high as 44 parts per billion by volume (ppbv). Greater changes in ozone were positively correlated with high UV. Much uncertainty still surrounds the magnitude of O_3 formation in the smoke plume, the degree of mixing with pre-existing urban O_3 sources and other precursors, and transport of O_3 downward to ground level (Sandberg et al. 2002), such as during atmospheric subsidence events.

Refuge prescribed burning is conducted in late fall or early spring under all alternatives, not the summer ozone season and therefore is unlikely to contribute significantly to O_3 exceedance episodes in Barnstable County or urban (metropolitan Boston) areas under any alternative.

Low intensity prescribed burning would release inconsequential amounts of other gases (Sandberg et al. 2002). Appropriate smoke management can minimize or nearly eliminate those negative effects. The consideration of the wind speed, direction, and mixing heights is all-important in managing smoke. In planning our prescribed burns, we consider all those factors, and other environmental and geographical factors. Based on our experience, we expect prescribed burning to produce no major, long-term negative impacts.

Prescribed fire emissions, including those from Monomoy NWR, are subject to regulation nationwide under the Clean Air Act by the U.S. Environmental Protection Agency and by the Massachusetts Department of Environmental Protection in the interest of protecting human health and welfare. Massachusetts has an approved State Implementation Plan for Ozone Attainment (2008a).

Prior to igniting any prescribed burn, the refuge must obtain an air quality permit from the Massachusetts DEP and a burn authorization from the Chatham Fire Department, and conduct burning operations in accordance with those authorizations. These permitting processes consider the expected quantity of emissions released over time (source strength) as well as smoke plume rise, trajectory, and down-range concentration (dispersion). The goals of smoke management on the refuges within the Eastern Massachusetts Complex incorporate goals enumerated by the National Wildfire Coordinating Group (1985): reduce fire emissions by maximizing combustion efficiency; enhance the dispersal of smoke plumes; steer smoke plumes away from smoke-sensitive areas; and coordinate the ignitions of prescribed burns (USFWS 2003c).

For purposes of comparing potential worst case air quality impacts from the differing levels of prescribed burning under the plan alternatives, we made an estimate of the maximum fuel biomass (tons) consumed during prescribed burning over a 10-year period was made. Once consumption was estimated, emission factors (pounds emitted/tons consumed) for each air pollutant of interest was applied to derive the maximum emissions estimate for the plan period for each prescribed burn pollutant of interest. Tables 4.2 and 4.3 illustrate a very simplified form of the worst case alternative consumption and emissions estimates. Actual emissions for each pollutant are expected to be considerably less than the worst case maximums listed in table 4.3 below. Air quality regulators and refuge managers use a number of more complex tools that permit more precise estimates for total emissions and their down-range trajectory and dispersion including, but not limited to, fuels characteristics classification system (FCCS), digital photo series, Consume, first order fire effects model (FOFEM), fire emissions production simulator (FEPS), VSmoke, HYSPLIT, CalPuff, and Bluesky. These tools use more site and time-specific fuel and weather variables, but all the tools available regardless of complexity involve estimating fuel consumption and the emissions produced during that consumption.

The alternatives vary in terms of the number and size of burn treatment units established across the Monomoy NWR landscape, and the frequency of prescribed burns during a 10-year period (table 4.2). Currently (alternative A), a single 35-acre burn unit encompassing the South Monomoy tern colony is burned on average every 3 years (3.3 times/decade). Alternative B retains the same 3-year burn interval as alternative A, but expands the area treated during each burning operation to 3 burn units of 25 to 35 acres each (median 30 acres/unit). Alternative C reduces the size of the current burn unit to 10 acres or less, and increases the burn interval to 5 years (2 times/decade).

The beach grass community growing in dry, nutrient-poor sands subjected to prescribed burn treatments under all alternatives is expected to have lower above ground biomass loadings than typical tall grass communities. Above-ground fuel loadings typical of tall grass dominated communities average 2 to 4 tons/acre (FBMS Model #3 after Anderson 1982, GR06 and GR07 after Scott and Burgan 2005). Alternative C with the longer (5-year) interval between burns allows slightly more vegetative biomass accumulation between burns and therefore was assigned a 4 ton/acre average loading. Alternatives A and B with a 3-year interval between burns were assigned a 3 ton/acre average loading for purposes of the worst case emissions estimate. It was then assumed that all this biomass loading was in the fine (1-hour time lag, 0 to ¼ diameter) and dead (0 percent live fuel moisture) categories and consumed during prescribed burning for the worst case scenario. Invariably, prescribed burning leaves unburned and many partially burned areas within a burn unit perimeter under moister conditions with greater live fuel components than the complete combustion assumed in this worst case estimate.

Table 4.2. Maximum Biomass Consumption Estimates From Prescribed Burning for a 10-Year Period, by Alternative.*

Plan Alternative	Maximum Acres per Burn	# X per decade unit is burned (Return Interval)	Maximum Acreage Burned over 10-year Period	Total Biomass (Fuel) Load**	Maximum Biomass Consumed in 10-year Period
Alternative A	1×35-acre unit = **35 acres/burn**	3.3 burns/ decade (3 years)	115.5 acres	3 tons/acre	**347 tons**
Alternative B	3×30-acre units = **90 acres/burn**	3.3 burns/ decade (3 years)	297 acres	3 tons/acre	**891 tons**
Alternative C	1×10-acre unit = **10 acres/burn**	2 burns/ decade (5 years)	20 acres	4 tons/acre	**80 tons**

** Estimate is based on maximum acreage that would be burned under each alternative.*

*** FBPS 3 (Anderson) and GR06 GR07 after Scott and Burgan (2005).*

For simplicity of estimation, it was assumed that because all fuels consumed are fine, dead fuels with little or no duff layer or coarse woody fuels, all prescribed burn emissions are released during flaming combustion. The primary combustion products emitted during flaming combustion of biomass fuels, essentially a reversal of photosynthesis, are the greenhouse gas CO_2 water vapor H_2O, and thermal (heat) energy (Hardy et al. 2001). While some biomass consumption and emissions release does take place through smoldering or glowing phase combustion following flaming front passage, these latter phases are very brief in grassland fuelbeds without a duff layer, helping keep the estimation error small. In table 4.3, flaming combustion emission factors derived from the FOFEM 6.0 emissions model were applied to the biomass consumption estimates to derive the total 10-year period prescribed burn emission estimates.

Under ideal laboratory combustion conditions, 1 ton of biomass fuel combines with 3.84 tons of air and yields 1.84 tons of CO_2 and 0.54 tons of water vapor (Prescribed Fire Effects Working Team 1985). Actual field wildland conditions are never ideal, leading to combustion inefficiencies that produce different emission yields and compounds such as particulates, carbon monoxide, methane, hydrocarbons, and nitrogen oxides (Hardy et al. 2001). The air emissions of greatest interest from prescribed burning include fine particulates (PM10 and PM2.5), carbon monoxide (CO), methane (CH_4), nitrous oxides (NO_X), sulfur dioxide (SO_2), and other greenhouse gases, including carbon dioxide that forms when elemental carbon combines with oxygen already in the atmosphere.

While CO overexposure causes serious health problems and can prove fatal, CO is diluted and disperses rapidly as it mixes with ambient air downrange from the combustion source. So, CO emissions are primarily an occupational health concern for prescribed burn personnel, not for the general public.

Prescribed fire can produce trace amounts of many different hydrocarbon compounds, a few of which are known to be harmful or toxic at higher concentrations. Wildland fuels typically contain less than 1 percent nitrogen, of which approximately 20 percent is converted to NO_x during combustion. Both hydrocarbons and NO_x are believed to be precursors for ozone formation

once exposed to sunlight and warm temperatures in the atmosphere (Hardy et al. 2001).

Table 4.3. Maximum Emissions From Prescribed Burning for a 10-Year Period for Air Pollutants of Interest by Alternative.

Alternative Air Pollutant of Interest	Biomass Consumed Over 10-year Period	Emission Factor Flaming Phase*	Total Emissions Tons Per Decade
Alternative A	347 tons		
PM2.5		5 lbs/ton	0.87 tons
PM10		6 lbs/ton	1.04 tons
CO		13 lbs/ton	2.26 tons
CH_4		2 lbs/ton	0.35 tons
CO_2		3,556 lbs/ton	616.97 tons
NO_x		6 lbs/ton	1.04 tons
SO_2		2 lbs/ton	0.35 tons
			622.88 tons
Alternative B	891 tons		
PM2.5		5 lbs/ton	2.23 tons
PM10		6 lbs/ton	2.67 tons
CO		13 lbs/ton	5.79 tons
CH_4		2 lbs/ton	0.89 tons
CO_2		3,556 lbs/ton	1,584.20 tons
NO_x		6 lbs/ton	2.67 tons
SO_2		2 lbs/ton	0.89 tons
			1599.34 tons
Alternative C	80 tons		
PM2.5		5 lbs/ton	0.20 tons
PM10		6 lbs/ton	0.24 tons
CO		13 lbs/ton	.52 tons
CH_4		2 lbs/ton	0.08 tons
CO_2		3,556 lbs/ton	142.24 tons
NO_x		6 lbs/ton	0.24 tons
SO_2		2 lbs/ton	0.08 tons
			143.6 tons

* *Derived from FOFEM 6.0 model using SRM 601 Bluestem Prairie typical and heavy fuel loadings and moderate moisture conditions.*

The estimated worst case emissions from prescribed burning over a 10-year period as presented above are not expected to adversely affect the region's air quality index (combined PM2.5 and 8-hour ground level ozone) given anticipated dispersion, mixing, and the seasonal timing of prescribed burning even under alternative B.

Air Quality Impacts of Alternative A (Current Management)

Current refuge management activities would neither substantially benefit nor adversely affect local and regional air quality. There is a small amount of hydrocarbon emissions caused by refuge activities, including emissions from transportation to and from the refuge. The vehicle fleet at the refuge headquarters is becoming more efficient and cleaner as older vehicles are replaced by low-emission hybrid cars and trucks.

There would be minor air quality benefits from the air pollutant filtering effects of shrubland, grassland, and aquatic vegetation. The sequestering effects of existing grassland and woody terrestrial vegetation and submerged aquatic vegetation would produce a negligible reduction in atmospheric carbon.

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American oystercatcher

The treatment of invasive plant species to maintain quality habitat conditions would occasionally incorporate chemical or biological control as needed under alternative A. Chemical application through both aerial and backpack sprayers have the greatest potential to impact a wider area than is targeted through spray drift (the movement of herbicides to non-target sites). Backpack sprayers are used most often on the refuge, and have optimal target specificity due to the close range of application. Aerial application of herbicides has not been used on Monomoy NWR in recent decades, and no conditions exist or are anticipated where backpack spraying is not feasible or cost-effective.

The installation of solar panels at the Monomoy Point Light Station to generate electricity would more than offset some of the pollution (ozone precursors, PM2.5, and GHGs) associated with electrical power production from fossil fuel combustion. Short-term, localized effects from construction vehicles and equipment exhausts would occur.

Air Quality Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))

Proposed management activities would neither substantially benefit nor adversely affect local and regional air quality. Under this alternative, invasive plant treatment would be more intensive compared to current management to ensure that there is less than 10 percent coverage refugewide for species that are highly invasive or replace stands of native vegetation. This would be accomplished through increased chemical application (compared to alternative A) or mechanical control as necessary and feasible; associated short-term impacts and long-term benefits would be slightly increased in alternative B.

Under this alternative, we propose several methods based on recommendations from the Volpe National Transportation Systems Center study to reduce traffic congestion at the refuge and better serve the needs of our visitors. The proposed visitor contact station located in downtown Chatham or Harwich would potentially reduce vehicle emissions on the refuge by offering a shuttle service from satellite parking. Although we anticipate an increase in visitors to the refuge, we believe that establishing an offsite location for parking and implementing a shuttle service would contribute to reduced vehicle emissions on the refuge, reduce traffic congestion at the headquarters site and along the causeway, and encourage the use of bicycles and kayaks. We expect to see an increase in emissions with the addition of regular ferry services to the offshore portions of the refuge via the concessionaire; however, we do not foresee the frequency of trips increasing significantly from current use.

Renovation of the headquarters/visitor contact station, dormitory, and maintenance facilities would cause some temporary, local impacts on air quality during the construction phase. The proposed visitor contact station in downtown Chatham or Harwich would preferably be located in an existing structure and not require construction of a new facility. Operations of these facilities would result in emissions from heating and cooling systems; visitor and employee travel would

add sources of air pollution. These would be partially offset by the installation of energy-efficient heating and cooling systems and replacement of our fleet with more energy efficient models.

Alternative B biomass emissions from prescribed burning activities are an estimated 156 percent increase over current levels (alternative A) for a 10-year period.

Air Quality Impacts of Alternative C (Natural Processes)

Air quality would benefit the most under this alternative, as we would no longer allow the use of motorized boat transportation to the refuge, and instead provide arrangements for non-motorized access via a concessionaire or special use permit. Impacts from the application of herbicide would be similar to alternative A. Prescription burns, if approved, would be carried out as described above in alternative B, but there would likely be fewer burns as a result of allowing natural succession, so the benefits and impacts would be less than described in alternative B. Alternative C prescribed burning emissions over a 10-year period are estimated at 23 percent of current (alternative A) levels and 9 percent of alternative B levels due to the smaller acreage treated and lower frequency of prescribed burn treatments expected. Wilderness policy may determine how these activities are prioritized. Less use of mechanized equipment in the wilderness area would result in reduced emissions and a lower carbon footprint.

A satellite parking location and shuttle transportation would benefit air quality by reducing the number of visitors commuting to the refuge in personal vehicles similar to alternative B. The possible relocation of all refuge facilities offsite would have the greatest reduction in emissions on the refuge compared to alternatives A and B.

Effects on Climate Change

Climate change has been identified by the Service as a serious management concern, as detailed in chapter 2. With climate change, we face great challenges (Scott et al. 2008, Griffith et al. 2009). Across the United States, we are already seeing a range of changes, from higher average air and water temperatures and greater extremes in precipitation events to accelerating sea level rise and an increase in the intensity of tropical storms. Furthermore, these and other physical changes associated with climate change are having a significant biological impact across a broad range of natural systems. For managers at Monomoy NWR and throughout the Refuge System, this means finding ways to address climate change by implementing conservation measures through a true adaptive management process. Developing a meaningful adaptation strategy for the refuge requires understanding the impacts, risks, and uncertainties associated with climate change and the vulnerability of the different features of relevant natural and human communities to those changes. Climate change vulnerability assessment is a key tool for bringing climate data and related ecological understanding to bear in conservation planning and management efforts (Glick et al. 2011).

The Northeast is already facing significant changes (Frumhoff et al. 2006, 2007; Hayhoe et al. 2006), including:

- Higher average air temperatures, particularly in winter months.
- More frequent heat waves.
- An increase in the number and intensity of heavy rainfall events.
- Reduced snowpack and earlier peak snowmelt and spring peak flows.
- A lengthening of the frost-free season and earlier date of last-spring freeze.
- Accelerating rate of sea level rise and increased ocean acidity.

- Higher sea surface temperatures.
- An increase in the intensity, duration, and destructiveness of hurricanes and winter storm events such as nor'easters.

Added to the challenge is the fact that the ecological impacts associated with climate change do not exist in isolation, but combine with and exacerbate other stresses on the region's natural systems. Much of Massachusetts' intertidal habitat has already been lost over the past two centuries due to human activities, including construction of roads and rail lines; urban, commercial, and agricultural development; and ditching and draining for mosquito control. These activities have restricted tidal flows, caused increased freshwater runoff and water pollution, and contributed to the expansion of harmful invasive species such as common reed (*Phragmites*) and purple loosestrife. Remaining habitats such as those found at Monomoy refuge (i.e., coastal dunes, beaches, small islands) are just fragments of what once existed, making them all the more important for the migratory birds, fish, wildlife, and human communities they support (The Manomet Center for Conservation Sciences [Manomet] and Massachusetts Division of Fisheries and Wildlife [MDFW] 2010).

Climate Change Impacts Common to All Alternatives

Benefits

Over the life of the plan, the refuge would implement departmental and Service policies regarding climate change, including biological planning, landscape conservation, and monitoring and research, to become more carbon neutral in day-to-day operations, partner with others on climate change, and educate the public and others.

The refuge is continuing long-term monitoring of climate change and has goals in place for reducing greenhouse gas emissions from both refuge operations and visitors by 2020. The refuge would seek to implement the findings of the Volpe Center Alternative Transportation Study and transport more people to the refuge for compatible wildlife-dependent recreation while promoting and demonstrating climate-ready and carbon-neutral practices. We would propose to implement several methods based on recommendations from the Volpe National Transportation Systems Center study to reduce traffic congestion at the refuge and along the causeway in order to better serve the needs of our visitors. We would decrease the amount of vehicle emissions directly on the refuge by providing a shuttle service from an offsite location to the refuge. This would result in fewer visitors travelling to the visitor contact station and the Morris Island trails in their personal vehicles, and would offset the overall increase in visitation we expect over the next 15 years.

The proposal to implement a shuttle service would reduce fossil fuel consumption and associated atmospheric carbon release and other pollutants, including ozone precursors (NO_x and VOCs). An estimated savings of 56,934 vehicle miles of travel (VMT)/season for automobiles, offset by a 24,360 VMT/season increase for the shuttle buses yields a net savings of 32,574 VMT/season (MassDOT). Applying standard automobile emission factors to the 32,574 VMT/season net savings yields estimated (air) emission reductions as seen in table 4.4.

Table 4.4. Estimated Air Emission Reductions.

Air Pollutant	Emission Factor (gm/VMT)	VMT/season Reduction	(Kg) Emission Reduction/season
VOCs (volatile organics)	0.695	-32,574	22.64
NO_X (Ozone precursor)	0.601	-32,574	19.58
CO (greenhouse gas)	12.15	-32,574	395.77

The primary ways in which the refuge would likely lessen its contribution to climate change under all three alternatives is through the ability of natural communities to sequester carbon and by limiting the emissions of greenhouse gases associated with energy use. Compared with urban areas, lands covered with natural vegetation offer greater opportunities for carbon sequestration, both in the form of vegetation (Heath and Smith 2004) and in the soil (Swift 2001). The habitat types on the refuge, however, do not have much capacity for carbon sequestration. The salt marsh habitat on the refuge offers the greatest capacity for carbon sequestration. Tidal salt marshes can produce up to 8,000 metric tons of plant material per year, a process by which plants continually remove carbon dioxide from the atmosphere and convert it to plant material (Mitch and Gosselink 2000). Above- and below-ground plant biomass represents a standing pool of carbon captured by plants, which remains the same each year unless more acreage of marsh becomes vegetated. The plants themselves do not contribute to continual carbon storage because marsh plants do not build up woody material from year to year, as trees do (Trulio et al. 2007). Therefore, estimates of carbon sequestration in estuarine ecosystems do not include contributions from the living plants (Brigham et al. 2006). Instead, carbon content in soils, especially in deeper layers, is the best measure of long term, continuing carbon storage (Brigham et al. 2006). Choi et al. (2001) found that as sea levels rise, the marsh plains continue to build up (accrete) and, as they do, continually store carbon in the process. As a result, tidal marshes help protect uplands from storm events while continuing to take carbon from the atmosphere, as long as there is sufficient input of mineral sediments to build marsh soil and keep pace with sea level rise. Choi et al. (2004) conclude that, "because of higher rates of carbon sequestration and lower methane emissions, coastal wetlands could be more valuable carbon sinks per unit area than other ecosystem in a warmer world." Carbon can be stored for some time in the tissue of plants (wood) and in soils. Only a small portion of the refuge consists of vegetation dominated by woody species, such as maritime shrubland, which has limited carbon sequestration abilities.

Recent studies have demonstrated that conserving and restoring sea grass meadows may also reduce greenhouse gas emissions and increase carbon stores (Fourqurean et al. 2012). Sea grass meadows are highly productive ecosystems that play a key role in supporting biodiversity, as well as acting as an enormous carbon sink. Some of this carbon gets transported to the deep sea, where it provides a supply of organic matter in environments that can often be limited in food sources (Orth et al. 2006). Most of the organic carbon produced by sea grasses is stored within the sediments, making these areas hot spots for carbon sequestration (Orth et al. 2006). Sea grass sediments are organic-rich, with an average organic concentration of 4.1 percent, and can be characterized by their capacity to sequester and store large amounts of carbon in their sediments (known as blue carbon) (Fourqurean et al. 2012). Sea grasses remove carbon dioxide from the atmosphere and incorporate it into organic matter; they contribute to approximately 10 percent of the yearly global carbon sequestration in marine sediments even though they occupy less than 0.2 percent of the ocean surface (Fourqurean et al. 2012).

In recent years, Monomoy NWR has made considerable advancements in building energy conservation and efficiency improvements as well as making large investments in equipment upgrades. In response to Federal mandates, various energy efficiencies have been incorporated into refuge facilities such as additional insulation in the attics and roofing, on-demand controls for heating/cooling offices, motion sensors for lights in common areas and bathrooms, Energy Star-compliant equipment, and timers for turning off equipment during non-work days and at night. A solar-thermal domestic hot water system was installed in the refuge dormitory building. In addition, the refuge vehicle fleet is being

converted to hybrid vehicles, which have lower emissions. In compliance with section 141 of the 2007 Energy Independence and Security Act, which requires Federal agencies to acquire low greenhouse gas emitting vehicles, the refuge would continue to replace older vehicles with hybrid or other low emission models, where feasible. Additionally, the refuge would continue to implement the Service's 2010 Fleet Action Plan (USFWS 2010d), with concomitant benefits to air quality.

Another way to reduce emissions is through outreach and education programs—by encouraging climate-friendly behavior through our interpretive materials and actions, such as implementing a shuttle bus to the refuge. Under all alternatives, the refuge would continue to explore recommendations made in the Volpe Center Alternative Transportation Study and improve bicycle and non-motorized modes of transportation on the refuge.

Several of the inventory and monitoring projects initiated by the refuge would benefit our understanding of climate change impacts as we establish baseline trend information. Some of these include bird phenology monitoring, shoreline change surveys, sediment elevation tables, salt marsh integrity study, and wilderness character report. The refuge would also continue to benefit from the use of periodic aerial photos to track the migration of the refuge lands and the rate of accretion and erosion. This information would improve our ability to manage the threats of climate change and maintain flexibility in our management. Our continued efforts to reduce human-induced stressors are becoming more important in the face of climate change. Our early detection and rapid response approach for invasive species benefits refuge habitats, and watershed-level control efforts.

Adverse Impacts

Monomoy NWR contributes to greenhouse gas emissions such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These greenhouse gases result from our daily activities, including combustion of fuels, use of refrigerants to operate buildings, and visitor vehicle travel both to and from and within the refuge.

Increasing temperatures, coastal climate change impacts, and changing precipitation patterns may alter Monomoy NWR's ecosystems, changing vegetation communities, habitats available for species, and the experience of refuge visitors. Whatever management alternative is chosen, no actions would be taken to cause additional impacts other than what are already occurring under current management.

Numerous studies suggest that climate change would have a significant impact on coastal habitats at Monomoy NWR and surrounding areas. For example, more frequent and severe coastal storms would cause beach erosion and overwash of barrier islands, threatening wildlife habitats and placing human infrastructure at risk (Drut and Buchanan 2000). Substantial changes in bird life are expected across the Northeast due to rising temperatures, shifting distribution of suitable habitat, or declining habitat quality (Frumhoff et al. 2007). Bird species that migrate to the Northeast from neotropical and temperate climate zones make up the majority of birds breeding in the region. These species are likely to suffer losses in the amount and quality of habitat, and associated declines in abundance. The manner in which humans respond to climate change would also have serious implications for refuges; for example, rising sea levels and more intense coastal storms may prompt coastal property owners to armor their shorelines, which would limit the adaptive capacity of coastal habitats (USFWS 2011). The main risks to Monomoy's wilderness are the chances of its being overrun with nonnative species or having its existing habitats shift or decline as

a result of climate change; uncharacteristic alterations in sea level, temperature, precipitation, soil moisture, and frequency and magnitude of storms may cause a distorted landscape. Erosion of the coastal bluff on Morris Island due to more intense wind and wave action could result in the need to relocate the first part of the Morris Island trail and might eventually be the impetus to relocate the headquarters/visitor contact station and other facilities on Morris Island.

According to Giese et al. (2010), "A marked increase in Nantucket Sound water depths could increase tidal range and currents in the eastern sound, increasing the scour of Pollock Rip Channel—an erosional trough (Uchupi et al. 1996)—thereby adding to the bulk of Handkerchief Shoal. This, in turn, coupled with an increased supply of sediment from the north, could enhance the southwestern growth of Monomoy Point. A large and rapid relative sea level rise would be accompanied by a similar rise in the South Monomoy water table, flooding low-lying areas and enlarging existing ponds and wetlands. Prevailing southwesterly wind waves coupled with higher sea levels could markedly increase erosion of sound-side Monomoy, narrowing the peninsula. At the same time, higher sea levels and reduced sediment supply could be expected to deepen Monomoy Flats." Based on this analysis, it can be assumed that the patterns of coastal change at Monomoy NWR in the next century would follow the general trends of those experienced in the recent past, but at an accelerated rate.

Bill Thompson/USFWS

Northern pintail

Sea level rise and coastal storm activity pose significant threats to Atlantic coast piping plovers (USFWS 2009). Current impacts on habitat availability and breeding success are expected to increase within the next 10 to 20 years. Furthermore, ongoing and near-term human coastal stabilization activities may strongly influence the mid- and long-term effects of climate change on piping plovers and their habitat. It is urgent, therefore, that we improve our understanding of threats from sea level rise and increased coastal storm activity and develop scientifically sound strategies to address them.

As described in chapter 3, prescribed burning would continue to be a valuable habitat management tool under all alternatives. The primary gases released during prescribed fire include carbon dioxide, carbon monoxide, and water vapor, with other gases present in trace amounts (EPA 40 CFR Part 5). The primary combustion products emitted during flaming combustion of biomass fuels, essentially a reversal of photosynthesis, are the greenhouse gas CO_2, water vapor H_2O, and thermal (heat) energy (Hardy et al. 2001). Under ideal laboratory combustion conditions, 1 ton of cellulose fuel combines with 3.84 tons of air and yields 1.84 tons of CO_2 and 0.54 tons of water vapor (Prescribed Fire Effects Working Team 1985). Based on our experience, and as described in Appendix F, Fire Management Guidance, we expect prescribed burning to produce no major, long-term negative impacts in terms of climate change.

In addition, climate change can influence how infectious diseases spread, particularly through vectors like mosquitos. If a serious threat were posed to impact the wildlife and habitats at the refuge, we would likely implement precautions that include pesticide use.

Climate Change Impacts of Alternative A (Current Management)

Under alternative A, personal motor vehicles or boats would continue to be the primary means to access the refuge and visitation would likely remain near current levels of 25,000. These localized and concentrated emissions, including dust and hydrocarbons, would continue to occur during periods of high use, typically during the summer months.

Monomoy NWR would continue to implement energy-efficient practices such as installing a photovoltaic system at the Monomoy Point Light Station. Solar energy is considered environmentally friendly because the sun is a natural energy source that does not require the burning of fossil fuels and the associated air emissions. In addition, it is considered renewable since the energy produced from the sun does not deplete any natural resources.

The Wilderness Character report (Sudol 2012) established a baseline assessment of the Monomoy wilderness and provides attributes that can be measured in subsequent years to actively monitor wilderness character, including the following indicators of climate change: plant and species composition; and physical resources, such as visibility, ozone levels, and total nitrogen and sulfur deposition; biophysical processes, such as mean sea level rise, wind speed, and wave height. In the future, refuge staff can correlate this data with species inventories and be more informed in the decision-making process.

Monomoy NWR benefits from the removal of invasive species and the promotion of natural vegetation communities. Large monotypic stands of *Phragmites* are the greatest invasive threat present at the refuge. The continued removal and monitoring of this invasive plant species reduces this additional stress on native plant communities and helps maintain a resilient landscape in the presence of climate change.

Climate Change Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))

Alternative B takes a more proactive approach in addressing the threats of climate change, including using dredge material in areas outside of the Monomoy wilderness to combat rising sea levels. The renourishment of Morris Island would help restore the eroded beach area that is vital to supporting public use activities on the refuge.

At some coastal sites, depositing sands adjacent to barrier beaches could temporarily minimize erosion from wave energy. However, based on the findings in Giese et al. (2010), "the suggestion of using Stage Harbor dredge spoil to create an islet, similar to Minimoy, which would provide a suitable environment for beach nesting birds raises several concerns. First, although a northerly location on Monomoy Flats would be preferred for economic reasons, it could have negative impacts on nearby navigation channels. Second, there is the question of the lifespan of such an islet. Unlike Minimoy, which developed slowly as a flood tidal shoal over an extended period under natural conditions, a single, quickly-deposited islet would soon be reworked by waves and tides, and lacking an extended source of additional sediment, could be transformed to an inter-tidal shoal sooner than expected. A possible alternative plan could locate a Stage Harbor dredge spoil deposition site immediately adjacent to the western shore of North Monomoy. While not providing the advantages of a separate islet, such a deposit would increase the bird nesting area and could be designed to be compatible in form with the existing wave-dominated shoreline." This could be a short-term benefit in the face of climate change by providing quality nesting habitat.

As in alternative A, the refuge would pursue the installation of a photovoltaic system at the Monomoy Point Light Station. Along with upgrades to improve energy efficiency, implementing a shuttle service, improving facilities for bicyclists, and installing an electric car charging station would reduce fossil fuel consumption and associated carbon emissions by refuge visitors and educate the public about our efforts to become carbon neutral. Alternative B would also pursue installing a wind turbine at the Morris Island headquarters complex to utilize the available renewable wind energy to generate electrical power and hot water for the headquarters complex and reduce power consumption from the

utility grid. This would also serve the dual purpose of demonstrating to refuge visitors and public officials energy-producing alternatives that reduce dependence on nonrenewable energy. Should the refuge receive funding for this project, a stand-alone NEPA analysis would be completed.

Under alternative B, the refuge would take a more aggressive role in controlling nonnative invasive plant species by maintaining less than 10 percent cover refugewide. The resiliency of the natural plant communities would increase and the restored habitats would be able to respond more effectively to climate change. Reducing non-climate stressors, including habitat destruction, invasive species, and pollution, would help improve the ability of natural systems to better withstand or adapt to impacts associated with climate change.

In order to better predict future scenarios regarding climate change, the refuge would benefit from a geomorphological study of Morris Island to determine the rate of coastal erosion and a cost-benefit analysis to determine which mitigation strategies would be most efficient.

Climate Change Impacts of Alternative C (Natural Processes)

Alternative C offers the greatest benefit to addressing the impacts of climate change. Under this alternative, a concessionaire and guided hunts would facilitate non-motorized boat use within the refuge boundary and Declaration of Taking, but this would likely necessitate motorized boat support outside of the wilderness area. The discontinuation of public motorized boat use within the wilderness area (with the exception of emergency use) would decrease emissions that can contribute to climate change; however, it is unlikely this would make a significant difference considering the frequency of visitors to the Cape Cod region.

Benefits from the removal of invasive species would be the same as discussed under alternative B. Similar to alternative B, alternative C would benefit from a geomorphological analysis of Morris Island and the use of dredge material to renourish Morris Island, in addition to the installation of a wind turbine at the headquarters. We expect that the erosion on Morris Island would continue without renourishment and we would benefit from further geomorphological analysis that would look more carefully at sediment transport and erosion to determine the best course of action.

Effects on Water Quality

Water Quality Impacts Common to All Alternatives

The waters immediately surrounding the refuge, in particular the Outer Cape Cod region, are the latest designation in the Commonwealth of Massachusetts to be approved as a No Discharge Area (NDA) (MA CZM 2012). Boats may not discharge any sewage, treated or otherwise, in these waters immediately adjacent to the Monomoy islands to protect this ecologically and recreationally important area. Influxes of sewage from boats, even when treated, can discharge nutrients, chemicals, and pathogens into the water, increasing public health concerns as well as overall concern for water quality. Increased levels of nitrogen, a component of sewage, can have wide-ranging effects on water bodies, including encouraging algal blooms, decreasing dissolved oxygen content, and increasing turbidity, which can impact species reliant upon these coastal waters. Nantucket Sound has experienced a yearly trend of increasing nitrogen input. Gaining compliance with EPA's total maximum daily loads (TMDLs) for nitrogen is and will remain the focus of wastewater planning initiatives across Cape Cod throughout the plan period, and is not unique to the waters surrounding Monomoy NWR. Under all three alternatives, none of the proposed management activities would contribute to this problem.

None of our proposed management activities would violate Federal or State standards for contributing pollutants to water sources; all three would comply with the Clean Water Act.

In managing the refuge, we would closely monitor and mitigate all our routine activities that may result in chemical contamination of water directly through leakage or spills or indirectly through soil runoff. These include control of weeds and insects around structures, use of chemicals for deicing walkways and roads, and use of soaps and detergents for cleaning vehicles and equipment. Our personnel take precautions to minimize the potential for chemicals and petroleum products from becoming a water quality problem. As part of regular maintenance activities, some grease and cleaning chemicals could be washed off vehicles and equipment. This is not expected to impact water quality because we would be using best management practices to minimize potential impacts.

Regardless of the alternative selected, we would continue to identify and control invasive plant species before they cause large changes on the landscape. An early detection and rapid response approach can succeed in preventing much larger problems later on. We would use integrated pest management, which employs a variety of mechanical, biological, and chemical means of controlling invasive plants, but our experience to date suggests that the use of herbicides would continue to be part of our invasive species control program.

Please refer to the Effects on Soils section to review the herbicides we use on the refuge. The level of review that Service policy requires before we can apply any chemical on a refuge ensures that the environmental risk is minimized, and that all facets of the proposed use have been examined and justified. We follow all of the precautions listed on the labels to minimize impacts on ground and surface waters. When used appropriately, these products do not have direct or indirect negative impacts on water quality. In addition, only herbicides specifically approved for aquatic application are used on or near refuge waters.

Some potential exists for the concentration of herbicides to build up over time in sediments and wetland habitats. The potential depends on the balance of herbicide input and removal from an aquatic system. Herbicide inputs may occur either through direct application, water inflow, or through re-suspension and diffusion from the sediment layer. Herbicide removal from the system may occur through outflow, degradation, volatilization, and settling or diffusion into the underlying sediment (Neitsch et al. 2001).

Impacts to freshwater ponds and wetlands (primarily located at the southern end of South Monomoy) are expected to be minimal because current and future visitation (for fishing) is very low. Additionally, many of the smaller freshwater ponds and wetlands are closed to human access to prevent disturbance to migratory birds and habitats. The refuge's population of seals does not have a significant impact on water quality. Based on analysis reported in chapter 2, the seal haulout site is not currently impacting water quality within the refuge and should continue to not adversely impact water resources. Analysis completed by the Woods Hole Institute between 2003 and 2012 of fecal indicator bacteria (FIB) found that beaches near the haulout sites showed a decreasing trend in yearly FIB exceedance events over the last decade (Woods Hole Oceanographic Institute 2012). Concern about the potential impact on water quality at seal haulout sites has been recognized by the Northwest Atlantic Seal Research Consortium and is likely to be studied more specifically in coming years.

Chapter 2 discussed the historical use of the refuge as a formerly used defense site (FUDS). The findings of the USACE (2010) report state that, "No munitions or explosives of concern are expected to be present on this munitions response site." During the military use of the FUDS, the center of the bombing target was located on land, but due to dynamic coastal processes, it is now located offshore in the Atlantic Ocean. It is therefore assumed that "no known or suspected hazards" are present on the land portion of the bombing range or air-to-ground gunnery

range. Regardless of which alternative is selected, these potential impacts have already occurred.

Water Quality Impacts of Alternative A (Current Management)

Refuge-related activities that could impact water quality are oil or gas leaks from motorized boats, refuge vehicles, or offshore boats; however, the impacts to water quality are likely to be negligible from these activities. Impacts to water quality of saltwater habitats (salt marshes and nearshore marine waters) may result from pollution from motor boats navigating in these waters in alternative A, but these are expected to be minimal.

Some risks could occur to water quality from use of herbicides by the refuge to control invasive plant species, but these risks are low (Shepard et al. 2004). We would use integrated pest management (IPM) to prevent or minimize any impacts from use of herbicides and would only use herbicides that are safe for aquatic habitats when working near water bodies on the refuge, as well as follow permitting regulations. Adverse impacts to water quality would include the continued use of pesticides to control mosquitoes. The use of pesticides to control mosquitos is permitted in cases where a human health risk has been established. Effects are expected to be relatively short-lived and of minimal consequence (Massachusetts Department of Agriculture 1998). A more detailed discussion on the impacts of mosquito control is addressed under the salt marsh section in Terrestrial Invertebrates and Insects.

Under alternative A, in the short term the Monomoy Point Light Station facilities would remain without electric power aside from small-capacity, temporary, and portable photovoltaic panels for small electronic devices. Over the long term, we also propose to install permanent panels. During the recent restoration, a new sewage disposal system and composting toilet replaced the non-compliant system. Leave-no-trace policies are in place throughout the refuge for refuge staff and permittees, including overnight camps. The refuge is closed to overnight camping by visitors. The field camp introduces some minimal impacts to water quality from runoff during activities like dishwashing. Biodegradable soaps are used and all human waste is packed out. Therefore, little to no potential for significant water quality impacts from overnight use by refuge staff or visitors exists under alternative A.

Water Quality Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))

Under alternative B, refuge-related activities that could impact water quality are the same as those discussed under alternative A. Impacts to saltwater habitats would be similar to alternative A. Under this alternative, invasive plant treatment would be more intensive compared to current management to ensure that there is less than 10 percent coverage of nonnative species, such as *Phragmites*, in the freshwater ponds. As in alternative A, the use of herbicides by the refuge to control invasive plant species could incur some risk to water quality, but these risks are low (Shepard et al. 2004). We would use IPM to prevent or minimize any impacts from use of herbicides, and would only use herbicides that are safe for aquatic habitats when working near water bodies on the refuge, in addition to following all permit regulations.

There are higher risks of short-term adverse effects on water quality associated with renovation of existing facilities directly on the refuge and new construction of facilities offsite. In all cases, appropriate permits would be obtained, and best management practices would be followed to minimize any potential adverse effects. Additional NEPA analysis would likely be conducted for major projects; that is beyond the scope of this CCP. Compared to alternative A, alternative B would provide additional opportunities for public use, resulting from increased outreach efforts and expanded public use opportunities. This could result in higher levels of vegetation trampling, soil disturbance, and erosion, potentially affecting water quality. However, we expect these impacts to be localized and of

minimal consequence. Closures to human access in sensitive habitats and during biologically important times of the year would continue to minimize impacts. During times of the year when access is not restricted, public use is generally very low, again resulting in very low impacts overall. Impacts from use of the light station and field camp would be the same as under alternative A. There are no anticipated long-term adverse impacts specific to this alternative.

Under all alternatives, the refuge would evaluate the use of dredge material from other ongoing projects to address erosion issues at Morris Island. Under alternative B, the refuge would also evaluate the use of dredge material to increase elevation of important bird nesting habitat outside of the Monomoy wilderness and most at risk from inundation due to sea level rise and increased storm surges and erosion. The primary environmental effects associated with dredging are suspended sediments and increased water turbidity. The short-term increases in the level of suspended sediment can give rise to changes in water quality that can affect marine flora and fauna, both beneficially and adversely. Examples are increased turbidity and the possible release of organic matter, nutrients, or contaminants, depending on the nature of the material in the dredging area (Brehmer 1965). The remobilization of contaminants trapped in the sediments can render them more available to the biota. The exposure of living organisms to contaminants could result in mortality or, more often, disturbances affecting biodiversity and species representation in target populations. Settlement of the suspended sediments can result in the smothering or blanketing of subtidal communities or adjacent intertidal communities, although this can also be used beneficially to raise the level of selected areas to offset sea level rise or erosion (Bray, Bates, and Land 1997). The refuge would follow MassDEP's Guide to Best Management Practices for Beach Nourishment (MA DEP 2007), as well as the Service's Tern Management Handbook (Kress and Hall 2004). Geise et al. (2010) reported that past dredging operations in the vicinity of the refuge (e.g., the entrance channel to Stage Harbor, which lies north and west of Morris Island, is regularly dredged) have not adversely impacted water quality with turbidity, nutrients, or toxins. The use of dredge materials would require additional NEPA analysis.

Should the refuge decide to no longer allow dredging to occur within the channel, there is the risk this channel could close due to natural accretion and restricted tidal flows. This might, however, reduce the need for additional sediments to be placed on the Morris Island beach itself.

Water Quality Impacts of Alternative C (Natural Processes)

Under alternative C, water quality impacts would be considerably lower than in the previous alternatives. Only non-motorized personal watercraft, such as kayaks, would be allowed as a means for water access within the wilderness area. This would reduce the overall discharge from motorized boats, as access would only be allowed in non-wilderness waters within the Declaration of Taking. This also lessens the chances of a catastrophic spill, which could greatly impact water quality within and near the refuge.

Alternative C also potentially limits the number of visitors at one time to enhance the wilderness experience. These measures would reduce the amount of petroleum discharges from motorized boat use into the waters surrounding Monomoy NWR.

Invasive species control would only be conducted if there were a direct threat to wetland integrity or a risk of the invasive species replacing stands of native vegetation. In that case, invasive species management techniques would be similar to those described in alternatives A and B.

The impacts from dredging and channel closure would be the same as those discussed under alternative B.

Effects on Soils

Soils are the structural matrix and nutrient source for plant productivity at the refuge and must be protected to sustain the barrier island habitats that meet our habitat and species management goals. Overall, the soils on the refuge are productive and in good condition, with no substantive erosion, compaction, or contamination problems. We evaluated and compared the management actions proposed for each of the refuge CCP alternatives on the basis of their potential to benefit or adversely affect soils of dunes, maritime shrubland, and beach areas.

We compared the benefits of the three alternatives based on actions that would, or would not, protect soils from erosion, compaction, or contamination, or that would restore eroded, compacted, or contaminated soils, including the:

- Protection of refuge lands from development.
- Habitat restoration projects.

The potentially adverse effects of the management alternatives included impacts from:

- Constructing buildings, parking facilities, access roads, and interpretive trails.
- Conducting habitat management activities, including prescribed burning and herbicides.
- Providing refuge visitor activities and programs.

Soil Impacts Common to All Alternatives

The refuge is exposed to the natural coastal processes of accretion and erosion, or the deposition and removal, of sand along shorelines. Sand that is eroded, or removed, from one beach will be transported downdrift and will accrete, or be added, on another. These processes are influenced by many factors, some of which include currents, tides, winds, sea floor bathymetry, and human modifications. The dynamic nature of these systems means that the same beach can both accrete and erode seasonally within a given year, and can fluctuate between accretion and erosion over long periods of time. These movements of sand provide ever-changing coastlines and habitats for many species of wildlife. The soil layer underlying our coastal refuge habitats is one of the most active sites of energy exchange; it plays a critical role in ecosystem processes such as the carbon, nitrogen, and oxygen cycles. Healthy soils are critical to nutrient cycling and plant productivity and must be protected to sustain the variety of tidal, wetland, and upland habitats on the refuge.

Benefits

Overall, Monomoy refuge's soils are productive and in relatively good condition. However, there is some concern about contaminated sediments associated with boat use, as well as the potential for erosion caused by large groups of users, such as birding groups and education field trips. Most pedestrian traffic is confined to designated trails, and the refuge would continue to be proactive in minimizing impacts to the soil environment. The Morris Island trail, boat launch sites, wildlife observation areas, parking areas, and other high-use areas will continue to be well maintained to keep their impact on refuge soils to a minimum. An established, maintained trail on Morris Island reduces vegetation trampling and soil erosion from pedestrian traffic. On North Monomoy Island and South Monomoy, some dune erosion is expected to occur as a result of pedestrian traffic and trampling, but through public education we would discourage pedestrians from walking across dunes and explain the impacts this has on fragile resources. Pedestrian-induced dune erosion is expected to be minimal in most areas because of the relatively low intensity use on the dunes. However, this has been an issue in past years on the east side of North Monomoy Island where there is a relatively narrow width of beach available to visitors at higher tides. Visitors are more likely to establish a presence on the slopes of the dunes (instead of at the toe of

the dunes) at higher tides, and this contributes to dune erosion in some years. We would note any erosion problems during routine monitoring and correct them as soon as possible.

Under alternative B, a we will consider a wilderness access pass, which would potentially limit the number of visitors at one time in the Monomoy wilderness, thereby reducing the likelihood of adverse impacts like soil compaction.

The prohibition of motorized vehicles on the refuge under all three alternatives significantly reduces, but does not eliminate, the risk of vegetation trampling and soil erosion from human recreational activity. Regardless of which alternative is selected, we would continue to use best management practices in all management activities to minimize erosion.

Adverse Impacts

Under all three alternatives, some soil disturbance occurs from prescribed burning and removing nonnative or otherwise invasive plant species. Herbicides would be used to control nonnative vegetation. The mobility of an herbicide is a function of how strongly it is adsorbed to soil particles and organic matter. Herbicides that strongly adsorb to soil particles are relatively insoluble in water and not environmentally persistent. These would be less likely to move across the soil surface into surface waters or leach through the soil profile and contaminate groundwater. We would choose the most effective herbicide available with the least potential risk to soils for use on the refuge. Removing plants has the potential to cause localized soil disturbance and erosion until new plant species establish. There could be more soil disturbance associated with higher levels of invasive species control, but any soil disturbed by the physical removal of plants would be tamped down and compacted. This is a standard aspect of any removal operation. The advantage of chemical controls is that they are often the most effective, particularly when treating large areas or sites where the invasive plants are well-established. The disadvantages are that the chemicals may affect non-target species at the site and may contaminate soils and surface or groundwater. We would take all appropriate steps when applying herbicide, including applying the minimum effective dose, using application methods that minimize non-target effects, applying during the optimal growth stage, and adhering to licensing requirements and other regulations. Again, we would only use herbicides

Prescribed burning

USFWS

approved by the regional contaminants coordinator and only in accordance with approved rate and timing of application.

Prescribed fires help reduce fuel loads and thereby prevent excessively hot future fires that could damage soils. Prescribed fires provide benefits by releasing stored nutrients back into the soil, offsetting any short-term adverse impacts following a burn. Soil damage from fires, or from erosion on fire-damaged sites, is unlikely to occur on the refuge because of the rarity of wild fires and the relatively flat topography of the area. We will implement small-scale prescribed fires on confined areas, in short durations and low-to-moderate intensities. Such fires consume only part of the upper layer, and rarely transfer major amounts of heat into the soils. We will use prescribed fires to remove litter and light fuels, and seek to avoid adverse effects of severe, hot wildfires on soil resources.

Neary et al. (2008) provide a comprehensive overview of current knowledge about fire impacts on soil. The rate at which heat energy from a fire burning through aboveground surface fuels is transmitted downward through the soil is limited by the soil's thermal properties. Most energy released by flaming combustion of aboveground fuels is not transmitted downward (Packham and Pompe 1971, Frandsen and Ryan 1986). The limited heat pulse and residence time of flaming fronts downward into Monomoy refuge's dry, sandy substrates that are low in organics and nutrients limit the prescribed fire severity and impacts to soil properties.

The greatest increase in temperature from the downward heat transfer during a surface fire occurs at or near the soil surface. However, the temperature increases quickly diminish within 2.0 to 3.9 inches (5 to 10 cm) of the soil surface, largely confining soil property impacts from the fire to this shallow surface zone. Dry soils are poor conductors of heat and do not heat substantially below about 2 inches (5 cm) unless heavy long-burning fuels are combusted. The low-severity, infrequent, prescribed burns proposed under any alternative are not expected to significantly change soil texture, bulk density, porosity, infiltration rates, water holding capacity, water repellency (hydrophobicity), or erodibility, or the sediment yields of underlying soils.

In non-fire environments, nutrient availability is regulated biologically by decomposition processes of widely variable rates depending on moisture, temperature, and type of organic matter. Through decomposition, this material breaks down, releases nutrients, and moves into the soil as organic matter. Fire dramatically accelerates biological decomposition rates to that of nearly instantaneous thermal decomposition during the combustion of organic fuels (St. John and Rundel 1976). The magnitude of these fire-related changes depends largely on fire severity (DeBano et al. 1998). Nitrogen (N), organic matter, and duff decrease as fire severity increases. Available NH_4-N and cations increase. The pH of the soil generally increases because of the loss of organic matter and its associated organic acids, which are replaced with an abundance of basic cations in the ash.

In grasslands, savannas, and tundra-covered areas, much greater quantities of organic carbon (C) are found in the underground plant parts than aboveground (less than 10 percent of the total C in these herbaceous vegetation ecosystems is found aboveground). In general, soils with larger proportions of organic matter in the aboveground biomass and on their forest floors are more prone to disturbances, including fire, in their nutrient and C regimes than those in which most of the C in the ecosystem is located below ground (Neary et al. 2008), such as the Monomoy refuge grasslands. Prescribed burning that consumes a large proportion of the organic fraction of the soil can at least temporarily deplete soil C and N availability as well as cation exchange capacity. If such high severity burning is frequent, then long-term site productivity can decrease due to depleted soil C and N reserves and cation exchange.

Nitrogen is likely the most limiting nutrient in natural systems (Maars et al. 1983), followed by phosphorus (P) and sulfur (S). Cations released by burning may affect soil pH and result in the immobilization of P. The role of micronutrients in ecosystem productivity and their relationship to soil heating during fire is, for the most part, unclear (Neary et al. 2008).

Nitrogen is particularly vulnerable to fire effects in N-deficient ecosystems (Maars et al. 1983) such as Monomoy refuge's dunelands. Nitrogen is the only soil nutrient not supplied to the soil by chemical weathering of parent material. Almost all N found in the vegetation, water, and soil of wildland systems is added to the system from the atmosphere. The amount of N lost is generally proportional to the amount of organic matter combusted during the fire. Volatilization is the chemically driven process most responsible for N losses during fire. As a general rule, the amount of total N that is volatilized during combustion is directly proportional to the amount of organic matter destroyed (Raison et al. 1985). It has been estimated that almost 99 percent of the volatilized N is converted to N_2 gas (DeBell and Ralston 1970). The N that is not completely volatilized either remains as part of the unburned fuels or is converted to highly available NH_4-N that remains in the soil (DeBano et al. 1979, Covington and Sackett 1986, Kutiel and Naveh 1987, DeBano 1991). Even small total N losses can adversely affect the long-term productivity of N-deficient ecosystems, and losses tend to be proportionally greater on dry soils over moist soils. In contrast, available N is usually increased as a result of fire, particularly NH_4-N (Christensen 1973, DeBano et al. 1979, Carballas et al. 1993). This increased N availability enhances post-fire plant growth. This apparent increase in fertility is short-lived. A temporary increase in available N following fire is quickly utilized by plants within a few years after burning.

The atmosphere supplies N to soil in natural ecosystems mainly through organisms that fix inert N_2 into forms that can be used by plants. Nitrogen additions to the soil by N-fixing organisms, both free-living and symbiotic, counterbalance the volatilized N lost during combustion and subsequent leaching of soluble N compounds into and through the soil following fire (DeBano and others 1998). Symbiotic N-fixation is carried out by symbiotic microorganisms associated with the roots of higher plants, obtaining energy required for N-fixation from the host plant. The most common symbiotic relationships found in wildland ecosystems are those formed by rhizobia or actinomycetes associated with plant roots. *Rhizobium* bacteria are found associated with the roots of leguminous plants that make up about 700 genera in the Leguminosae family (Haynes 1986). Beach pea is a common and prominent legume within duneland habitats subjected to prescribed burning on Monomoy.

Changes in microbial population size and activity are common following wildfire and prescribed fire. Heat penetration into the soil during a fire affects biological organisms located below the soil surface, depending on the heat transfer mechanism, soil moisture content, and duration of combustion. Because many living organisms and the organic matter in soils are located on or near the soil surface, they are exposed to heat radiated by flaming surface fuels and smoldering forest floor fuels. Resilience is a trademark of the microbial community. Population sizes often match or surpass pre-burn levels within a growing season (Ahlgren and Ahlgren 1965, Renbuss et al. 1973). Intense wildfire can have severe and sometimes long-lasting effects on microbial population size, diversity, and function. Low-severity underburning generally has an inconsequential effect on microorganisms, although microbial activity often shows a positive response to this type of fire, particularly with respect to N-fixation (Jorgensen and Wells 1971) and N availability (Schoch and Binkley 1986, White 1986, Knoepp and Swank 1993a, 1993b).

The combustion of organic matter leaves a relatively large amount of highly available P in the surface ash on the soil surface immediately following fire. This highly available P, however, can be quickly immobilized and become unavailable for plant growth if calcareous substances are present in the ash.

Soil cations such as calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), and ammonium (NH_4) released from surface organics during fires are however often redeposited in relatively soluble mineral forms in the ash left behind the flaming front. Combustion of organic matter during a fire and subsequent release of soluble cations tend to increase pH slightly as basic cations are released during combustion and deposited on the soil surface. The increase in soil pH, however, is usually temporary, depending upon the original soil pH, amount of ash released, chemical composition of the ash, and wetness of the climate (Wells et al. 1979). The pH of the soil is an important factor affecting the availability of plant nutrients such as phosphorus (P), iron (Fe), and copper (Cu), which are most likely to be affected by a fire. Phosphorus is a macronutrient that is frequently limiting in wildland ecosystems and can also become insoluble at high or low pHs.

The low-severity and infrequent refuge grassland and shrubland prescribed burns (3- to 5-year intervals) can improve soil properties in two ways: stimulating and maintaining native vegetation vigor, and periodically returning back into soils a quick pulse of nutrients in a form more readily used by plants across the refuge landscape on a rotational basis.

Soil Impacts of Alternative A (Current Management)

Any of the low-severity prescribed fires conducted by the Service on Monomoy refuge should benefit soils in the short term by releasing nutrients bound up in plant biomass back into the soil (Dudley and Lajtha 1993); the degree depends on fire intensity (USFWS 2003c). The mechanical removal of invasive plant species has the potential to cause localized soil disturbance and erosion until new plant species establish. Maintaining native shrubland habitat and reducing invasive plant species would likely improve soil condition. Native vegetation supports the natural functioning and production of ecological services that improve soil fertility and sustain soil health.

Some soil compaction occurs from walking on the unmaintained trail network during refuge management and monitoring visits, as well as from public use. In some areas, particularly in and around the field camp and tern nesting areas on South Monomoy, trails used by refuge staff are well worn and devoid of vegetation for much of the growing season. The field camp location and some of the management trails stay the same from year to year, and in these areas, very little vegetation regrows because of the extensive use. Staff intentionally use a small number of trails to concentrate impacts and prevent disturbance through the larger areas. Past observations have shown that when these trails and camp locations are no longer needed and use is abandoned, they are generally revegetated naturally within one to two growing seasons. However, revegetation may result in different species composition than was previously there, particularly at abandoned field camp sites. Soils on the refuge are well-drained, sandy soils that help filter waste and byproducts; however, all human waste is packed out and biodegradable cleaning products are used at the field camp for activities like dishwashing.

Under current management, the refuge has a minimum requirements analysis that permits motorized vehicles for the purpose of restoring the historic light station. These activities are occasional and short-term, and as a result soil compaction is minimal overall.

Alternative A proposes installing solar panels at the Monomoy Point Light Station. During the construction of these structures, some upper layers of soils would be disturbed and compacted. Most, if not all, small project construction would be located where high levels of soil disturbance from visitors or previous

construction and maintenance activities already exist. This would increase soil compaction and erosion only in these already disturbed areas. As with other activities on the refuge that have the potential to disturb soils, the refuge would implement best management practices, including soil protection plans as necessary to minimize any negative effects on soils, including erosion and compaction. If the Monomoy Point Light Station is used to accommodate staff and visitors, there may be the potential for long-term impacts from trampling and other activities. Installation of solar panels on South Monomoy would result in short-term, temporary impacts, such as wearing away or removal of protective vegetative cover, which exposes the soil to wind, sun, and precipitation, and can destabilize the dunes. Disturbed soil areas would be reshaped to original contours and, where vegetation is worn away in the course of construction, bare soil areas would be revegetated using native dune plants. For both new construction and maintenance of facilities, we would employ best management practices during construction of any facilities in proximity of sensitive vegetation to avoid runoff of sediments.

Soil Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))

Impacts from habitat and wildlife management activities would be similar to alternative A. Under alternative B, the use of prescribed fire would increase by 55 additional acres compared with alternative A. Impacts would be the same as those discussed under Soil Impacts Common to All Alternatives. We would also incorporate invasive plant treatment as necessary to maintain quality habitat and promote biological integrity. This would be enacted through manual, chemical, or biological control. Though similar to alternative A, impacts would possibly be more short-term as we control more invasive plants and increase the presence of refuge staff. Impacts from use of the field camp would be the same as alternative A, although with a slightly greater potential for short-term impacts.

Alternative B would provide more onsite Service presence to manage visitor services and offer greater enforcement of unauthorized uses. This would help restore and protect dunes by designating authorized trails and directing foot and vehicular access away from sensitive areas to more stable beach sandy areas. Under alternative B, increased visitor services staff and expanded environmental education and interpretation, including additional signs, would raise awareness among visitors about the sensitivity of the refuge habitats and potential effects of unauthorized uses. Alternative B proposes additional facilities on Morris Island, including small trail expansions, observation area, kiosk, Americans with Disabilities Act-compliant ramp, and possible renovation of the existing headquarters facility. We anticipate some short-term, localized adverse impacts to the soil environment during these minor construction projects. Best management practices would be employed to maintain the integrity and productivity of refuge soils and minimize erosion, compaction, and other impacts. Overall, these impacts are considered minimal, as the total affected area is a small fraction of the total refuge.

Impacts from the proposed installation of solar panels at the Monomoy Point Light Station would be the same as those discussed under alternative A.

Under alternative B, the proposed downtown visitor contact station, if it were to be built, would cause localized compaction and loss of soil productivity where soils are removed or surfaced for the building and associated parking area; the same is true for immediately adjacent areas where vehicles and heavy equipment would be used for site access and preparation work. Otherwise, an existing structure would be purchased, and any impacts to the soils would already have occurred. The proposed relocation of refuge headquarters and visitor contact station, if realized, would be located off-refuge and would not impact the existing refuge resources. The impacts from additional proposed construction activities would be assessed under a separate stand-alone NEPA.

Alternative B would continue to rely on symbolic fencing, although with greater use of adaptive management and onsite presence of Service staff to determine location and duration to protect habitat and dune processes.

As a part of alternative B, a cultural resource overview is proposed, which may result in additional short-term soil disturbance activities. Any soil disturbance would be temporary, and would be replaced or tamped down when the project was completed.

This alternative would evaluate the use of dredge material obtained from projects outside the refuge to increase elevation of important refuge bird nesting habitat outside of the Monomoy wilderness, and most at risk from inundation due to sea level rise and increased storm surge. Placement of the dredge material would be determined on a case-by-case basis, but it would likely be placed as high possible, above the intertidal zone, for maximum benefits to beach- nesting birds. In most areas of New England, sediment is predominantly composed of quartz particles, so the borrow material would likely have adequate strength and high resistance to abrasion (MA DEP 2007). The refuge would follow MassDEP's best management practices for beach nourishment (MA DEP 2007).

Soil Impacts of Alternative C (Natural Processes)

Alternative C would provide the greatest protection of refuge soils through more focused public use and emphasis on natural processes. We would not pursue the installation of solar panels at the light station and would therefore maintain the integrity of the soils at that location. In addition, impacts from staff would be decreased since we would no longer maintain a field camp on South Monomoy and only make periodic trips to the refuge.

Impacts from the proposed visitor contact station in downtown Chatham or Harwich would be the same as described under alternative B.

Impacts from prescribed burns would be the same as previously discussed; however, acreage under alternative C would be 23 percent of the current acreage and 9 percent of the acreage proposed under alternative B. Therefore, we would expect any adverse impacts associated with this management activity to be considerably less than in the other alternatives.

Prescribed burn protocols would be evaluated through a minimum requirements analysis to identify the minimum impact methods and tools to accomplish necessary activities safely and with minimal impairment of wilderness character. In addition, refuge staff visits would be reduced from alternative B, so any compaction as a result of staff activities would be minimal and possibly even less than alternative A.

Effects on Federal Threatened and Endangered Species

Preservation, enhancement, restoration, and management of federally endangered and threatened species and their habitats are among our highest priorities on the refuge. This includes researching and monitoring their populations. Working toward recovery of roseate tern (endangered), piping plover (threatened), northeastern beach tiger beetle (threatened), red knot (candidate species), leatherback turtle (endangered), the northwest Atlantic distinct population segment of loggerhead turtle (threatened), Kemp's ridley (endangered), green (threatened) and hawksbill (endangered) sea turtles is fundamental to achieving our refuge goals. We will complete an intra-Service evaluation with our New England Field Office for Ecological Services in Concord, New Hampshire, to ensure the selected alternative complies with the Endangered Species Act. Management for federally listed species would also benefit several other species of conservation concern, including American oystercatchers, common and least terns, and gray and harbor seals.

We evaluated the proposed habitat management actions and strategies of all alternatives for their potential to affect, beneficially or adversely, the habitats

required for sustaining healthy and viable populations of these species. Our proposed conservation actions targeting Federal and State endangered species include managing beach and inland habitats to reduce predation and disturbance, and restoring native vegetation.

The benefits we considered included:

- Protecting and enhancing migratory bird species and their habitat components at currently inhabited sites on the refuge.
- Creating new habitats.

The potential adverse effects of the Monomoy refuge management alternatives that we evaluated included impacts from:

- Vegetation management methods that may affect the potential for successful recovery of threatened and endangered species or their habitats.
- Inventory and monitoring activities by refuge staff.
- Predator management activities.
- Public and economic use activities on the refuge that might damage habitat or disturb the species.

Roseate Tern

Roseate terns nest on the ground, making them vulnerable to human disturbance and predators. After habitat loss, these factors are among the greatest threats to the recovery of this species (USFWS 1998). We would continue to close all nesting sites to public use from May through August. Symbolic fencing used in all alternatives would minimize human disturbance and help achieve the productivity levels for this species. Regular law enforcement patrols would help enforce the posted closures. Predator management, both nonlethal and lethal, would continue to be a major management strategy to aid our efforts to maintain desired productivity levels. Careful removal of individual predators that pose the greatest threat to roseate tern colonies would result in higher fledgling success, benefitting this endangered species. In addition, establishing a human presence during the nesting season would help deter some predators, further benefitting the tern colony. Minimizing human disturbance at nest sites reduces the energy reserves terns need to defend their nest sites, reduces the susceptibility of nests to predation from other seabirds such as gulls, and reduces the time adult terns are kept away from their nests. Closing areas and managing predators during the breeding season should improve the nesting success of the endangered roseate tern and benefit other tern colonies.

Kirk Rogers/USFWS

Roseate tern

We would also continue to use artificial nesting structures in all alternatives, as these have been shown to lure terns to nesting sites and reduce predation by gulls on common tern chicks (Burness and Morris 1992); these would also help reduce predation on roseate tern chicks by avian predators.

Habitat management would also remain an important component of roseate tern management. Through the use of fire, herbicides, or manual means, we would maintain an optimal vegetative structure (a mosaic of open areas for common terns in close proximity to more densely vegetated areas preferred by roseate terns) in potential nesting areas, increasing the opportunity for common and roseate tern colonies to become established. Dormant-only seasonal burning common to all alternatives eliminates the potential risk of mortality to nesting adults, nests, unhatched eggs, and unfledged nestlings. Waiting until spring to conduct prescribed burning foregoes the head-start effects, or even sets back seasonal vegetative recovery. It also risks terns avoiding the site and potentially

losing some or all of the burned acres from the nesting habitat base for the entire first post-burn nesting season.

Under alternative A, roseate terns would continue to benefit from maintaining 30 acres of nesting habitat in addition to 2 acres of prime habitat specifically for this species. The installation of artificial nesting structures and use of decoys and sound systems would help increase the likelihood that roseate terns would select an area on the refuge to establish a nesting colony; this has been shown to be effective at other locations (Kress 1983) and is an established management tool (Kress and Hall 2004).

Management actions under alternative B take a more proactive approach in the recovery efforts of this species and would likely provide the greatest benefit to this species compared with alternatives A and C. As in alternative A, alternative B would employ the use of decoys and sound systems to attract nesting roseate terns. We would expand the acreage of nesting habitat for common and roseate terns by 45 acres compared with alternative A, with an additional 8 acres of prime nesting habitat for roseate terns. Roseate terns and other migratory nesting species would benefit from efforts to control nonnative plant species in the dune grasslands. The benefits of maintaining no more than 10 percent coverage of invasive plant species refugewide is discussed in more detail under Effects on Vegetation.

Under alternative B, roseate terns would benefit from efforts to establish new tern habitat in areas not currently used on the refuge, in addition to the possibility of creating new habitat outside of the Monomoy wilderness through the use of dredge material. The dynamic coastal processes of accretion and erosion have made Monomoy refuge susceptible to losing valuable habitat. Using dredge material would protect habitats that benefit roseate terns from the effects of erosion and sea level rise, and further support recovery efforts to reach a productivity of 1.0 chicks per nesting pair. Increased partnerships and participation in research relevant to the roseate tern and its habitat would better inform future management and conservation efforts.

Under alternative C, the roseate tern would continue to benefit from recovery efforts; however, we would only focus on protecting 10 acres of tern colony nesting habitat and, as with alternative A, only 2 acres of prime nesting habitat for roseate terns. The benefit of a 24-hour human presence found in alternatives A and B would decrease in alternative C to 3 times per week. This may adversely impact the productivity of roseate terns by reducing protection efforts and increasing opportunities for predators.

Piping Plover

Piping plovers would greatly benefit from proposed activities under all alternatives. In addition to intensive beach management and monitoring on the refuge, staff monitor all nesting activity on the refuge. Under all the alternatives, Monomoy refuge would continue to make an important contribution toward recovery of the Atlantic coast population of piping plovers.

Seasonal closures using temporary symbolic fencing and law enforcement patrols would continue to protect nesting areas from human disturbance. Along the Atlantic coast, piping plover parents and young seem to lose considerable foraging time because of human presence. Active predator management would additionally improve nest success and help us achieve the target productivity levels (number of young that successfully fledge per nest) necessary for population growth. Predator exclosures would continue to protect nests from a variety of mammalian and avian species that prey on plovers, contributing to the targeted productivity levels. Symbolic fencing has been shown to help minimize the impacts of human disturbance by keeping a safe distance between

prospecting and nesting plovers and the public (Patterson et al. 1990, Doherty 2007). The refuge would continue to restrict certain activities that are not compatible wildlife uses. For example, beach fires can disturb nesting birds as well as attract predators, thereby increasing predation of bird species.

For the most part, refuge management activities do not significantly impact the number of piping plovers that nest on Monomoy's beaches from year to year. The main factors influencing the numbers of nesting pairs are quantity and quality of nesting habitat and shape of beach. The Northeast and Atlantic regional population has been growing since piping plover monitoring began. The shape of the beach is mainly affected by natural maritime forces. Large nor'easters can either reduce habitat by creating steep foredunes or create habitat by overwashing backdunes and setting back succession. Since plovers are adapted to this rapidly shifting habitat mosaic, allowing natural processes to occur would benefit the piping plover over the long term. South Monomoy has shown an increase in available habitat as a result of accretion and we do not anticipate any significant loss of habitat that would adversely impact this species over the next 15 years.

Because plovers tend to return to sites where they successfully raise young, increasing productivity tends to increase local populations, and vice versa. We aim to increase productivity by minimizing disturbance (closing areas of the refuge, symbolically fencing off nesting areas), outreach and education, and reducing predator pressure (nest exclosures, electric fencing, staff presence, selected predator removal). By protecting critical feeding and resting areas, we would be contributing to improved physical condition of piping plover during their migration, and ultimately contributing to the recovery of the species.

Under alternative A, the refuge's piping plover population would continue to benefit from refuge actions, with increases in productivity. Without active refuge involvement (funding for supplies, staffing for monitoring and management, expertise, and predator management), the number of nesting pairs and productivity are likely to be much reduced.

Under alternative B, we include the use of solar-powered electric fencing to further increase piping plover productivity, but this use of electric fencing would be minimal because of the time necessary to install and maintain fencing and the relatively few areas on the refuge where habitat conditions are optimal for electric fencing. In alternative B, we would increase management to protect nesting piping plovers in a manner consistent with preserving wilderness character by closing to the public all available high-quality habitat by mid-April.

The rationale for objective B1.2 discusses the likelihood of rising sea levels and coastal erosion. Piping plovers are at risk of losing valuable habitat due to storm surges that may amplify rates of habitat change along coastal beaches. Piping plovers would benefit from the use of dredge material to create additional nesting locations should we determine that their habitat is at risk. These additional strategies might help us achieve higher productivity and nesting pairs compared to alternatives A and C.

Alternatives A and B propose the installation of solar panels at the Monomoy Point Light Station. Construction activity on South Monomoy would not commence until at least August, after piping plover and roseate and least tern nesting is complete for the year and near the end of the normal chick fledging period. Setback distances and Service presence would be required any time there is project-related activity on the beach-dune interface within the sight distance of any foraging piping plovers with unfledged chicks (possible during August). No unsupervised project-related activity would be undertaken from the beginning of April to the end of August unless all plover chicks have fledged, minimizing the potential for any project-related adverse effects on piping plover under any

alternatives. The greatest impact would be loss of potential habitat where solar panels are installed; however, these structures would be placed in previously disturbed areas where nesting does not occur.

In alternative C, piping plovers would not benefit from the use of dredge material or other habitat alterations to accommodate sea level rise, and electric fencing would not be used.

Northeastern Beach Tiger Beetle

In addition to habitat loss, mortality and degradation of suitable breeding areas caused by off-road vehicles and other activities have been shown to be among the major threats to northeastern beach tiger beetles. Continued vehicle closures on North Monomoy Island and South Monomoy would protect beach habitat from degradation and minimize direct mortality of beetles. As a result of the protection afforded on the refuge, the population is currently estimated at more than 500 individuals, which was the target for a sustainable level in all three alternatives. The refuge's support and participation in relevant research projects not only helped protect the beetles' habitat, thus helping beetle populations, but also informed the public about the need to protect the species and its habitat. The mark-and-recapture studies require refuge staff to handle beetles and could result in the accidental death of individuals during periods of handling and keeping in captivity.

Alternative B would provide the greatest protection efforts for the northeastern beach tiger beetle by increasing partnerships with the New England Ecological Services Field Office staff to find additional sites for translocation, and utilizing the existing population at Monomoy refuge as a donor population. These actions would further contribute to the recovery and protection of this endangered species. Projects with partners may involve the direct take of individuals; however, we believe the benefits from increasing our knowledge on the recovery of this species outweigh the adverse impact of a loss of a very small portion of the population.

In addition to the protection afforded to tiger beetles under alternative A and addressing research needs identified in the most recent 5-year review, management for this species under alternative B would include working with partners to locate new introduction sites, and hopefully increase the population and geographic extent rangewide. 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.

Red Knot

Piping plover and shorebird management strategies proposed under all alternatives would benefit the red knot. Red knots would continue to benefit from our collaborative efforts to monitor and document the importance of Monomoy NWR to this species' recovery. We would continue to monitor red knot usage and implement additional strategies as we learn more about the species and its life history.

Bill Thompson/USFWS

Red knot

The ban on horseshoe crab harvesting would remain in effect for all three alternatives. If the refuge did not have this measure in place, we would expect high harvest pressure on the refuge, especially in consideration of closures elsewhere in the Cape Cod region, and would likely see a decline in the local horseshoe crab population. Chapter 3 details the importance of horseshoe crab eggs to migrating shorebirds, including red knots. Since the ban on horseshoe crab harvest on Monomoy NWR was implemented, we have seen an increase and even a repopulation in Stage Harbor—an area that was fished out years ago. The benefit of enforcing this management action is a viable and continuous food source for migrating red knots and other shorebirds. Law enforcement patrols would help ensure that the public stays out of posted areas and adheres to the

refuge policies and regulations. In all three alternatives, we would continue working with partners to document the importance of Monomoy refuge to migrating red knots and contribute to research that would inform and contribute to the species' recovery.

Alternative B would provide the greatest benefit to the red knot by implementing strategies that protect foraging habitat and reduce the impact of human disturbance. Increased public awareness through an outreach campaign would contribute to recovery efforts by educating the public about the importance of minimizing disturbance. The prohibition of mussel harvesting would further benefit the red knot by preserving a valuable food source.

Sea Turtles

Fishery interactions, vessel interactions, and channel dredging operations are the principal activities affecting sea turtles using the nearshore marine (neritic) environment, and were among the principal threats that led to their original listing under the Endangered Species Act (NMFS-NER 2012). Leatherback sea turtles are by far the most commonly encountered of the five sea turtle species known to use nearshore open water areas around Monomoy NWR. Leatherbacks are followed in prevalence by loggerhead, Kemp's ridley, and green sea turtles. Although rare, hawksbill sea turtles have also been documented in Nantucket Sound waters. The spatial range of leatherbacks in Massachusetts waters largely depends upon the seasonality (May to October, with July to August peak months) and location of their primary food supply, gelatinous zooplankton (Burke and Sharp 2010). Pelagic and benthic juvenile loggerheads are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988, NMFS and USFWS 2008). Sub-adult and adult loggerheads are primarily coastal-dwelling and typically prey on benthic invertebrates, such as mollusks and decapod crustaceans, in hard-bottom habitats (NMFS and USFWS 2008).

Loggerhead or leatherback sea turtles caught or wrapped in the buoy lines of trap gear can die as a result of forced submergence, or incur injuries such as severe constriction of a flipper, leading to death. A review of leatherback mortality documented by the Sea Turtle Sighting and Stranding Network in Massachusetts suggests that vessel strikes and entanglement in fixed gear (primarily lobster pots and whelk pots) were the principal sources of leatherback mortality (Dwyer et al. 2002). A 1990 National Research Council report concluded that, for loggerhead juveniles, sub-adults, and breeders in coastal waters, the most common cause of human-related mortality in U.S. Atlantic waters was fishery interaction. The Loggerhead Biological Review Team determined that the greatest threats to the loggerhead northwest Atlantic distinct population segment result from cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 2009).

Leatherbacks may also be more susceptible to marine debris ingestion than other sea turtle species due to the tendency of floating debris to concentrate in convergence zones that juveniles and adults use for feeding (Shoop and Kenney 1992, Lutcavage et al. 1997). Leatherbacks might not be able to distinguish between prey items such as jellyfish and plastic debris (Mrosovsky 1981) that may resemble food items as it drifts about, inducing a feeding response in leatherbacks (Balazs 1985). NMFS Northeast Region established the Northeast Sea Turtle Disentanglement Network (STDN) in 2002 in response to the high number of leatherback sea turtles found entangled in pot gear along the U.S. northeast Atlantic coast. The STDN is considered a component of the larger Sea Turtle Stranding and Salvage Network (STSSN) program and operates in all states in the region.

Leatherbacks are susceptible to entanglement in lines associated with trap/pot gear used in several fisheries. From 1990 to 2000, 92 entangled leatherbacks

were reported from New York through Maine (Dwyer et al. 2002). Additional leatherbacks stranded were wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer et al. 2002). More recently, from 2002 to 2010, NMFS received 137 reports of sea turtles entangled in vertical lines from Maine to Virginia, with 128 confirmed events (verified by photo documentation or response by a trained responder; NMFS 2008a). Of the 128 confirmed events, 117 involved leatherbacks. NMFS identified the gear type and fishery for 72 of the 117 confirmed events, which included lobster (42), whelk/conch (15), black sea bass (10), crab (2), and research pot gear (1).

There were 97 confirmed or probable vertical line entanglement reports of leatherbacks from Maine to New York during 2002 to 2010. During the period 1980 to 2000, there were 119 reported leatherback sea turtles entangled in lobster trap gear from Maine to New York. Documented leatherback entanglements from Maine to New York averaged 10.77 annually from 2002 to 2010. Forty-three leatherback events involved lobster gear, 22 events involved fishery gear from a different source, and for 32 events the gear could not be assigned to a specific fishery. From the total of 65 events involving a verified gear, 66 percent came from the lobster fishery. All 43 leatherback lobster gear entanglements involved vertical line of the gear and occurred in Maine, Massachusetts, Rhode Island, with one in Connecticut waters, and occurred in the warmer months as illustrated in figure 4.2.

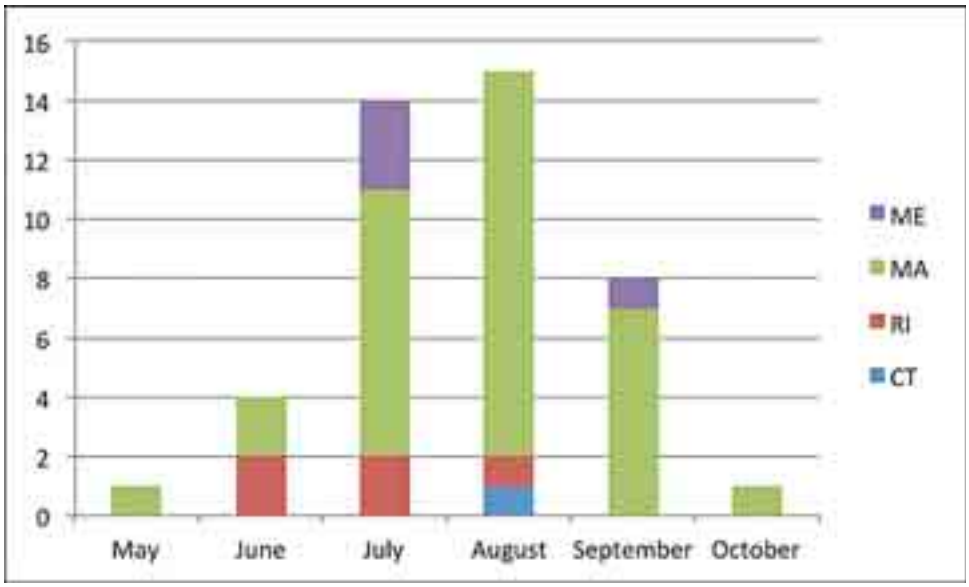

Figure 4.2. Leatherback Sea Turtle Lobster Gear Entanglements by New England State for 2002 to 2010.

Of the 43 confirmed or probable sets of gear, one was verified as Massachusetts recreational lobster pot gear (August 2006), and two sets of gear have been identified to a fisherman with both Massachusetts State and Federal permits for lobster pot gear. Four entanglements involved gear from fishermen with State permits, and possibly Federal permits, but this could not be confirmed. In seven entanglements, it was unknown if the gear came from a state, Federal, or recreational fishery. All other lobster gear has been confirmed to be state commercial (Maine, Massachusetts, Connecticut, or Rhode Island) coastal lobster pot gear.

Recorded loggerhead interactions with American lobster fishery gear are few. There have been three loggerheads reported entangled in lobster gear.

For 1980 to 2000 there was one loggerhead (alive) entangled in lobster gear in Massachusetts (SEFSC STSSN database: *www.sefsc.noaa.gov/species/turtles/strandings.htm*) and none during the recording period 2002 to 2010, according to the STDN database. During the same time period, 10 loggerhead sea turtle entanglements in other vertical line trap/pot gear (i.e., crab, whelk, and unknown) were documented. Five of the other gear entanglements were in whelk pot gear, and two entanglements were confirmed to be from a crab fishery. Whelk pots, unlike lobster traps are not fully enclosed, and have been suggested as a potential source of entrapment for loggerhead sea turtles enticed by the bait or whelks in the trap (Mansfield et al. 2001). Gear from three of the loggerhead entanglements was never identified. The factors influencing loggerhead sea turtle entanglements in pot/trap fishing gear are unclear. Actions taken to reduce anthropogenic impacts to loggerhead sea turtles from various sources, for example, turtle excluder devices on trawl gear and chain mat regulations on sea scallop dredge gear, represent a significant improvement in the baseline gear effects on loggerheads in the northwest Atlantic.

For the 3 years beginning June 1, 2007 and ending May 31, 2010, the Massachusetts Sea Turtle Disentanglement Network (MASTDN) undertook 36 on-water responses to 41 confirmed entangled sea turtle reports throughout Massachusetts coastal waters and shorelines (Burke and Sharp 2010). These entanglements consisted of 40 leatherback and 1 loggerhead, of which 24 were successfully disentangled and released alive by MASTDN response teams. Where it could be identified, the gear type involved in the entanglements is shown in table 4.5.

Table 4.5. Sea Turtle Entanglements by Fishery or Gear Type During 2007 to 2010.

	Number of Documented Entanglements	
Fishery/Gear Type	Count	Percent
Lobster	10	43
Whelk/Fish Pot	9	39
Weir	2	9
Unknown buoy line	2	9

Lobster pots and whelk/fish pots entangled approximately equal numbers of leatherback turtles during the period. Most of the whelk and fish pot gear in Massachusetts waters exists in Nantucket Sound, including within the Monomoy NWR Declaration of Taking boundary. The majority of lobster gear occurs north and east of Cape Cod, but lobster gear is placed annually within the Monomoy NWR Declaration of Taking boundary. A fish weir is operated some years within the refuge Declaration of Taking boundary, and has been responsible for at least two known sea turtle entanglements.

Northeastern Nantucket Sound and the waters lying west of the Monomoy land mass are emerging as a potential hot spot for southern New England entangled sea turtle discoveries as evident in Figure 4.3. The actual entanglement sites for many of the turtles discovered in northeastern Nantucket Sound near Monomoy NWR may be long distances from these discovery locations. Prevailing winds during warmer months when sea turtles are present in Nantucket Sound are from the southwest. Sea turtles entangled elsewhere may drift and swim long distances with wind driven currents before they are detected as they reach the shallow waters and busy boat channels lying just west of the Monomoy land mass. The STDN receives the majority of reports from private boaters and recreational fishermen who encounter entangled turtles in the water. Since the majority of entanglements are reported by recreational boaters, these data may be skewed toward coastal waters that are easily accessible and highly utilized by boaters.

Reports may also be skewed toward entanglements in buoy lines because those entanglements are visible at the surface. Despite these limitations, this STDN dataset is the most complete and best available consolidation of sea turtle entanglement data in the Northeast region, and will be used by NMFS-NER to estimate sea turtle interactions in the American lobster fishery.

Figure 4.3. Southern Massachusetts Confirmed Sea Turtle Entanglements June 2007 to May 2010; adapted from Burke and Sharp 2010.

The Massachusetts Division of Marine Fisheries and Provincetown Center for Coastal Studies continue to work to better understand these spatial relationships between sea turtles and fishing gear and methods for reducing the incidence and severity of entanglements. Some of the entanglement mitigation strategies currently being explored by the Massachusetts Disentanglement Network include buoy line density and other gear modifications targeted at turtle entanglement aggregation hot spots.

The National Marine Fisheries Service (NMFS), Northeast Region, recently completed a biological opinion on continued implementation of management measures for the American lobster fishery in Federal waters (NMFS-NER 2012) for the next 10 years. American lobsters are managed under a dual State and Federal regulatory combination of authorities. The Atlantic States Marine Fisheries Commission (ASMFC) manages the lobster fishery in state waters 0 to 3 nautical miles from shore, and NMFS manages the lobster fishery in Federal waters from 3 to 200 miles from shore (the Exclusive Economic Zone), both under the authority of the Atlantic Coastal Fisheries Cooperative Management Act. The predominant area of harvest in the United States is the Gulf of Maine in depths up to 40 meters (ASMFC 1999). The southern New England (SNE) lobster stock unit is primarily fished by Connecticut, Massachusetts, New York, and Rhode Island fishermen, with smaller contributions from New Jersey, Delaware, and Maryland accounting for 19 percent of the U.S. landings between 1981 and 2007. From 2000 to 2007, landings from the SNE accounted for only 9 percent of the U.S. landings, reaching a time-series low of 6 percent in 2004.

The 2012 NMFS-NER biological opinion concluded that continuing current lobster fishery management measures will not affect Kemp's ridley, green, or hawksbill sea turtles. There are no documented interactions of Kemp's ridley sea turtles with gear from the lobster trap/pot fishery. Because there are no proposed changes to the lobster fishery that would increase the likelihood of interactions between Kemp's ridleys and lobster trap/pot gear, no future interactions are anticipated. Similarly, there are no documented interactions of green sea turtles with gear from the lobster trap/pot fishery, and because there are no proposed changes to the lobster fishery that would increase the likelihood of interactions between greens and lobster trap/pot gear, no future interactions are anticipated.

An October 29, 2010, biological opinion concluded that operation of the federally regulated portion of the lobster trap fishery may adversely affect loggerhead and leatherback sea turtles as a result of entanglement in the ground lines or buoy lines associated with this type of gear. An incidental take statement was issued with the 2010 biological opinion, exempting the annual incidental take (lethal or nonlethal) of one loggerhead sea turtle and five leatherback sea turtles (NMFS 2010a). The trap reduction measures associated with an interstate plan for rebuilding the depleted southern New England lobster stocks will benefit sea turtles by reducing the amount of gear (specifically buoy lines) in the water where sea turtles also occur. Additionally, NMFS must implement reasonable and prudent measures (RPM) in its management of the American lobster fishery over the next 10 years as detailed in the 2012 biological opinion.

The lethal removal of five leatherback sea turtles annually from the Atlantic Ocean as a result of the continued operation of the American lobster fishery over the next 10 years will not appreciably reduce the likelihood of survival or recovery of leatherbacks in the Atlantic. The 2012 biological opinion concluded that trap gear fixed on benthic habitat as a result of the fishing activities will have an insignificant effect on loggerhead sea turtle prey or habitat and is unlikely to appreciably reduce the likelihood survival and recovery of the northwest Atlantic distinct population segment of loggerhead turtles.

The only fishery that NMFS determined would reduce the reproduction, numbers, or distribution of ESA-listed sea turtles, and reduce appreciably their likelihood of survival and recovery, is the pelagic longline component of the Atlantic highly migratory species fishery (Atlantic bluefish, Atlantic mackerel/squid/butterfish, Atlantic sea scallop, highly migratory species, monkfish, Northeast multispecies, red crab, skate, spiny dogfish, and summer flounder and scup fisheries). Pelagic, long-line fishing does not occur in the nearshore open waters around Monomoy; it is practiced well offshore along the edge of the

continental shelf. On June 1, 2004, NMFS released a biological opinion on the Atlantic pelagic longline fishery that stated the fishery was likely to jeopardize the continued existence of leatherback sea turtles and developed a reasonable and prudent alternative (RPA) aimed at removing the jeopardy. This requires that NMFS reduce post-release mortality, improve monitoring the effects of the fishery, confirm the effectiveness of the hook and bait combinations required as part of the proposed action, and take management action to avoid long-term elevations in leatherback takes or mortality. The biological opinion specified an RPA that allows the continuation of the Atlantic highly migratory species fishery without jeopardizing ESA-listed species.

In general, the significantly reduced fishing effort in the Northeast multi-species fishery under recent amendments to this fishery management plan results in substantially less time that gear is in the water and therefore less opportunity for sea turtles to be captured or entangled in multi-species fishing gear.

NMFS completed section 7 consultation on the Skate Fishery Management Plan (FMP) on October 29, 2010, and concluded that operation of the skate fishery may adversely affect ESA-listed sea turtles as a result of interactions with gillnet and trawl gear. The incidental take statement issued with the 2010 biological opinion exempted the annual incidental take of up to 24 loggerheads over a 5-year average in trawl gear, of which up to 11 per year may be lethal. The annual take is up to 15 loggerheads over a 5-year average in gillnet gear, of which up to 6 per year may be lethal. The incidental take statement also exempted four leatherbacks, four Kemp's ridleys, and five green sea turtles in skate gear (NMFS 2010b). New information estimating loggerhead bycatch in bottom trawl gear has recently been published in Warden (2011). Using Northeast Fisheries Observer Program (NEFOP) data from 1996 to 2008 applied to vessel trip reporting (VTR) days fished, the average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the skate fishery between 2005 and 2008 was estimated to be seven loggerhead sea turtles per year (Warden 2011).

Section 7 consultation on the Spiny Dogfish FMP completed October 29, 2010, concluded that operation of the fishery may adversely affect ESA-listed sea turtles as a result of interactions with and capture in gillnet and trawl gear. The incidental take statement issued with the 2010 biological opinion exempted the annual incidental take of up to one loggerhead over a five-year average in trawl gear, which may be lethal or nonlethal, and the annual take of up to one loggerhead over a five-year average in gillnet gear, which may be lethal or nonlethal. The incidental take statement also exempted four leatherbacks, four Kemp's ridleys, and five green sea turtles in spiny dogfish gear (NMFS 2010c).

Various crab fisheries, such as horseshoe crab and blue crab, also occur in Federal and state waters. The crab fisheries may have detrimental impacts on sea turtles beyond entanglement in the fishing gear itself. Loggerheads are known to prey on crab species, including horseshoe and blue crabs. The decline in loggerhead abundance in Virginia waters (Mansfield 2006), and possibly Long Island waters (Morreale et al. 2005), commensurate with noted declines in the abundance of horseshoe crab and other crab species, raises concerns that crab fisheries may be impacting the forage base for loggerheads in some areas of their range.

The refuge would remain open to fin fishing (except using methods that disturb the bottom) and whelk, lobster, and crab fishing with pots under State

regulations. These uses pose minimal entanglement risk for leatherback and loggerhead sea turtles under all alternatives. Refuge staff will review sea turtle stranding and entanglement reports throughout the plan period under all alternatives to ensure the actual incidence remains as low as expected.

Under alternative A, refuge waters remain open to operation of all vessel types, including motorized boats. Therefore the risk and incidence of sea turtle vessel strike injuries or mortality (incidental take) within the refuge boundary (Marine Protected Area) will persist through the plan period.

Under alternative B, refuge waters also remain open to operation of all vessel types, including motorized boats, but increased emphasis on refuge visitation may increase motorized boat traffic in refuge waters over current levels. Therefore, the risk and incidence of sea turtle vessel strike injuries or mortality (incidental take) within the refuge boundary (Marine Protected Area) may increase somewhat over the plan period. Refuge staff will review sea turtle stranding and entanglement reports throughout the plan period under all alternatives to ensure the actual vessel strike incidence remains as low as expected.

Under alternative C, greater emphasis on non-motorized (paddling) watercraft for accessing the Monomoy wilderness should reduce the risk and incidence of sea turtle vessel strike injuries or mortality within the refuge boundary. Impacts to sea turtles from gear will be the same as under alternative B.

Effects on Vegetation and Habitats

The refuge includes an amazing diversity of habitats, some of which are unique to the Refuge System. Our limited habitat management on the refuge is focused on maintaining beach and dune grasslands to provide breeding areas for various seabirds. In addition, some areas of the refuge are treated to remove nonnative invasive plants. The effects of our management actions on refuge habitats, including dune grasslands, maritime shrubland, intertidal, salt marsh, freshwater wetlands, and nearshore marine open water are described below for each of the proposed alternatives. Effects on native and invasive plant communities are also discussed.

Effects on Dune Grasslands, Dune Edges, and Beach Shoreline

This section considers impacts from strategies related to objectives A1.1, B1.1, C1.1, A1.2, B1.2, C1.2, A1.3, B1.3, A1.4, B1.4, A1.5, B1.5, and C1.3. Coastal beach (above mean high tide) and dune habitat are some of the most threatened habitats in the U.S. (Brown et al. 2001). These habitats are part of a naturally unstable, dynamic ecosystem that is subject to erosion and accretion processes from wind and wave action. Development, beach stabilization projects, and heavy recreational use affect the quality of this habitat for wildlife species of conservation concern. The refuge has approximately 1,970 acres of dune and beach habitat that provide habitat for nesting terns and shorebirds, including piping plover, roseate tern, and American oystercatcher. All three alternatives employ varying degrees of active management in order to protect and maintain dune habitat, but the level of protection and management of the barrier beach ecosystem varies by alternative. Each alternative offers differing levels of wildlife and plant inventories and monitoring, as well as adaptive management strategies to guide the management of dune and beach habitat and associated species. Due to the dynamic nature of coastal habitats, there is continuous fluctuation in the geographic distribution of resources. Therefore, it is necessary to view coastal habitat protection and management in a regional ecosystem context. All alternatives would incorporate actions, where possible and as funding allows, that monitor for any impacts to the refuge due to sea level rise.

All alternatives would implement periodic prescribed burns in the tern colony to set back succession and improve habitat. The primary intent of prescribed burning in the tern colony is to periodically remove accumulated dead grass litter, increase the amount of exposed bare sand for nesting terns, and maintain native perennial grassland dominance, with woody encroachment kept to less than 10 percent cover. The low-severity ignition patterns and burns common to all alternatives effectively remove only dead vegetative materials, with little to no injury to the largely below-ground, dormant but living portions of the plants. Fall and winter burning is preferred over early spring burning, as the blackened ground surface absorbs more solar heat, raising the surface soil temperatures and stimulating an earlier green-up of the burned area than the surrounding unburned areas. This earlier green-up of the burned areas prior to the return of nesting migratory birds to the colony site the following spring gives the post-burn vegetative recovery enough of a head start that the burn unit remains attractive as nesting habitat. Waiting until spring to conduct prescribed burning foregoes the head start effects on vegetative recovery.

The spread of invasive plant species invasive plants are left untreated would potentially degrade the quality of the vegetated dune habitat for focal species. Invasive plants may adversely impact native dune plants through direct resource competition, and can contribute to the decline of threatened or rare native plant species (Thomson 2005). The short-term impacts of habitat management activities, such as herbicide use or mechanical removal, contribute to maintaining suitable, quality habitat in the long term.

Visitors engaging in wildlife-dependent recreational activities, whether independently or as part of an organized tour, are expected to stay on maintained trails and obey seasonal and permanent closures in sensitive beach and dune habitats to minimize disturbance and other negative impacts. Onsite activities, particularly group activities, may result in short-term impacts by trampling vegetation. All alternatives would maintain vehicle closures to protect this habitat.

Under all alternatives, we are committed to managing the area to maintain and enhance wilderness character. Some refuge management actions (dune vegetation and maintenance measures, control of invasive species, predator management for gulls, and artificial nesting structures for tern species) may be modified or reprioritized to comply with wilderness policy guidelines. Proposed actions and protocols would be evaluated through a minimum requirements analysis to identify the minimum impact methods and tools, if necessary, to accomplish essential management activities with a minimal amount of impairment to wilderness character.

Dune Grasslands, Dune Edges, and Beach Shoreline Impacts of Alternative A (Current Management)

Under current management, we would continue to protect and manage approximately 30 acres of dune and beach habitat to benefit priority bird species and enhance 2 acres of prime nesting habitat for roseate terns. We would continue to modify the habitat using mechanical methods, herbicide, and rotational prescribed burning to promote a mosaic of dense and sparse vegetation, which would benefit tern colonies on the refuge.

Under alternative A, we would continue to provide public access to South Monomoy and North Monomoy Island via boat landings and ferries operating under a special use permit. Soil compaction and vegetation trampling would likely occur along the dunes, although under current public use levels, neither is considered a major threat to refuge resources. Visitors would continue to utilize the existing unauthorized land-bridge and unmaintained footpaths created by extensive use near the lighthouse.

The presence of a seasonal field camp used by refuge staff also poses some minor impacts to the surrounding vegetation due to trampling and high use. However, given the small percentage of acreage the camp occupies in relation to the refuge, we believe this is a temporary and negligible impact.

Impacts associated with the installation of solar panels at the Monomoy Point Light Station would be the same as those described under Soil Impacts in Alternative B.

Dune Grasslands, Dune Edges, and Beach Shoreline Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))
Alternative B proposes a significant increase in habitat management and intervention. Under this alternative, we would actively manage up to 75 acres of vegetated dune habitat for nesting common terns, and provide 10 acres of prime nesting habitat for roseate terns. This would include a more concerted effort to control invasive plant species to provide greater benefit to dune focal species. Invasive species management would be more aggressive under alternative B, aiming for a target of less than 10 percent coverage refugewide of nonnative invasive plant species throughout the dune grasslands. This would benefit native plant species within this habitat type. To maintain the herbaceous dune habitat and prevent succession to woody growth, we would remove woody vegetation as needed with prescribed fire, herbicide, or mechanical means. The proposed maximum acreage for prescribed burns under alternative B is almost three times the area in alternative A. The quality of this habitat would improve as a result of a more regular burning regime and removal of woody and invasive plant species.

This alternative would also consider the use of dredge material outside of the Monomoy wilderness. Benefits of beach re-nourishment projects are discussed in chapter 3, objective B1.1. The impacts of dredge material are discussed under Effects on Water Quality and Effects on Soils. Adaptive management would be used to guide seasonal closures depending on time of year and species presence (see chapter 3). The time and location of seasonal closures will vary year to year based on wildlife use and habitat conditions. New research and inventory and monitoring would also allow greater use of adaptive management to better protect habitat and better respond to shifting coastal habitat dynamics.

We would provide greater protection of coastal dune and shoreline habitats in balance with priority public uses. More onsite refuge seasonal staff would provide greater protection to habitat through increased public awareness, enforcement of closures, and additional signs. Providing more habitat may allow for 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. A larger habitat base would also allow terns to move around between microhabitats within the larger area as we apply a rotational-based habitat management scheme. Under this alternative, we would replace our current signs with fiberrod posts and string. This method would be less visible and more appropriate within the Monomoy wilderness.

Through implementation of the North Atlantic LCC, the Service would be able to set aside additional coastal lands for conservation, share resources and scientific information with partners, and collaborate on management activities to protect a greater amount of beach and dune habitat under this alternative. More proactive land protection efforts with partners would provide opportunities to permanently protect more coastal dune and shoreline habitats, and create a larger area of continuous protection for species like the roseate and common tern, piping plover, least tern, American oystercatcher, and northeastern beach tiger beetle.

Under alternative B, there would be potentially more vegetation trampling as sites like the Monomoy Point Light Station become open to the public. We would

also expect to see a minor increase in vegetation trampling with an increased staff presence and field camp. Impacts associated with the installation of solar panels at the Monomoy Point Light Station would be the same as those described under Soil Impacts of Alternative B.

Dune Grasslands, Dune Edges, and Beach Shoreline Impacts of Alternative C (Natural Processes)
Under alternative C, we would only protect 10 acres of the existing 30 acres of nesting habitat for common terns and maintain an additional 2 acres of prime nesting habitat for roseate terns. The reduction in common tern nesting habitat may result in fewer nesting common terns, but the results of our efforts to maintain 2 acres of high quality roseate tern nesting habitat are comparable to the current efforts for roseate terns under alternative A. Ten acres of quality habitat could still support thousands of nesting pairs, and we would therefore still maintain an active predator management program to enhance productivity of both species of terns. In contrast to alternatives A and B, our presence in and around the tern colony would likely be reduced as we would no longer maintain a field camp. This would reduce the impacts of vegetation trampling, but would also likely increase the risk of avian and mammalian predation due to reduced human presence.

Natural, rather than anthropogenic processes, would dominate the remaining 20 acres of existing common tern habitat within these habitat types. We would only conduct vegetation manipulation in this 10-acre area, therefore it is likely that woody species may begin to dominate in some areas and nonnative invasive plants would spread. We would significantly decrease acreage burned compared with alternatives A and B.

Portions of these habitats would continue to be lost on Morris Island through erosion and sea level rise. Without beach renourishment or armoring, this habitat may gradually transition to intertidal habitat. More proactive land protection efforts compared to current levels with partners would provide opportunities to permanently protect more coastal dune and shoreline habitats and emphasize the protection of, and management for, coastal species of concern.

Effects on Maritime Shrubland

This section considers impacts from strategies related to objectives A1.6, B1.6, and C1.5. The refuge's maritime shrubland, while impacted by nonnative plants like rugosa rose, provides habitat for a number of declining species associated with early successional habitats, including black-crowned night-herons and snowy egrets. The approximately 500 acres of this habitat on Monomoy NWR support one of the few remaining nesting sites in Massachusetts for colonial nesting wading birds, and many of these birds are nesting in nonnative rugosa rose. In all three alternatives, we would not control rugosa rose in areas where wading birds are nesting.

Maritime Shrubland Impacts of Alternative A (Current Management)
Under alternative A, nonnative rugosa rose may spread in some areas of the refuge, but this has not been problematic to date. This habitat has been expanding over the last few years, and we do not anticipate any adverse impacts from our passive management. Alternative A would evaluate the importance of maritime shrubland for migrating songbirds.

Maritime Shrubland Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))
Under alternative B, we would evaluate maritime shrubland habitat for its regional importance, looking specifically at habitat conditions, including species composition, nonnative plant presence, and community structure, to better inform us regarding conservation implications and future management. We would utilize

biological, mechanical, chemical, or fire management to reduce nonnative invasive species to no more than 5 percent of habitat composition in utilized habitats. Maritime shrubland quality would improve as invasive species would be removed.

Maritime Shrubland Impacts of Alternative C (Natural Processes)
Under alternative C, this habitat would fall under the umbrella management of BIDEH. We would utilize manual tools, herbicide, or prescribed fire to ensure less than 10 percent coverage refugewide for maritime shrubland in combination with salt marsh and freshwater pond habitats.

Maritime shrubland quality may improve as invasive species would be removed. We would not anticipate any significant impacts from shifting to a biological integrity, diversity, and environmental health (BIDEH) focus because this habitat has never been actively managed and is controlled by the soils and salt spray in its environment.

Effects on Intertidal Habitat

This section considers impacts from strategies related to objectives A1.7, B1.7, C1.4. The intertidal habitat of Monomoy NWR provides important nesting, resting, and foraging habitat for migrating and staging birds, particularly species of conservation concern. All the alternatives would employ seasonal closures to reduce human disturbance from public use activities. The timing and location of these closures would vary year to year based on wildlife use and habitat conditions. Under all the alternatives, we would continue our ban on horseshoe crab harvesting.

Apart from sensitive areas (bird resting/foraging sites) being seasonally closed, the refuge would not conduct any active management in this habitat. Shellfishing for softshell clams and quahogs would continue to be allowed under all alternatives, although the prohibition of motorized boat use within the wilderness area under alternative C might limit the number of people shellfishing. Intertidal habitat is naturally a high-energy zone subjected to various levels of substrate disturbance by wind, tides, and waves. The intensity and scale of the anticipated shellfishing activities, whether reduced or not, would not significantly alter the disturbance regime as a whole.

Horseshoe crab research on the refuge

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Actual shellfish harvest impact stems from the spatial extent and degree that the pre-disturbance and post-disturbance intertidal environments differ (Ray 2005, Beukema 1995). Effects of sediment re-suspension can include reduced light available for photosynthesis, burial or smothering of benthic biota and spawning areas when anoxic conditions result, and negative effects on feeding and metabolic rates of intertidal organisms (Johnson 2002). Re-suspension of sediments also occurs naturally during storms, or from human activities such as operating boats in shallow estuarine areas. Monomoy refuge is characterized by a highly dynamic system of tide and wind-driven shifting sands; therefore, it is likely that at Monomoy refuge natural tide and wind-driven sand movements cause more sediment re-suspension than shellfish harvesting activity. Additional detail on the impacts of shellfishing can be found in the Shellfishing Compatibility Determination in appendix D.

Intertidal Habitat Impacts of Alternative A (Current Management)
Under current management, there is no active habitat management that significantly benefits or impacts this habitat. Under alternative A, the refuge would consider using dredge material from ongoing non-refuge projects in the area. The initial impact of nourishment operations is often the direct loss of benthic species as a result of being covered by dredge sediments or forcing relocation of mobile species. These operations can result in high turbidity in the short term and reduced populations of benthic organisms.

Intertidal Habitat Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))
Under alternative B, we would expand our management within this habitat by protecting up to 2,500 acres. In recent years, public access closures have generally occurred between April 1 and September 30, however we would use an adaptive management process to annually adjust the size and length of closures based on habitat conditions and wildlife use. In addition, we would bring Nauset/South Beach under refuge management consistent with how we are managing those resources elsewhere on the refuge. As in alternative A, no active habitat management would directly benefit or adversely impact this habitat. Alternative B would also consider the use of dredge material; impacts would be the same as discussed under alternative A.

Intertidal Habitat Impacts of Alternative C (Natural Processes)
Under alternative C, passive management would be in place for this habitat type. We do not anticipate any direct benefits or adverse impacts to the intertidal habitat.

Effects on Salt Marsh Habitat

This section considers impacts from strategies related to objectives A1.8, B1.9, and C1.5. Under each of the alternatives, we would continue to protect salt marsh habitat from trampling and disturbance through seasonal closures during the growing season and peak public use periods. On North Monomoy Island, we would continue to provide an east-west pedestrian access corridor in all three alternatives to allow visitor passage across the island. The corridor location is the same every year, and significant changes to salt marsh habitat from trampling have been observed within this corridor as a result. However, while this may be a substantial impact on a very small portion of the salt marsh, it does not detract from the overall salt marsh integrity.

Salt marsh habitat and vegetation may also be altered by pedestrian access. During peak times of public visitation, most of the salt marsh on Monomoy refuge is closed to pedestrian access to protect wildlife and prevent trampling. In particular, on North Monomoy Island, where the largest salt marsh exists on the refuge, a narrow corridor for pedestrian passage stays open and connects the east and west sides of the island. The location of this corridor is the same every year, and soil compaction and trampling impacts are evident but very localized. During non-peak times of public visitation (generally October through April), salt marsh habitats are not closed to pedestrians, but visitation is low and negative impacts to the habitat have not been observed during these times of year.

Under all alternatives, we would continue to allow the Cape Cod Mosquito Control District (CCMCD) to conduct mosquito monitoring on Morris Island. Direct impacts of monitoring include temporary disturbance to habitat and possible direct effects to non-target wildlife. Areas of vegetation may be crushed under foot, with impacts ranging from temporary in nature to loss of habitat over time. Invasive weeds may be introduced or spread by foot. A more detailed discussion on the impacts of nuisance mosquito management and control is under the Insects section in the discussion on Effects on Other Native Wildlife.

Salt Marsh Habitat Impacts of Alternative A (Current Management)
Under alternative A, we would continue to minimally manage about 250 acres of salt marsh with the use of seasonal closures to minimize trampling of vegetation and invertebrates, and benefit nesting saltmarsh sparrows and American oystercatchers.

Salt Marsh Habitat Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))
Under alternative B, we would take a more proactive approach by actively managing at least 150 acres of the 250 acres of coastal salt marsh to ensure that the quality and natural function of the marsh is sustained. Salt marsh habitat provides valuable nesting habitat for saltmarsh sparrow and American oystercatchers, as well as foraging areas for wading birds, roosting areas for shorebirds, and nursery habitat for horseshoe crabs. Invasive species management would be more aggressive under alternative B by aiming for a target of less than 10 percent coverage of nonnative invasive plant species throughout the salt marsh.

This habitat would benefit from information gathered through a regionwide study of salt marsh integrity, in addition to determining the presence and abundance of purple marsh crabs—a species associated with salt marsh degradation. If it is determined that this species is present on the refuge, we would initiate studies to research the impacts and manage accordingly.

Impacts from nuisance mosquito control would be the same as those discussed under alternative A.

Salt Marsh Habitat Impacts of Alternative C (Natural Processes)
Under alternative C, impacts from vegetation and habitat management would be the same as in alternative B. Refuge habitat management actions that increase biological integrity, diversity, and environmental health, and avian diversity have the potential to provide a buffer against future disease outbreaks.

Effects on Freshwater Wetlands

This section considers impacts from strategies related to objectives B1.10 and C1.5. Refuge wetlands include approximately 150 acres of freshwater ponds and associated emergent and shrub wetlands, primarily located on South Monomoy. Refuge wetlands are the least well-known habitat type on the refuge. All alternatives would allow this habitat to continue supporting migratory birds and breeding and wintering waterfowl species. Secretive nesting marshbirds also nest in the freshwater marshes, and pied-billed grebe and American coot use these habitats for migration. The freshwater wetlands also provide a food source for migrating bats.

Freshwater Wetlands Impacts of Alternative A (Current Management)
Under alternative A, there is no active management of this habitat. The freshwater ponds are used for fishing; we anticipate minimal vegetation trampling as a result. This use has been allowed since the refuge was established and has not posed a significant impact on the resource. The nonnative, invasive plant species common reed (*Phragmites)* is found on some of the freshwater ponds on South Monomoy; it has not been treated and would continue to exist. In general, *Phragmites* decreases the value of the pond to wildlife; native vegetation generally provides more food and shelter value than nonnative vegetation. The *Phragmites* population has been relatively stable over the past 10 years, therefore we do not anticipate any significant adverse impacts from its continued presence.

Freshwater Wetlands Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))
Under alternative B, we would work to maintain the ecological integrity of approximately 150 acres of freshwater ponds and associated emergent and

shrub wetlands by removing invasive species to ensure no more than 10 percent coverage. The removal of nonnative invasive plant species, predominantly common reed, would benefit wetland habitats and associated species (Chambers et al. 2003). Removal techniques would include manual tools, herbicides, or prescribed fire. The impacts of these management tools include the potential loss of native vegetation, but we do not anticipate any significant adverse impact to this habitat.

Freshwater Wetlands Impacts of Alternative C (Natural Processes)
Under alternative C, wetland impacts from management actions would be similar to alternative A, but would be evaluated through a BIDEH focus. This alternative would benefit from nonnative invasive species management similar to that in alternative B.

Effects on Nearshore Marine Open and Subtidal Waters

This section considers impacts from strategies related to objectives A1.9, B1.11, and C1.5. All alternatives would enforce a closure on mussel and horseshoe crab harvesting and restrict fishing techniques that disturb the bottom. These activities are not compatible with refuge purposes, and by not allowing these activities within refuge waters we would protect quality habitat for fish nurseries and other aquatic life.

Eelgrass meadows have a complex structure that provides habitat for a diverse community of microorganisms, algae, and marine animals (CT DEP and DA 2007). Eelgrass plants contribute to the overall productivity of the marine ecosystem by using the energy of sunlight to produce organic matter in the form of roots, rhizomes, and plant leaves (CT DEP and DA 2007). Eelgrass meadows support a diverse assemblage of marine invertebrates, including species of marine worms, crustaceans (e.g., barnacles, crabs, shrimp, copepods, amphipods) hydroids, bryozoans and mollusks (e.g., mussels, snails and clams). Eelgrass meadows are widely recognized as important fish habitat. Most fishes using eelgrass extensively are young-of-year, juveniles, or adults of species that are small in size. Eelgrass is an important food source for waterfowl such as Atlantic brant, black duck, canvasback duck, and Canada goose.

Under all alternatives, the refuge would remain open to fishing using techniques that do not disturb the bottom. These techniques include demersal long-line fishing; mid-water trawl fishing; hook and line/rod and reel fishing; lobster, crab, whelk pot fishing; and the hand-harvest of scallops. Since submerged aquatic vegetation grows in nearshore waters, fishermen may fish in and around eelgrass from either boat or shore. Fishing in eelgrass can be difficult because it can foul baited hooks and lures. At the present level of fishing effort, these types of fishing do not have an appreciable effect on eelgrass.

Shellfishing has the potential to damage aquatic vegetation; however, hand tools are generally used in the intertidal zone where eelgrass does not occur. Therefore we do not anticipate any significant adverse impact from this activity.

Nearshore Marine Open and Subtidal Waters Impacts of Alternative A (Current Management)
Fishing for fin fish, lobster, scallops and whelk occurs in nearshore open waters, in accordance with State regulations, along North Monomoy Island, the western shore of South Monomoy, and within the refuge's Declaration of Taking boundary.

Lobster and fish pots can damage aquatic plants during their placement and removal. When pots are hauled off the bottom habitat, they can scrape plants and result in the loss of leaf blades, or uproot entire plants (CT DEP and DA 2007).

The extent of damage by these pots largely depends on the number of pots set, duration, and hauling frequency. The current and expected level of use on the refuge for lobstering and fishing is very minimal, therefore we do not anticipate any significant adverse long-term impacts from these activities.

Moorings can have negative impacts on subtidal vegetation. If a mooring is located within an eelgrass meadow, the chain can damage plants in numerous ways, ranging from leaf shearing to below-ground impacts. In cases where a single mooring is used, the mooring chain is dragged across the bottom repeatedly with each tidal cycle and changes in wind direction. With repeated scouring, the chain can completely denude a circular area defined by the length of the chain and angle of sweep. A boat that swings 360 degrees around the mooring will form a circular mooring ring scar in the eelgrass meadow. Setting and retrieving anchors in eelgrass meadows can dislodge and damage eelgrass leaves and rhizomes (CT DEP and DA 2007).

Nearshore Marine Open and Subtidal Waters Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))
There may be some increase in fishing under alternative B, with the potential for greater adverse impacts.

Of greater concern under alternatives A and B is the potential impact of boats motoring through or anchoring in eelgrass. Due to the relatively small number of fishermen fishing from boats, the cumulative damage to eelgrass from boat propellers, propeller wash and anchors is not significant at this time. In addition, there are numerous people using boats for other recreational purposes that may cause the same type of impacts. Although we expect an increase in visitation under alternative B, we anticipate many of the visitors will be arriving by concessionaire instead of in their own boats.

Nearshore Marine Open and Subtidal Waters Impacts of Alternative C (Natural Processes)
Impacts are the same as in alternatives A and B.

Effects on Birds

The Service has the responsibility for protecting migratory birds under international migratory bird treaties with Mexico and Canada. Providing habitat for declining coastal plain and beach birds is an important contribution of the region. Many species of conservation concern use the outer Cape Cod region, including the refuge, during the breeding season, in migration, or during winter.

We evaluated the proposed management actions and strategies of all alternatives for their potential to affect beneficially or adversely the habitats required for sustaining healthy and viable populations of waterfowl, waterbirds, shorebirds, and seabirds, and for restoring other species of high conservation concern. Our proposed management actions include seasonally closing areas for breeding, feeding, or resting to reduce human disturbance, eliminating or continuing to prohibit particularly disruptive or disturbing public uses, managing and improving habitat, managing predators to reduce predation, and engaging in outreach and education to increase understanding and compliance with regulations.

Waterfowl and Waterbirds

This section addresses impacts regarding objectives A1.6, A1.8, A1.9, B1.6, B1.9, B1.10, B1.11, and C1.5. Migratory waterfowl and waterbirds would continue to benefit from the refuge's salt marsh, freshwater pond, and nearshore marine open water habitats. Across all the alternatives, controlling invasive plant species, particularly *Phragmites*, is an important management activity conducted in refuge wetland habitats. Migrating and wintering waterfowl and waterbirds

would experience direct benefits from the reclamation of *Phragmites* areas that quickly revert to native plant foods (spikerushes, millet, smartweeds, and grasses). Since these native plants are also associated with specific native insect community assemblages that do not exist in *Phragmites* stands, these invertebrates provide additional food sources that supplement waterfowl plant foods. All waterfowl and waterbirds would also indirectly benefit from the refuge's predator management program.

Considering the vast distances that waterfowl travel to complete their annual migratory circuit and the loss of habitats that have occurred over the last 100 years, it has become increasingly essential to recognize the importance of providing high-quality habitats that are available to waterfowl. During migration stopovers, waterfowl must be afforded the time and opportunity to forage in high-quality habitat to attain desired body mass and fat deposits and replace lost energy reserves. To meet these metabolic demands, waterfowl rely on many Federal, State, and private wetlands, including Monomoy NWR, to rest, feed, and reacquire lost fatty deposits. Daily waterfowl maintenance activities such as feeding, flight, metabolic processes, molting, preening, and resting are costly from an energetic standpoint, and require that waterfowl have undisturbed access to quality habitats with diverse food resources. The National Wildlife Refuge System, along with many state and private wetlands, provides the only secure and guaranteed wetland habitats in the United States and has the responsibility of maintaining these resources for the benefit of wildlife.

Unregulated access in the wetland and salt marsh habitats could adversely impact the feeding strategies of waterfowl using the refuge. Birds at migratory stopover sites spend their time resting and foraging as they rebuild protein and energy stores in preparation for their next migratory flight (McWilliams et al. 2004). It is also important to recognize that flight is a very expensive activity from a metabolic perspective, and forcing birds into flight creates the need to replace lost energy reserves that could have been used for other maintenance activities. Although providing protected areas, these alternatives provide no protection to allow waterfowl to completely avoid the energetic costs associated with being forced into unnecessary flight. The molting of feathers requires an increase in nutrient demand, making it necessary for individuals to be afforded the opportunity for undisturbed foraging. Disturbance caused under this alternative may negatively impact the ability of waterfowl to secure nutrients, thus disrupting molting processes and associated reproductive strategies. Maintenance of feathers by preening has been previously correlated to molt activity and is undoubtedly influenced by molt chronology. Adverse impacts to preening activities would be similar to those associated with the molting process.

Providing waterfowl sanctuaries would minimize some of these impacts and allow waterfowl to have undisturbed access to these areas during biologically critical periods of the day. Havera et al. (1992) and Dahlgren (1988), in comprehensive literature reviews of human disturbances to migrating and wintering waterfowl, have noted that the use of sanctuaries (non-hunted areas) was the most common and effective solution to mitigating adverse disturbance impacts.

Nonmotorized boating can affect refuge resources in a number of ways. Studies show that canoes and kayaks disturb wildlife (Bouffard 1982, Kaiser and Fritzell 1984, Knight 1984, Kahl 1991). They may affect waterfowl broods, wintering waterfowl, shorebirds, raptors, and wading birds, but their low speed and their use primarily during the warmer months would mitigate those impacts, especially on wintering waterfowl.

The use of pesticides for the purpose of mosquito management may directly or indirectly affect resident and migratory waterfowl. A detailed discussion on the

impacts associated with mosquito management is addressed under Terrestrial Invertebrates and Insects.

Research activities may disturb fish and wildlife and their habitats. For example, the presence of researchers can cause waterfowl to flush from resting and feeding areas, cause disruption of birds on nests or breeding territories, or increase predation on nests and individual animals as predators follow human scent or trails. Efforts to capture animals can cause disturbance, injury, or death to groups of wildlife or to individuals. To wildlife, the energy cost of disturbance may be appreciable in terms of disruption of feeding, displacement from preferred habitat, and added energy expended to avoid disturbance.

Waterfowl and Waterbird Impacts of Alternative A (Current Management)
Under alternative A, we would continue to minimize disturbance to nesting wading birds using maritime shrubland habitat refugewide. Some nesting areas are in close proximity to high recreational use, and without seasonal closures, these sensitive wading bird species would likely abandon these sites or suffer from increased predator loss and low productivity.

Waterfowl and Waterbird Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))
Under alternative B, we may slightly expand the area and length of seasonal public access closures based on wildlife use and habitat conditions. When wading birds are disturbed and adults flush off nests, eggs and chicks are left vulnerable to nearby nesting gulls and other avian birds that actively prey on these species. Further reducing disturbance may therefore increase productivity of nesting wading birds. This would be very beneficial considering the large number of gulls that will prey on eggs and chicks nesting in close proximity to herons and egrets.

We would continue to conduct our annual wading bird survey, in addition to a complete census of all wading birds refugewide every 5 to 10 years. This would improve our understanding of which species are utilizing this habitat and how to best maintain it.

Alternative B provides a greater benefit to these species with the presence of additional staff to manage predator impacts and provide protection through habitat management. We anticipate an increase in visitor use under alternative B and would expect to see an increase in human disturbance.

Hunting is a priority, wildlife-dependent, consumptive activity with additional direct effects on waterfowl. Waterfowl hunting has been ongoing on refuge lands for decades, including prior to refuge establishment. Under this alternative, the refuge would implement a waterfowl hunt program that follows Federal and State regulations for annual harvest levels and seasons by species. These regulations are set within each state based on what harvest levels can be sustained for a species without adversely affecting its overall Atlantic coast flyway population. As such, hunting results in individual losses, but the projected cumulative harvest would not jeopardize the viability of any harvested species' population. Some disturbance to non-target wildlife species may occur; however, those impacts should be minimal because hunting pressure is moderate and occurs outside the breeding season.

General adverse impacts of waterfowl hunting are mortality, crippling, and disturbance. Belanger and Bedard (1995) concluded that disturbance caused by waterfowl hunting to waterfowl resources can modify the distribution and use of habitats by waterfowl, affect their activity budget and decrease their foraging

time, and disrupt pair and family bonds and contribute to increased hunting mortality.

Migratory waterfowl hunters may also disturb migratory birds and other wildlife as they travel to and from their hunting sites or when retrieving downed birds. Depending on the location and the number or species of migratory birds in the area, a disturbance can be temporary, with displaced birds moving to nearby backwaters, or major, as in the case of motoring through a large flock of common eider.

Waterfowl and Waterbird Impacts of Alternative C (Natural Processes)
Impacts from habitat and wildlife management activities would be the same as previously described. Impacts from implementing a waterfowl hunt program would be the same as in alternative B. Under alternative C, we expect to see a decrease in visitor use by only allowing nonmotorized watercraft within wilderness waters. However, we may expect to see a minor increase in impacts from canoes and kayaks proportional to the demand for these activities.

Shorebirds (Nesting, Staging, Migrating)

This section addresses impacts regarding objectives A1.3, A1.7, A1.8, B1.3, B1.7, B1.9, C1.4, and C1.5. The primary goal in all our alternatives is providing quality breeding, migrating, and non-breeding habitat for migratory birds that yields considerable indirect beneficial impacts for shorebirds. Specific habitat management actions targeted for shorebirds translate into direct benefits from the provision of high-quality intertidal mudflats and beach habitats for feeding and roosting habitats for both spring and fall migrants and breeding shorebirds. Public education, particularly for beach users, is another important component in the overall management strategy.

Another direct benefit for shorebirds is derived from seasonal beach closures to public use. Minimizing human disturbance would increase nesting and foraging opportunities on overwash habitats to increase shorebird nesting productivity. Indirect benefits for shorebirds are obtained by educating the public about special beach closures with news releases and other outreach mechanisms to engage the public in understanding the needs of nesting shorebirds.

Common tern

Kirk Rodger/USFWS

Pfister et al. (1992) investigated human disturbance as a factor that might limit the capacity of appropriate staging areas to support migrating shorebirds. Long-term census data were used to test the hypothesis that human disturbance at an important coastal migration staging area had adverse impacts on shorebird movement patterns from preferred resting areas and the birds' utilization of food resources. Results indicate that adverse impacts from human disturbance were greater on species

using the front side of beach habitats, with the abundance of impacted species possibly reduced by 50 percent. Such disturbance is implicated as a potential factor in long-term declines in shorebird abundance during migration periods. Birds devote nearly 50 percent of their time watching for or avoiding people. Disturbance can cause shorebirds to spend less time roosting or foraging and more time in alert postures or fleeing from disturbances (Burger 1991, 1994, 2007, Thomas et al. 2003). Shorebirds that are repeatedly flushed in response to disturbance expend energy on costly short flights (Nudds and Bryant 2000).

Disturbance factors causing displacement becomes a very crucial issue during incubation or nesting periods. According to Korschgen and Dahlgren (1992), there are four direct adverse impacts of displacement caused by human disturbance during nesting periods: (1) egg exposure to heat or cold when the adult is displaced; (2) predation of eggs when the nest is vacated by the adult; (3) accidental loss of eggs and chicks, and (4) predation of eggs at a later time due to predators following human trail or other markers to nest sites.

Public education, active protection methods (small fences around nests, signs, wardens), legal measures (beach use regulations, active enforcement patrols), and well-advertised closures of portions of the beach are management actions that often successfully reduce the adverse impacts of human disturbance when shorebirds are most vulnerable. We seasonally close portions of the beach dunes and overwash areas to public use to minimize disturbance to nesting shorebirds such as American oystercatchers. The timing and location of these closures vary year to year based on wildlife use and habitat conditions. All the alternatives predict some increase in annual visitation. However, adverse impacts from an anticipated increase in visitation would vary with the type of habitat management and the kinds of visitor use each alternative proposes. Public use activities are not expected to have any considerable adverse short-term, long-term, or cumulative impacts on shorebirds, as the refuge would maintain beach closures or restrictions in sensitive areas.

At Monomoy refuge, we are particularly concerned about direct and indirect impacts of shellfish harvesting to migratory birds, for which the refuge was originally established. Of particular note is the importance of protecting high-quality stopover sites that shorebirds use while migrating long distances between breeding and non-breeding grounds (Senner and Howe 1984, Myers et al. 1987, Helmers 1992). Human disturbance causing changes in foraging shorebird behavior and distribution of shorebirds at foraging and roosting sites has been well documented. Prolonged or intense human disturbance may also cause shorebirds to expend more energy to avoid disturbances (Helmers 1992) or completely abandon a site (Furness 1973, Burger 1986, Pfister et al. 1992). Shellfish harvesting can alter benthic communities or result in competition for shorebirds that feed on target organisms. Burial or mechanical (vertical) redistribution of invertebrate infauna to deeper depths in the substrate may additionally reduce the availability of invertebrate prey to predators.

Our observations at Monomoy refuge in 2005 and 2006 suggested that some species of shorebirds remained farther from a standing person than from shellfish harvesters. Soft-shell clam harvesters in coastal New England typically use short hand-rakes, 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). Additionally, anecdotal observations of shorebirds congregating in recently shellfished areas at Monomoy refuge 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). Some species of shorebirds congregate

near clammers and seem to benefit from the disturbances that result from hand digging for softshell clams. For additional details on the direct and indirect impacts of shellfishing to migratory shorebirds and other species of concern, refer to the Shellfishing Compatibility Determination in appendix D.

Under all three alternatives, we would also continue important work with partners to determine the relative importance of tern staging sites on Cape Cod, identify problematic disturbances, and develop solutions to minimize disturbances. This collaborative effort would, we hope, lead to better protection at the most important sites, which would then result in reduced post-fledgling mortality and higher recruitment into the breeding population.

Shorebird Impacts of Alternative A (Current Management)
It is well documented that gulls are nest predators of tern and other coastal bird species, and also compete with terns and other species for nesting habitat (O'Connell and Beck 2003, Donehower et al. 2007). Under alternative A, management would include maintaining a 125-acre gull-free zone accomplished by habitat management, harassment to prevent nesting, nest removal, egg destruction, or lethal removal. In addition, maintaining a human presence from early May through August would provide further protection from predators.

There are potential impacts during banding activities as a result of handling; however, direct loss is very rare and most studies indicate that banding has no known negative impact on individual birds (*http://www.pwrc.usgs.gov/bbl/MANUAL/consid.cfm*; accessed April 2013). The bands are very lightweight and birds are not harmed during capture and banding. To minimize the effects of banding on birds and the costs of processing banding data, it is necessary to restrict the use of bands and markers to well-designed projects that will enable people to gain a better understanding of birds. Without banding, we could not determine the population and life span of birds, as well as the impact of pesticides, hunting, and development. Refuge staff mitigate for any adverse impacts by following established protocols (e.g., duration of handling, number of birds in a confined space, etc.).

Shorebird Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))
In this alternative, we take a more proactive approach to minimizing disturbance to migrating and staging birds on the intertidal flat. The most significant adverse impacts of human disturbance include displacement of shorebirds from preferred resting areas and abandonment of nests; additional impacts of human disturbance are discussed in previous sections. Developing a rapid-assessment method to identify areas that consistently support foraging or staging shorebirds or terns would reduce the levels of human disturbance and benefit species of conservation concern. Periodic monitoring of human disturbance levels would also provide data to improve how we manage this resource, and can further support efforts like recovery of the red knot and enforcing the prohibition on all horseshoe crab harvesting on the refuge.

Least terns would benefit from the additional management actions under alternative B, which may include increasing predator management, using chick shelters, and using electric or non-electric fencing. American oystercatchers would benefit from greater protection and increased efforts to band under alternative B. Impacts from banding efforts would be the same as those under alternative A. Actions involving deposition of dredge material considered in this alternative for terns would likely benefit American oystercatchers.

Disturbance of refuge wildlife and habitats may be more pronounced with commercially guided activities for wildlife observation. While field trip routes and observation sites are usually located in areas open to the general public, disturbance caused by group tours could be more intense because the number of people, and desire to get close to wildlife, may be greater than normally occurs during general public activities. Restricting the number of guides and managing how guided activities are conducted would reduce adverse habitat effects, conflicts between competing guide services, and conflicts between guided operations and other refuge users. Limiting and monitoring group size and areas accessed by visitors would also minimize impacts on the wilderness character of the refuge.

We plan to eliminate dog walking upon implementing the CCP to further protect wildlife health and to minimize disturbance. Eliminating dog walking would reduce disturbance to nesting and migratory birds and reduce dog feces left on the beach.

Under this alternative, we may slightly expand (in size and/or length) current temporary seasonal closures of intertidal habitat from the edge of the salt marsh based on habitat conditions and wildlife use. This may further reduce the impacts of disturbance to migratory shorebirds from the visiting public. Additional portions of intertidal mudflat may be closed to all human access for several weeks if these areas are consistently highly productive and support large concentrations of foraging shorebirds.

In alternative B, we would only allow non-mechanized harvest of subterranean species (softshell clams, quahogs, and razor clams) and would prohibit harvest of mussels. Hand harvesting of scallops will be allowed according to Town of Chatham and State regulations. Species that grow above sediment, such as mussels, are an important food source for many migratory birds. We would provide additional protection for priority wildlife species such as red knots and other migrating shorebirds by not allowing harvest of their food species.

Shorebird Impacts of Alternative C (Natural Processes)
Alternative C has the least protection for shorebird species; reduced predator control and decreased staff presence may present additional adverse impacts. We would not be participating in banding efforts for American oystercatcher, which would adversely impact our knowledge of this species, but may benefit individual birds as they are not subjected to banding.

Seabirds

This section addresses impacts regarding objectives A1.1, A1.4, A1.7, B1.1, B1.4, B1.7, C1.1, and C1.4. Symbolic fencing would minimize human disturbance and help achieve the target productivity levels for common terns. Regular monitoring would help enforce the posted closures. Predator management is the only practical way to reduce the impact of predation by locally reducing the numbers of mammalian and avian species that prey on common tern eggs and chicks and, sometimes, adults. These actions would limit predation on common terns and other species, especially on more vulnerable eggs and chicks, helping us reach the desired productivity levels. All three alternatives would maintain gull-free zones to benefit these species.

We would continue to use artificial nesting structures, as these have been shown to lure terns to nesting sites and to reduce predation by gulls on common tern chicks (Burness and Morris 1992). These strategies have been effective at other locations (Kress 1983) and are established management tools (Kress and Hall 2004). Least terns indirectly benefit from management activities, including seasonal closures and predator management.

Seasonal closures would benefit seabirds as discussed under Shorebirds. Habitat management activities, such as prescribed fire and invasive plant control, would benefit seabirds by improving quality habitat for nesting. Impacts from banding efforts would be the same as those previously discussed.

Herring and black-backed gulls are considered predator species if they are within the tern colonies. Laughing gulls experience a direct loss from nest destruction if the population exceeds 1,000 pairs on the refuge. The destruction of nests by scattering nesting materials and removing eggs is a direct adverse impact on these birds; however, the benefits afforded to species of conservation concern outweigh the impacts caused by this management action. Gulls benefit from the seasonal closures on South Monomoy by reducing the impacts of human disturbance and protecting their habitat (outside of the gull-free zones). Predator management of mammalian species also provides indirect benefits to these species. Laughing gulls are negatively impacted by our prescribed burns because it removes preferred vegetation; however, the purpose of these burns is to improve habitat for the tern colony and discourage nesting by laughing gulls.

Seabird Impacts of Alternative A (Current Management)
The presence of our 24-hour field camp would continue to benefit terns and other seabirds by reducing the threat of predator species. Impacts from banding activities would be the same as previously discussed.

Seabird Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))
Benefits from the field camp would be the same as in alternative A. There may be increased impacts affiliated with banding activities with an increased staff presence. Seabird species would benefit from potential new habitat through more regular prescribed fires and mechanical thinning of dune grassland and shrubland, as well as possible beach re-nourishment projects. Maintaining a 10 percent cover refugewide of invasive plants species would benefit the quality of habitat available for these birds.

Seabird Impacts of Alternative C (Natural Processes)
Least terns would have the least protection under alternative C, as we focus our management on federally listed species. Adverse impacts would likely result from decreased staff presence and reduced predator management. The removal of structures within the tern colony may provide a minor benefit as we reduce the risk of bird injuries.

Other Colonial Nesting Waterbirds

This section addresses impacts regarding objectives A1.6, B1.6, and C1.5. Other colonial nesting waterbirds, including black-crowned night-heron, egrets, and glossy ibis, benefit from seasonal closures and predator management. These impacts are the same as previously described. Under all alternatives we would continue to lethally remove black-crowned night-herons if they are found within the tern colony on South Monomoy. The benefit to protecting the tern colony outweighs the direct loss of individual birds. Research projects may provide some additional minor benefits to these species as we improve our knowledge and can make more informed management decisions.

Other Colonial Nesting Waterbird Impacts of Alternative A (Current Management)
Impacts would be the same as previously described.

Other Colonial Nesting Waterbird Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))
The expected increase in visitor use may have additional minor adverse impacts as a result of increased levels of human disturbance. These birds would benefit

from a slight expansion in the length and area of seasonal closures and increased staff presence.

Other Colonial Nesting Waterbird Impacts of Alternative C (Natural Processes)
Under alternative C, we expect to see a decrease in visitor use in the wilderness portion of the refuge, which may provide a benefit to these birds with reduced levels of disturbance. However, reduced staff presence and decreased predator management may create additional vulnerability to predators and disturbance.

Other Birds of Conservation of Concern
This section addresses impacts regarding objectives A1.6, A1.8, B1.6, B1.9, B1.10, and C1.5. Land birds, raptors, and songbirds would benefit from seasonal closures and reduced human disturbance. These birds would indirectly benefit from predator management and invasive plant control. Under alternatives A and B, there may be minor impacts from the banding station, as well as minor adverse impacts from mist-net activity and research projects. These species benefit from our increased knowledge improving our management efforts. There may be short-term adverse impacts to breeding songbirds resulting from solar panel installation at the Monomoy Point Light Station.

Effects on Other Native Wildlife

The majority of our biological survey efforts focus on bird species that breed or winter on the refuge; however, the refuge provides habitat for fish, reptiles and amphibians, invertebrates, crustaceans, and small mammals.

Marine Mammals

Marine mammals would continue to benefit under all alternatives from enforcement of the Marine Mammal Protection Act and efforts to partner with the Cape Cod Stranding Network to assist with rescues of stranded and entangled marine mammals and help monitor injured or sick marine mammals. Fishing has the potential to result in conflicts with seals over fish if anglers do not observe the 150-foot buffer distance from seals required by the Marine Mammal Protection Act. Visitor use also has the potential to disturb loafing seals. Gray and harbor seals haul out on the refuge year-round. The buffer around all seals is required by the National Oceanic Atmospheric Administration to ensure compliance with the Marine Mammals Protection Act.

Under alternatives A and B, marine mammals, particularly seals, would continue to be adversely impacted by motorized boats that are used for wildlife tours and transportation to the refuge. The refuge mitigates for impacts to marine mammals by communicating with tour guide operators about the required 150-foot buffer distance and enforcing the Marine Mammal Protection Act; however, we acknowledge there may still be instances when boats come too close and disturb resting seals. Alternative B offers the greatest benefit to marine mammals by supporting efforts to facilitate and participate in research opportunities that would contribute to improving our knowledge about priority species, including gray and harbor seals. Under alternative B, seals would benefit from the possible use of symbolic fencing for haulout and pupping sites to further reduce the impacts from human disturbance.

Alternative C would benefit marine mammals by not allowing motorized boats within the wilderness area. We anticipate fewer visitors under this alternative, decreasing the likelihood of disturbance to resting seals and other marine mammals.

Terrestrial Mammals

The management actions with potential to impact terrestrial mammals are strategies for maintaining and improving native habitats and controlling

invasive or nuisance species and would continue regardless of the alternative we select. These actions indirectly benefit mammalian populations over the long term by ensuring the continuation of quality natural habitats on the refuge for resident mammals and migratory mammalian wildlife such as bats.

USFWS

Deer

Controlling invasive plant species benefits mammals by maintaining the balance of food resources and native vegetative communities with which they evolved or adapted to for cover, nesting, and quality food resources. Those invasive species that pose the biggest threats to mammals are those that quickly colonize an area and form dense, monotypic stands. Herbivorous mammals that depend on a variety of native food resources throughout the year would be adversely impacted by monocultures of invasive plants. For smaller, insectivorous mammals, degradation of native plant diversity and structural integrity by invasion of exotics adversely impacts the biodiversity and availability of invertebrate food resources associated only with native floral assemblages.

Under all alternatives, the most significant impact would be direct mortality of mammal species identified as predators, such as coyotes. Cumulative effects on non-predatory mammals are expected to be minimal. These include species such as voles, moles, mice, shrews, and bats. Except for some species of migratory bats, these species have very limited home ranges and predator management would not affect their populations regionally. Some species of bats are migratory. Cumulative effects to these species at the flyway level should be negligible.

The cumulative effects of disturbance to wildlife under all alternatives are expected to be negligible. Maintenance activities such as prescribed burns naturally present a direct risk to some individuals among small mammals. However, the risk is low, or the impact minor at the population level and always of short duration. Most mammals can scurry out of the way or go underground. Small mammals such as mice, shrews, or voles generally burrow underneath the duff and can escape injury. The direct mortality of some mammals, such as rabbits and raccoons, may occur occasionally during prescribed burns. Another direct effect arises after a prescribed fire has removed their protective cover, exposing small rodents and rabbits to predation and, if it is winter, to cold. The extent to which they are exposed depends on the proximity of available cover and the density of raptors, foxes, and feral cats in the area. We believe the cumulative benefits of fire-improved habitat for the population of small mammals would outweigh the negative effects of exposure.

Direct impacts on wildlife can be expected wherever humans have access to an area. In general, human presence disturbs most wildlife, which typically results in a temporary displacement without long-term effects on individuals or populations. Some species will avoid areas frequented by people, such as developed trails and buildings, while other species seem unaffected or even drawn to a human presence. Vehicles are restricted to Morris Island, and harassment or taking of any wildlife other than legal game species is not permitted. The majority of public use activities at the refuge are in well-traveled corridors where we do not anticipate any significant impact from human disturbances.

Under alternatives A and B, the installation of solar panels at the light station would result in the displacement of some small mammal species. Installation of a solar panel array at the Monomoy Point Light Station would shade out small mammal ground vegetation habitat on approximately less than 1 acre. This disturbance may temporally displace small mammals, but the overall impact is expected to be minimal, especially with the abundance of similar habitat surrounding the construction site. Waste disposal measures for workers would be incorporated into all contracts under all alternatives to minimize the potential attraction for mammalian predators to construction areas and nearby nesting birds.

Under alternative B, we expect to see an increase in visitor numbers to Morris Island and South Monomoy, especially if the Monomoy Point Light Station is opened to the public for tours. Greater risk of human disturbance to mammalian species could result.

Alternative C would present the greatest impact to small mammals as a result of decreased predator management, thereby increasing the local population of predator species.

Amphibians and Reptiles

Expected impacts to sea turtles were previously discussed in the Threatened and Endangered Species section. Impacts to terrestrial amphibians and reptiles would be similar to those described under Terrestrial Mammals for management and public use activities. We would expect some minor, temporary impacts that range from displacement to direct loss from herbicide treatments in the freshwater ponds and when mosquito management is implemented on Morris Island. Controlling invasive species would benefit amphibians and reptiles by contributing to the restoration and propagation of native plants and their associated insects that are essential prey resources. Applying herbicides to control invasive species also needs to be done with care to avoid herbicide chemicals and surfactants intended for terrestrial use from getting into the freshwater ponds and wetland areas, where they would be lethal to developing amphibian eggs, larval stages, and tadpoles. Great care would be exercised to mitigate potential damage by adhering strictly to label directions.

We would expect to see an increase in disturbance to amphibian and reptile species under alternative B as a result of increased numbers in visitors to the refuge. Impacts would be the same as those discussed under Terrestrial Mammals.

We anticipate short-term impacts on amphibian species during prescribed fire activities; however, given the low-intensity duration and relatively small burn area we do not consider this to be a significant impact. According to a review by Russell et al. (1999), there are few reports of fire-caused injury to reptiles and amphibians, even though many of these animals, particularly amphibians, have limited mobility. The freshwater ponds may provide protection from fire, and activities such as breeding by aquatic species may be carried out with little interruption from fire (Russell et al. 1999).

Fisheries

Many of our management actions, such as controlling invasive plant species and maintaining native vegetation, would benefit aquatic resources and fish nursery habitats by protecting good water quality and functioning wetland ecosystems. Many marine fish use salt marshes as breeding grounds or nursery habitats for juveniles; in these places they find an abundant supply of prey such as worms, mollusks, and crustaceans, and few predators. Menhaden, flounder, sea trout, spot, and striped bass are just a few examples of game fish that use salt marshes at some point in their lives. Non-game fish such as killifish and mummichogs also rely on salt marshes and are key forage species for game fish such as striped bass and bluefish (Carlisle et al. 2002).

Negative effects on fish populations are not expected if proposed larvicides and pupacides are used according to label directions. Insects are crucial food components in aquatic habitats for fish species on the refuge.

Fishing seasons and limits are established by the Commonwealth of Massachusetts and adopted by the refuge. These restrictions ensure the continued well-being of overall populations of fish. Fishing results in the taking of many individuals within the overall population, but restrictions are designed to safeguard adequate population and recruitment from year to year.

Major concerns of any refuge fishing program are the accidental or deliberate introduction of nonnative fish used for bait, accidental introduction of invasive plants, pathogens, or exotic invertebrates attached to fishing boats, and overharvesting. Another common concern is the reduction or alteration of the prey base important to fish-eating wildlife. Refuge-specific regulations address this concern by following Massachusetts regulations and would adopt any State harvest limits that should become applicable to the fish species within the refuge's aquatic habitats. These limits are set to ensure that harvest levels do not cumulatively impact native fish resources to the point they are no longer self-sustainable. We also follow recommendations of Service fisheries biologists who may conduct periodic sampling of refuge ponds. Under alternatives B and C, effects on interjurisdictional fishes are expected to be unlikely from waterfowl hunting because the majority of the refuge would experience minimal, transitory use by hunters.

Salt water intrusion into freshwater marshes may result in direct mortality or stress on freshwater fish species from increased salinity. Large fish kills may result if saltwater intrusion is rapid. The stress of salt water on freshwater marsh vegetation may result in the loss of vegetative cover and subsequent decrease in dissolved oxygen levels due to decaying biomass.

Under alternatives B and C, expanded freshwater and salt water fishing and crabbing opportunities should coincide with increased monitoring of possible adverse effects on fish populations and habitat degradation from increased public use. Opportunities for lobstering, whelking, and crabbing (not horseshoe crabs) within the Declaration of Taking are expected to cause minimal impacts on fisheries resources. The hand harvest of scallops will have minimal impact on eelgrass beds. Non-motorized and motorized watercraft may indirectly impact fish nurseries if they destroy eelgrass meadows. Alternative C would benefit fish resources by not allowing motorized boats within the intertidal waters of the refuge wilderness. Not opening the refuge to fishing that is conducted in a manner that disturbs the bottom (e.g., dredging, otter trawling, hydraulic pumping) would reduce the likelihood of damage to eelgrass beds and benthic communities, combined with reduced overall human disturbance and reduced fishing harvest pressure.

Seals on South Monomoy Island

Jon Lanza 2013

In 2002, after extensive analysis and research demonstrating that refuge shorebirds eat horseshoe crab eggs, harvest of horseshoe crabs from the waters of Monomoy refuge was found to be incompatible. The ban on horseshoe crab harvesting within the refuge boundary would continue to protect these species as a valuable food resource for migratory

birds, while maintaining the biological diversity and environmental health of the intertidal ecosystem. Refer to the Horseshoe Crab Harvesting Finding of Appropriateness in appendix D for more information.

The larger size class shellfish sought by harvesters for human consumption is part of the available mature, breeding population for shellfish species that, like many other marine organisms, exhibit sporadic and somewhat unpredictable reproductive success. Direct and indirect mortality induced by shellfish harvest, recruitment, reproductive failures that delay population recovery, and shifts in species diversity toward smaller, short-lived and more mobile species can reduce the abundance of preferred prey items for higher trophic level predators such as amphipods, copepods, echinoderms, gastropods, crabs, fish, or birds (Peterson and Estes in press, Piersma et al. 2001, Verhulst et al. 2004).

Direct mortality or injury of shellfish can occur from harvesting rakes that contact shellfish, from trampling under foot, or from rough handling by the harvester during measuring and sorting (Heffernan 1999, Ferns et al. 2000, Johnson 2002). During shellfish harvest activities, many invertebrates are discarded, and returned to the intertidal flats near where they were taken, alive and intact, injured, or dead. Reasonably intact live individuals rebury themselves within a few minutes, leaving only moribund ones on the surface (Ferns et al. 2000). Invertebrates may be inadvertently reburied at depths exceeding their ability to migrate upwards or to extend filter-feeding structures into the water; smothering with anoxic sediments during harvesting and backfilling can cause benthic invertebrate mortality (Coen 1995, Cox 1991).

Many relevant studies have not shown long-term significant changes to benthic communities resulting from shellfish harvest, with the exception of changes in distribution of the target species. MacKenzie and Pikanowski (2004) found little to no effect on benthic communities resulting from raking in sandy, subtidal substrates, and attributed this lack of effect to invertebrates' adaptation for survival in environments where sediments are naturally re-suspended by severe storms.

Repeated physical disturbance can decrease productivity of affected communities (Odum 1985, Gray 1989). The effects of a single passage of a rake may be relatively limited, while chronic raking may produce long-term changes in benthic communities (Jennings and Kaiser 1998). If disturbance is routine, the post-disturbance benthic communities are likely to be less abundant and diverse than in undisturbed habitats (Ray 2005). Marinelli and Woodin (2002) demonstrated that disturbing the surface of soft sediments altered sediment chemistry, making it less attractive for recruiting infauna. Submerged and floating shellfish cultivation gear may also have negative impacts on essential marine habitats.

Although the rate of recovery from hand raking can be highly variable in space and time, this low-intensity traditional harvesting appeared to have little impact on benthic communities (Kaiser et al. 2001). Kaiser et al. concluded from benthic samples collected from plots more than a year after hand raking for cockles that small-scale variations in habitat heterogeneity had been altered, and suggest that, while effects of hand raking may be significant within a year, they were unlikely to persist beyond this time-scale unless larger, long-lived species are present within the community. A detailed discussion on the impacts of shellfishing to marine invertebrates and benthic fauna can be found in the Shellfishing Compatibility Determination in appendix D.

Derelict crab pots, also known as ghost crab pots, which are lost during storms or have been accidentally cut loose from their buoys by boat motors can also have a detrimental impact on marine invertebrates by catching individual species in the

traps and resulting in direct loss. This has not been an issue within the refuge boundary at the present time, nor do we anticipate it becoming one.

Terrestrial Invertebrates and Insects

The terrestrial invertebrate community is an important contributor and modifier in the functioning of refuge ecosystems and related food webs. Insects are part of every food chain and represent the most important component of food webs responsible for directly maintaining birds, fish, amphibians, reptiles, mammals, insects, and native plant resources on the refuge. As such, invertebrate community health and diversity is directly linked to our conservation of trust resources, such as all guilds of migratory birds.

Removing invasive species permits native flora to re-establish and expand. This especially benefits insects that coevolved with the native flora, particularly those that are host-specific such as the monarch butterfly, which mostly uses milkweed as the host plant for its eggs. Although the Service approves the herbicides we use in controlling invasive species because of their neutrality on animal life, should soft-bodied insects, eggs, pupae, or organisms with permeable skin come in direct contact with an herbicide or its surfactant, mortality, reduced fitness, or abnormal development may result. Many species of invasive, nonnative plants are not optimal hosts for native insects and do not contribute to the health or diversity of the pollinator community. We presume that any dependence on those plants is minimal and, therefore, removing them would not result in unacceptable losses in the insect populations.

To avoid invasive herbicide damage to host plants associated with pollinator insects, precautions can be taken, such as using back-sprayer or other similar targeting techniques. This would allow for the selective control of undesirable plants while avoiding negative impacts on nontarget beneficial larval host plants required by insect pollinator species.

The effects of prescribed fire on the upper ground layer can have consequences for insect communities. Some groups of invertebrates, such as beetles and some spiders, have been shown to increase after fire treatment (Sullivan et al. 2003). The vulnerability of insects and other invertebrates to fire depends on their location at the time of fire. While adult forms can burrow or fly to escape injury, species with immobile life stages that occur in surface litter or aboveground plant tissue are more vulnerable (Smith 2000). Seasonality of fire can also have an influence on the degree of impact for many invertebrates.

Mosquito Management

Under all alternatives, the refuge would follow the Service's Integrated Pest Management policy and the Biological Integrity Diversity and Environmental Health policy and continue to issue special use permits to the Cape Cod Mosquito Control Project (CCMCP) for annual mosquito monitoring and management. This management action only applies to several small pools within a 5-acre salt marsh located on Morris Island. Mosquito monitoring would be conducted on the basis of surveillance data indicating a need to do so, and would occur during the months of May through September.

The CCMCP would control mosquito populations by hand application of *Bacillus thuringiensis* var. *israelensis* (Bti). Like other varieties of the natural soil bacterium, *Bacillus thuringiensis* (Bt), Bti is a stomach poison that must be ingested by the larval form of the insect in order to be effective. Bt contains crystalline structures containing protein endotoxins that are activated in the alkaline conditions of an insect's gut. These toxins attach to specific receptor sites on the gut wall and, when activated, destroy the lining of the gut and eventually kill the insect. The toxicity of Bti to an insect is directly related to the specificity of the toxin and the receptor sites. The issue of Bti concentration is important with regard to impacts on nontarget organisms. The only long-

term study on the nontarget effects of Bti for mosquito control demonstrated significant adverse effects on the chironomid community of treated wetlands, and this translated into numerous significant negative effects within the food web (Hershey et al. 1998; Niemi et al. 1999). Chironomid (non-biting midge) larvae are often the most abundant aquatic insect in wetland environments and form a significant portion of the food base for other wildlife (Batzer et al. 1993; Cooper and Anderson 1996; Cox et al. 1998). Negative impacts on chironomid density and biomass could have deleterious effects on wetland wildlife food webs and could also lower biodiversity.

Bti is widely used because of its reportedly high specificity for target species and environmental safey (Ali 1981; Merritt et al. 1989). Laboratory and field studies have shown that Bti is toxic to some larval chironomids, but many factors, such as temperature, water depth, aquatic vegetation, and suspended organic matter, may act to reduce its toxicity to chironomids in the environment (Charbonneau et al. 1993; Merritt et al. 1989).

Adulticide treatments have rarely been used on the refuge, but were applied in Plymouth and Bristol counties during 2006, 2010 and 2012 as a public health emergency response to an outbreak of eastern equine encephalitis virus. Adulticides are inherently non-specific, i.e., they kill nontarget species, as well as mosquitoes. Adulticiding kills only mosquitoes that contact insecticide droplets. Although the local mosquito population is reduced for a few days, fogging does not prevent mosquitoes from re-entering the area.

No mechanical tidal circulation enhancements and restoration are anticipated under any alternatives on Monomoy NWR, including non-wilderness. Should this change, effects to nontarget organisms could include, at a minimum, temporary disturbance or displacement from their habitat. In the event that ditching, berm or levee breaching, or removal actions are conducted, effects could include injury or death to some mammal and bird species. In order to avoid impacts to wildlife, construction would be scheduled to avoid reproductive periods or extreme high tides. Removal of vegetation within the construction area can be scheduled during low tide to significantly reduce the likelihood of mammal or bird presence. As site-specific projects are identified, potential effects to wildlife will be further analyzed. Best management practices or conservation measures to eliminate or minimize any negative effects will be identified in a project-specific document.

The greatest concern the Service has with chronic mosquito chemical use is the potential degradation of biological integrity and diversity and disruption of vital food webs. Aquatic invertebrates play important roles in wetland ecology. They aid in the breakdown and recycling of freshwater and salt marsh-derived organic matter and provide important food resources for different life stages of fish, breeding and migrating birds, and other wildlife. As such, they are critically important and are directly linked to the future conservation and management of refuge-specific resources of concern listed in CCP goals and habitat objectives.

Impacts to birds, mammals, reptiles, or amphibians may occur as a result of ground access. However, bird and mammal impacts are considered limited because areas that need mosquito management are small in size and provide only limited habitat. The use of pesticides for the purpose of mosquito management may directly or indirectly affect resident and migratory bird, mammal, reptile, or amphibian populations of the refuge. Direct effects may occur from direct contact with the pesticides. Indirect effects are related to the potential reduction in the invertebrate food supply. Pesticide effects on reptiles and amphibians may occur through reductions in insects that serve as a food source (Hoffman et al. 2008), through direct individual effects from pesticide application or from trampling of individuals or habitat. Birds are often used as a surrogate for effects on reptiles and fish as a surrogate for amphibians (Hoffman et al. 2008). Bti has

practically no acute or chronic toxicity to mammals, birds, fish, or vascular plants (EPA 1998).

Migratory birds that depend on invertebrate food resources may not be mobile enough to seek alternative feeding sites if necessary post-treatment, particularly during the breeding season. Precocial young seek food items on their own. Since they are flightless, food items must be available within a relatively small home area. Therefore, reduction of invertebrate food resources within even a small geographic area may be detrimental to breeding wetland birds and precocial young.

The use of larvicides and pupacides for mosquito management are not likely to directly affect native mammal populations of the refuge. Negative effects on fish populations are not expected from proposed larvicides and pupacides. Adverse effects on mammals from Bti, methoprene, and Agnique (monomolecular film) are not expected when applied according to the label instructions. Extensive acute toxicity studies indicated that Bti is virtually innocuous to mammals (Siegel and Shadduck 1992). These studies exposed a variety of mammalian species to Bti at moderate to high doses and no pathological symptoms, disease, or mortality were observed. Methoprene is not considered toxic to mammals. Impacts to the mammalian community as a result of reduced invertebrate populations are not expected because most mammal species that inhabit wetlands of the refuge are herbivorous and invertebrates are not a primary component of their diet. Insectivorous shrews experiencing reduced arthropod food availability may be reduced post-treatment over the short term.

For more detailed information on the refuge's mosquito management, refer to the Mosquito Management Compatibility Determination in appendix D.

Effects on Wilderness Recommendations and Designation

Appendix E, Wilderness Review, describes the wilderness inventory process we undertook for this CCP. The majority of Monomoy NWR lands lying above mean low water were designated as wilderness in 1970. With the exception of excluded areas, the Monomoy wilderness boundary includes all lands extending to mean low water within the original 1944 Declaration of Taking that established Monomoy NWR. It also includes the 717-acre Nauset/South Beach accretion. Wilderness designation does not include subtidal or open water areas below mean low water. The Monomoy wilderness is currently the only nationally designated wilderness on the densely populated southern New England coastline. The 1970 wilderness designation excluded four parcels: (1) the 40-acre property on Morris Island that contains the refuge headquarters and visitor contact station; (2) the approximately half-acre Stage Island lot; and (3) the Inward Point and (4) Powder Hole areas on South Monomoy.

The refuge property on Morris Island along with two tracts on South Monomoy were excluded from the 1970 designation because they contained residences, permanent roads, summer cottages, and other facilities still being used or in private ownership. Those two wilderness designation exceptions on South Monomoy, totaling 595 acres, are Inward Point (432 acres) and Powder Hole (163 acres). Although not included in the wilderness designation because they contained summer cottages, historic light station structures, and other facilities then in use or private ownership, Congress expected that they would be designated as wilderness in the future once the cabins and other structures in these two areas were removed. Additionally, Congress directed the Secretary of the Interior to manage the entire area consistent with the concept of wilderness (House of Representatives, Report No. 91-1441).

In our wilderness inventory, we evaluated whether we could maintain, over the long term, the quality of wilderness values and character without compromising

our ability to meet refuge purposes and the Refuge System mission. We considered impacts from existing and planned resource and public use programs and activities based on the criteria that define a wilderness area: generally appears to have been affected primarily by the forces of nature, with the imprint of man substantially unnoticeable; has outstanding opportunities for solitude or a primitive and unconfined type of recreation; has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and may also contain ecological, geological, or other features of scientific, educational, scenic, or historic value.

No current non-wilderness portions of Monomoy NWR possess wilderness character sufficient for wilderness study area designation due to the remaining presence of some human structures and further detailed study is not planned to be conducted during the 15-year plan period. The refuge will undergo another wilderness review in 15 years as part of the next planning cycle, at which time wilderness study area designation and the wilderness study and recommendation phases will be reconsidered for the Inward Point and Powder Hole areas. We may also conduct a wilderness review prior to the next planning cycle should significant new information become available, ecological or other conditions change, or we identify a need to do so.

Wilderness Impacts Common to All Alternatives

All three alternatives manage the existing Monomoy wilderness to simultaneously secure an enduring resource of wilderness and accomplish refuge purposes in a way that preserves wilderness character. In all alternatives, we will continue managing the existing Monomoy wilderness and the Inward Point and Powder Hole non-wilderness exclusions to maintain or enhance their 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 accord with Service wilderness stewardship policy (610 FW).

Other than boats, the use of motorized vehicles, motorized equipment, and mechanical transport in the Monomoy wilderness would be allowed only for emergency purposes or when necessary to meet minimum requirements for administering the area as wilderness and accomplishing refuge purposes. Proposed or new refuge management activities, including the need to use motorized vehicles, motorized equipment, or mechanical transport for administrative purposes, would be evaluated through a minimum requirements analysis and NEPA compliance to assess potential impacts and identify mitigating measures to protect wilderness character.

The existing baseline character (Sudol 2012) of the Monomoy wilderness, and its natural values and opportunities for solitude and primitive recreation, will remain effectively unchanged under any CCP alternative. We would adjust our refuge management strategies and techniques to comply with the provisions of the Wilderness Act and Service wilderness management regulations (50 CFR 35) and policy (610 FW 5) to prevent degradation of wilderness character, natural values, and outstanding opportunities for solitude and primitive recreation. None of the alternatives propose actions that would directly or indirectly degrade the wilderness character or jeopardize the roadless character, size, or outstanding ecological or scenic features of the Monomoy wilderness or the Inward Point and Powder Hole inventory areas.

Monomoy NWR and surrounding areas have a long history of human use. The Inward Point inventory area includes the site of the former Monomoy Branting Club and seasonal camps. The Inward Point area is nearing but not yet free of visual evidence of permanent or human-made structures. While all the camps

that were located in this area when excluded from the original wilderness designation have since been removed, utility poles, building foundations and cisterns are still visible. The Powder Hole inventory area includes sites of the former Whitewash Village fishing community, where little evidence remains today, and the former Monomoy Point Lifesaving Service and Coast Guard Stations. In addition, the Powder Hole area also includes the "cherry stem" access trail corridor and approximately 4-acre site of the existing Monomoy Point Light Station buildings, designated on the National Register of Historic Places. These buildings and the remains of other structures, such as concrete building foundations, water cisterns, and utility poles, are signs of past human use and occupation that continue to serve as reminders that the Powder Hole and Inward Point non-wilderness areas have not yet attained a primeval, undeveloped, and natural condition. Restoration of the Monomoy Point Light station buildings began in 2010 and partial renovations were completed in 2012. The buildings were renovated firstly to preserve their National Historic Register value, and secondarily to accommodate staff during seasonal fieldwork.

Significant progress toward achieving wilderness character was made in both areas since 1970. Continuing to apply wilderness stewardship principles in both areas through the 15-year planning period will bring them still closer to achieving wilderness character, and they may once again be reviewed by the Service for suitability as additions to the National Wilderness Preservation System.

Human developments on the mainland and motorized boats are visible during clear weather from most locations within the Monomoy wilderness. It is also apparent that primeval, natural, and non-anthropogenic processes are at work, especially the constantly shifting sands and intertidal substrates that dominate within the Monomoy wilderness. Although the use of motorized vehicles are prohibited within the Monomoy wilderness, motorized equipment such as motorboats and aircraft introduce noise disturbance that may influence the distribution of wildlife and reduce the wilderness experience for some public visitors. This impact is reduced by the specified location of two boat landings and the minimum altitude of 2,000 feet for all aircraft flying over the refuge.

The Service's Wilderness Study Report (January 9, 1967) recognized that fin fishing and shellfishing have been significant factors in the economy and life of the local people and continue to provide a livelihood for mainland residents. Shellfish harvest using traditional hand raking methods within the Monomoy wilderness also potentially provides a rare, outstanding opportunity for unconfined, primitive outdoor recreation or solitude in a primarily natural-appearing coastal barrier system landscape. Non-mechanized shellfish harvest from intertidal refuge areas otherwise open to public use affords refuge visitors an opportunity to increase their understanding and appreciation of the refuge, its resources, resource management, and refuge regulations along with traditional, local, cultural practices. Shellfish harvesting on intertidal flats visible from or within the Monomoy wilderness may result in a diminished degree of solitude for some wilderness users, but should not adversely affect the overall wilderness character of the Monomoy wilderness.

The vast majority of the Monomoy wilderness will remain essentially unvisited and virtually undisturbed by intertidal shellfish harvesting. Visible impacts from hand digging are temporary, generally lasting a few weeks before all traces of digging are gone from a harvested area. Scrapes left on the edge of the flats from boat propellers are evident for quite some time. These physical disturbances are most evident near shellfish harvest sites but are not expected to significantly compromise the perception of naturalness of the Monomoy wilderness landscape nor impact the wilderness user experience (Cole 2002, Hendee and Dawson 2002).

With typically long sight-distances across Monomoy wilderness' rolling, nearly treeless, intertidal and coastal barrier landscape, too many individuals encountered or observed during visits by other Monomoy wilderness users can detract from the sense of solitude experienced by wilderness users (Stankey and Schreyer 1987, Hendee and Dawson 2002). Intertidal shellfish harvest use is still relatively dispersed across the intertidal flats open to public use, and offers outstanding opportunities for solitude and unconfined, primitive outdoor recreation that can be experienced by other Monomoy wilderness users. At this time, the level of intertidal shellfish harvest does not and is not expected to adversely impact the wilderness character of the Monomoy wilderness.

At present, it seems that nearby developments have not trammeled the wilderness' physical processes. Because most of the beaches north of Monomoy NWR are part of the Cape Cod National Seashore, the threat of deleterious coastal development appears low. The global danger of climate change may have a series of consequences on Monomoy NWR, the most serious of which is sea level rise and perhaps increased storm event frequency and magnitude. Some habitats may shift, but Giese (2010) predicts that the historical coastal processes of accretion and erosion should continue.

The Monomoy wilderness and the Inward Point and Powder Hole inventory areas are currently accessible only by boat. In general, however, Monomoy NWR is subject to public entry at many locations along its shoreline that may affect solitude. The limited topographic relief and generally low-growing or sparse vegetation means that when human intrusions occur, they are often observable from considerable distances. At the time of its designation, the Service recognized that the preservation of the Monomoy wilderness offered a special mission: "It is a natural refuge for birds and an ideal retreat for people willing to undertake the journey for the sake of its rewarding seclusion." Under all alternatives, the refuge's outstanding opportunities for solitude and primitive recreation would be preserved and available consistent with seasonal closures.

Sunset on the refuge

Ravin Thomasson 2013

All alternatives propose the use of prescribed burning to reduce habitat suitability for nesting laughing gulls (a competitor species of terns), increase habitat for nesting terns, and reduce shrubby vegetation that provides shelter for mammalian predators. Impacts from fire management are discussed under Effects on Air Quality and Effects on Soils.

Under all alternatives, the refuge would continue to prepare minimum requirements analyses (MRA) to evaluate proposed refuge management actions and determine how they can be conducted to minimize their impact on wilderness character. In addition, we would develop a detailed wilderness stewardship plan to sustain these wilderness values in perpetuity. Refuge management strategies and techniques would be chosen to comply with wilderness stewardship principles and prevent degradation of wilderness character. All refuge management activities and uses that would require use of motorized vehicles, motorized equipment, and mechanical transport would be evaluated through a minimum requirements analysis, either on a programmatic or case-by-case basis, to determine if the activities are necessary and to identify measures to mitigate impacts to

wilderness character. Additionally, proposed refuge management activities that modify ecosystems, species, or natural processes would be subject to the MRA process. We would conduct or authorize such activities only if we demonstrate that it is necessary both to meet the minimum requirement for administering the area as wilderness and to accomplish refuge purposes.

Wilderness Recommendations and Designation Impacts of Alternative A (Current Management)

None of the proposed management actions under any alternative would adversely impact the untrammeled, undeveloped, and natural qualities of the wilderness or its capacity to provide outstanding opportunities for solitude or a primitive and unconfined type of recreation.

Refuge visitors are currently only permitted during daylight hours and are not permitted to camp overnight on the refuge. Although refuge staff do stay overnight in tents for short periods at a primitive, seasonally operated field camp or at the light keeper's house, the field camp is temporary and removed annually after the bird nesting season ends. Within the Monomoy wilderness, humans are visitors who do not remain. Visitors to the Monomoy wilderness can see from horizon to horizon across open grassland and undulating dunes to vast open water, and feel unconfined and small.

Some ways that refuge staff and volunteers conduct resource management, such as the base camp near the tern colony, roseate tern attraction devices, using blinds to collect biological information or to control predators, have short-term impacts to the wilderness character. Some birding groups exceed a maximum size of 20 and can impact the sense of solitude. Visitors who choose to recreate within the wilderness may engage in activities such as swimming and sunbathing that could impact the wilderness experience for other visitors who seek the sense of solitude and primitiveness of Monomoy wilderness. However, all these uses or practices are short-term and are either done in an area that is closed to the general public or are isolated in and of themselves, with refuge visitors rarely disturbed by other visitors.

This alternative would implement a prescribed burn every 3 to 5 years within a 35-acre unit in the Monomoy wilderness in order to restore a more natural fire regime while improving habitat for the tern colonies. For the most part, however, the Monomoy wilderness would continue to be impacted primarily by natural forces. There would be no changes in land use or land ownership and no new or expanded refuge management activities or refuge uses that would significantly alter the existing physical landscape of the wilderness. For most of the year, wilderness visitors would experience solitude that is unique among the Atlantic seaboard barrier beaches and islands, all within sight of exceptionally popular tourist destinations on the Cape Cod mainland.

As part of the Service's effort to reduce energy consumption, alternative A would continue to seek funding to develop alternative energy at the Monomoy Point Light Station. Should funding become available and construction of a solar panel array at the Monomoy Point Light Station begun, all efforts would be made to keep the wilderness area untrammeled by confining construction activity to the existing trail and boat landing outside the wilderness. The proposed solar panel array would cover a surface area of approximately 4,000 square feet. Solitude within the Monomoy wilderness on South Monomoy would temporarily be interrupted, as there would be a higher than normal amount of people on the island and increased noise during the construction phase of this project; that would return to normal once construction is completed. Transportation of renewable energy system components to and from the light station would be on an existing abandoned road footprint and would avoid sensitive habitat and minimize impacts on the wilderness and other environmental values.

The Monomoy Point Light Station site is an already developed non-wilderness site; the addition of a solar array at this site under alternative or B would add a new unnatural, i.e., human-made, feature visible from within portions of the Monomoy wilderness. With the exception of a solar panel array, no other areas would be developed and the naturalness of the environment would otherwise remain the same. The refuge would prepare a MRA prior to starting work on the proposed solar panel array to ensure that the project is carried out in a manner that does not degrade the untrammeled, natural, primeval, undeveloped wilderness character or opportunities for solitude or unconfined primitive recreation of the Monomoy wilderness. In addition, we would employ best management practices.

Wilderness Recommendations and Designation Impacts of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))

Under alternative B, all management actions in the Monomoy wilderness would be evaluated and modified as necessary to ensure wilderness character is preserved. This may result in modifying how we conduct certain activities, if conducted at all. We would still conduct active habitat management, but would ensure that we use the simplest tools possible and conduct the management in a manner consistent with the protecting wilderness values.

Under alternative B, the refuge expects the greatest increase in public use. This could have impacts on the wilderness values of solitude and primitiveness, but we do not anticipate that it would significantly detract from the overall wilderness character of the refuge or Monomoy wilderness. It is possible that having a majority of the visitors arrive by concessionaire would decrease solitude in the immediate vicinity of the pickup and drop off locations but could increase solitude elsewhere on the refuge if the majority of visitors arrive at the refuge via a concessionaire rather than their own motorized transportation. Alternative B explores the possibility of opening the historic Monomoy Point Lighthouse to the public for tours. In order to maintain the wilderness character of the Monomoy wilderness, we would likely limit group size, frequency, and duration of visits on South Monomoy. Hiring a wilderness ranger would benefit the Monomoy wilderness by raising awareness about its importance and value, and educating the public about wilderness stewardship and ethics.

Alternative B would place a greater focus on wilderness stewardship in outreach and education programs on the refuge. The completion of a wilderness stewardship plan and obtaining baseline data regarding visitor use thresholds within the wilderness would allow us to implement a minimum access program to reduce any potential adverse impacts on wilderness character. Implementing a limited group size access pass would further enhance our ability to manage the refuge to maintain outstanding opportunities.

Alternative B proposes prescribed burning within 90 acres of the Monomoy wilderness, a 55-acre increase compared with alternative A. However, as this management action aims to restore natural processes in a fire-dependent ecosystem, we do not anticipate any significant impacts beyond those already addressed in Effects on Air Quality and Effects on Soils.

Impacts from the proposed installation of solar panels would be the same as described under alternative A.

Wilderness Recommendation and Designation Impacts of Alternative C (Natural Processes)

Alternative C would most likely provide the greatest benefits to sustaining the wilderness characteristics of solitude, primitive recreation, and being affected primarily by the forces of nature. Management actions such as removing all signs and only allowing nonmotorized transportation within the Monomoy wilderness would contribute to the criterion of being “affected primarily by the forces of nature” and improve opportunities for “solitude or primitive and unconfined recreation.”

The decision not to install solar panels at the Monomoy Point Light Station would not necessarily benefit or adversely impact the wilderness character, as this area is already developed and the structure is not located within designated wilderness. Management actions to not maintain the light station structures and decrease the use of boats for staff transport to North Monomoy Island and South Monomoy would further benefit the values of wilderness character.

Effects on Public Uses and Access

As described previously, the Cape Cod region is a major attraction for outdoor recreation enthusiasts. Although the refuge is not typically the primary destination of most visitors, it does enhance the experience by offering public access to premiere sites with outstanding opportunities for wildlife-dependent recreational activities. Since refuge lands are held in the public trust by the Service, access is generally allowed for compatible, priority, wildlife-dependent public uses. Uses are limited when Federal trust resources will be impacted or when the activity will detract from achieving refuge purposes or the refuge System mission. Use limits also occur if a commercial use or refuge economic activity does not contribute to the purpose of the refuge or when administrative resources are not available to ensure a safe, quality experience for visitors. Monomoy refuge is currently open to five priority wildlife-dependent public uses: fishing, wildlife observation, photography, environmental education, and interpretation. Other popular activities allowed on the refuge include, but are not limited to, sunbathing and motorized and nonmotorized boating. In the text that follows, we describe in general terms the beneficial and adverse impacts of these uses. For more specific information on the potential beneficial and adverse impacts of these uses, especially in relation to alternative B, refer to the attached compatibility determinations (appendix D).

Impacts on Public Use and Access Common to All Alternatives

Regardless of the alternative, Monomoy NWR would remain open to five of the priority wildlife-dependent public uses: wildlife observation, wildlife photography, fishing, environmental education, and interpretation. Opportunities to observe and photograph wildlife exist daily in designated areas on the refuge, exceping seasonal closures to benefit certain wildlife species that are particularly sensitive to human disturbance. We would continue to provide the public with wildlife interpretation and environmental education opportunities. To support public use, we would continue to maintain refuge facilities including a refuge headquarters, visitor contact station, maintenance facility and dormitory on Morris Island, public restroom on Morris Island, the Morris Island and Stage Island parking lots, Morris Island Trail, and interpretative kiosks. Under all three alternatives, the refuge would explore ways to implement recommendations from the transportation study, including shuttle service, improved signs, and bicycle corridors.

Of the management activities that would not vary by alternative, the following would benefit or adversely affect public use and access on the refuge: protecting land, maintaining facilities, and implementing existing priority public use opportunities. A discussion of the general impacts follows.

Operating Hours—In all the alternatives, we would continue to open the refuge for public use from ½ hour before sunrise to ½ hour after sunset, 7 days a week. Access to Morris Island would continue to be allowed 24 hours a day, 7 days per week, for surf fishing. However, unpredictable emergency situations may arise on the refuge resulting in closures.

Existing Priority Public Use Opportunities—The beneficial impacts of providing the existing level of wildlife-dependent activities include helping meet existing and future demands for outdoor recreation and education, as documented in the State Comprehensive Outdoor Recreation Plan (MA EOEEA 2006). Anglers, birders, and photographers would find high quality opportunities to engage in their favored pastimes. Visitor use is increasing over time as local residents and visitors become more aware of refuge opportunities, and as we progress in

Ravin Thomasson 2013

Wildlife photography is a popular activity at the refuge.

creating new facilities and programs. The economic benefits of increased tourism likely would also benefit local communities.

Eventually, the level and means of use resulting from this increase in visitation could change the nature of the experience for many visitors. Some may choose to forgo certain recreation due to issues of crowding or behavior, or will go elsewhere. Because currently the refuge provides opportunities for only a small portion of the area's visitors, if that shift occurs, it is not imminent and would likely occur outside the 15-year period of this plan. If it does occur, it could put additional strains on other public lands, or diminish the refuge contribution to the broader Refuge System mission. We would work to avoid that by continuing to moderate our programs and facilities to minimize conflicts among users.

Maintaining Facilities—Having well-maintained visitor facilities is important for encouraging and welcoming visitors to public lands. It reflects on the Service's responsibility to spend taxpayer dollars effectively and efficiently. It is also important to protect public safety and refuge resources, both of which can be directly impacted or compromised when facilities deteriorate. Under all alternatives, we would continue to take this responsibility seriously and insure all facilities are up to Service standards and safe conditions.

Wildlife Observation and Photography—Opportunities to observe and photograph wildlife exist daily in designated areas on the refuge, except for seasonal closures for wildlife that vary in space and time. We would continue to maintain a self-guided interpretive trail and two viewing platforms in the headquarters area, allow canoeing and kayaking within the refuge's waters, and support opportunities for commercial boat tours (motorized (alternatives A and B) and non-motorized within the refuge wilderness (alternative C)) through a concession or special use permit to provide visitors with wildlife viewing and photography opportunities. The refuge also supports occasional wildlife-related events such as birding field trips and special events, which would continue under any of the alternatives.

Guided tour activities may also conflict with other refuge users. For example, commercial tours would most likely use the same areas as independent wildlife viewers, kayakers, canoeists, and anglers during open seasons. Unregulated or inadequately regulated commercial guiding operations may adversely affect the safety of other refuge users, the quality of their experience, and the equity of opportunity. Proposed stipulations for commercial guides should mitigate these concerns by volume and space restraints.

Environmental Education—As regional tourism and coastal populations increase, the demand for local outreach and environmental education programs is also increasing. In all the alternatives, we would continue to provide at least limited environmental education and outreach. That includes hosting college or public school field trips as requested and as timing and resources allow, taking part in local events, speaking to local organizations, releasing newspaper articles, and providing refuge brochures to chambers of commerce and information centers upon request.

Staffing is a limiting factor in the refuge's ability to provide additional opportunities for environmental education. The renewed involvement with our Friends group, volunteers, and partners is essential to the long-term success of this wildlife-dependent activity.

Interpretation—We would continue to provide interpretive materials such as information signs, brochures, and a refuge Web site, and develop interpretive exhibits that inform the public about the Refuge System and wildlife present at Monomoy. In all the alternatives, we would continue to provide at least the current level of interpretation. Interpretive activities that coincide with other public use activities would not disrupt them.

Wilderness Protection—In all the alternatives, we would continue to manage the Monomoy wilderness as part of the National Wilderness Preservation System and adhere, as much as possible, with the Wilderness Act and Service wilderness policy (610 FW 1-5). Preservation of the wilderness character of the refuge and implementation of our wilderness stewardship plan, once written, are important commitments.

Fishing and Shellfishing—Fishing is a priority, wildlife-dependent use. We would continue to allow fishing in accordance with State and Federal regulations on all refuge lands and waters otherwise open to the public from ½ hour before sunrise to ½ hour after sunset. We would also allow 24-hour access for surf fishing on Morris Island. Fishing in the offshore open waters above the submerged lands would be conducted in accordance with State and Federal regulations. This includes demersal long line fishing; mid-water trawl fishing; hook and line/rod and reel fishing; lobster, crab, and whelk pot fishing; and, hand harvest of scallops. Seasonal closures to protect wildlife would vary each year based on their nesting, breeding, and staging activities, as well as changes in habitat due to dynamic shoreline changes. These closures would occur regardless of the alternative selected, although the size of the area and length of the closure would be extended under alternatives B and C. These limits are set to ensure that harvest levels do not cumulatively impact native fish resources to the point they are no longer self-sustainable.

The Service will continue to allow the harvesting of some shellfish under all alternatives, but with some variance in the species that can be harvested. The harvesting of clams in the intertidal and nearshore zones in the Cape Cod region is not only significant to the State's economy, but is also a traditional and historic way of life for the community of Chatham. We would continue to allow Chatham residents and refuge visitors to harvest some shellfish using traditional, non-mechanized, hand raking methods in accordance with town regulations. All areas, unless otherwise posted, would be open to the public for this use. Seasonal closures would continue to limit some portion of the refuge for this use. As mentioned above, the size of the area and length of the closure would be extended under alternatives B and C. We have no current information on the level of harvest or the number of harvesters using the refuge intertidal areas, as the Town of Chatham issues shellfishing permits. Monitoring the level of use and harvest within the refuge's Declaration of Taking is needed to determine how Federal trust resources are affected. Other potential impacts of fishing and shellfishing are detailed in the findings of appropriateness and compatibility determinations in appendix D.

Impacts on Public Use and Access of Alternative A (Current Management)

Demand and Access—Areas on North Monomoy Island and South Monomoy would remain open to the public from October to March, with designated closures during the nesting season. The majority of the refuge would remain open and we do not expect significant impacts to public access. Under the current alternative, access to the portion of the refuge at Morris Island would continue to be a problem during the summer due to limited parking. Transportation on the

refuge would remain restricted to foot travel, although boats would continue to be allowed to land anywhere along the refuge shoreline (with the exception of the seasonally posted closed areas). Although these actions may limit public access to some extent, we believe the benefits resulting from these actions far outweigh any adverse effects.

Visitation is expected to increase slightly in alternative A. Eventually the level of use could change the nature of the experience for many visitors. Should that occur, some visitors would choose either to give up certain recreation due to issues of crowding or behavior, or to visit alternate locations. We do not anticipate that this increase would adversely affect resources or their use or enjoyment by visitors, because the increases we project for the refuge would be well distributed.

Public Use Opportunities—Alternative A would maintain the current level of programs and types of public use opportunities on the refuge. We would not expand permitted uses, programs, or facilities. The refuge would continue to prohibit the following activities: camping, bicycling off-road, kite boarding, use of all-terrain vehicles or off-road vehicles, and use and landings of personal water craft (wave runners, jet skis). Dogs would still not be permitted on North Monomoy Island and South Monomoy. These activities are deemed inappropriate on the refuge, have the potential to adversely affect refuge resources and wildlife, and can cause conflict with members of the public engaged in priority public uses, i.e., fishing, wildlife observation, and photography. We believe the benefits associated with prohibiting these uses are greater than any adverse effects resulting from limiting these activities.

Wildlife-dependent priority uses and non-priority public use opportunities would continue to be provided, albeit to the extent allowed by current funding and staffing. Without sufficient law enforcement staff to enforce regulations, there is the continued potential for visitors to engage in activities deemed not appropriate with refuge purposes, such as entry into seasonally closed areas, allowing pets off leash, camping, or kite boarding.

Wildlife Observation and Photography—According to results from the USGS National Wildlife Refuge Visitor Survey Results: 2010/2011 (Sexton et al. 2011), the top three activities visitors engaged in during their visit to the refuge were hiking, wildlife observation, and bird watching.

Peter Paton 2013/University of Rhode Island

American oystercatcher banding

Being in a natural, undeveloped area and experiencing a serene environment are equally important to their refuge experience as well as the trails that afford this opportunity (Sexton et al. 2011). These are activities that are equally important to consumptive and non-consumptive use visitors. Survey respondents reported that they were satisfied with the photography and bird watching opportunities on the refuge (Sexton et al. 2011). Adequate opportunities for wildlife observation (trails, viewing platform) would continue to be provided.

Environmental Education, Interpretation, and Outreach—The refuge would continue to host college or public school field trips as requested and as resources

allow. A growing percentage of the local and regional community would continue to become aware of the refuge through our outreach program. We would continue the activities we describe in chapter 2, such as information kiosks and seasonal interpretive programs. Under alternative A, we would continue to provide at least the current level of interpretation, as well as explore the appropriateness of virtual technology to conduct interpretation. Interpretive activities that coincide with other public use activities would not disrupt them. Other beneficial impacts of the current level of onsite interpretative activities are incorporated in providing general access and opportunities discussed previously.

Environmental education would not become more developed under this alternative. Staffing is a limiting factor in the refuge's ability to provide additional opportunities for environmental education. A formal, curriculum-based program would not become available to area schools, and the number of field trips supported by the refuge is not likely to increase. We would educate a limited number of people about the significance of the refuge for birds and other wildlife. As a result, our ability to foster an appreciation of conservation and encourage the public to make environmentally responsible decisions would remain at low levels.

Although this alternative would explore virtual technology as a tool to reach a wider audience, the onsite resources would continue to be overwhelmed. The visitor contact station would not be expanded and would continue to be inadequate to meet the needs for onsite environmental education and interpretation programs.

Fishing and Shellfishing—Same as the fishing and shellfishing impacts described under the section on "Impacts on Public Use and Access Common to All Alternatives."

Impacts on Public Use and Access of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))

Demand and Access—Alternative B would increase opportunities for wildlife-dependent public use and access by enhancing those programs and facilities at the refuge. Providing new public recreation opportunities would enable people to participate in outdoor activities where they otherwise could not. Increased public awareness, improved community relations, and enhanced support of the refuge mission would result as a byproduct of this new interaction. A 25 percent increase over current visitation and an increase in opportunities for compatible, wildlife-oriented, consumptive and non-consumptive uses would combine to increase the risk of conflicts between humans and wildlife and habitat damage. We would help meet demands from the communities where we are located, and from tourists, for outdoor recreation and education, as documented in the Massachusetts Comprehensive Outdoor Recreation Plan (2006). By attracting visitors from outside the area, local communities should experience economic benefits from sales of food, lodging, and supplies.

The development of an alternative visitor contact station in either downtown Chatham or Harwich with shuttle services to Morris Island would allow the public greater access, reduce traffic congestion, and ease parking problems. A concessionaire would be used as the primary means of access to North Monomoy Island and South Monomoy. The benefits of a concessionaire include protecting the natural environment; providing additional opportunities for safe and quality recreational experiences and guided trips; ensuring that visitors practice a "leave no trace" ethic on the refuge; disseminating information about the refuge to the general public; and contributing jobs and income to the local community. Concessionaires also furnish the convenient access to the refuge and are a benefit to those individuals who do not have a private boat or are not physically able to kayak across the Morris Island channel into the Southway. We would also coordinate with the Town of Chatham to implement some of the strategies from the alternative transportation study, such as a multi-use bicycle and pedestrian path along the causeway and improved directional signs. A concessionaire

operating from an offsite parking location would also reduce traffic congestion and ensure visitors would get to the Morris Island trail, or to fish on Morris Island, as they would not have to worry about finding a parking spot.

Paid parking may deter some visitors, but the effect is expected to minimal. Adverse effects due to seasonal closures of selected areas on North Monomoy Island and South Monomoy are expected to be minimal, as described under alternative A.

Implementing a wilderness access permit may also reduce the number of visitors accessing North Monomoy Island or South Monomoy. However, the permit would be easy to obtain and we do not expect any substantial effects following implementation.

Public Use Opportunities—Under alternative B, dogs would not be allowed anywhere on the refuge, including Morris Island and Nauset/South Beach. In addition, beach sports, grilling, and shade tents would no longer be permitted on the refuge, including North Monomoy Island and South Monomoy Island. Dog and pet walking is not a wildlife-dependent activity and is not considered appropriate on the refuge. There may be a slight reduction in the number of visitors (particularly repeat visitors who are primarily on the refuge to walk their dogs). This would inconvenience and anger some refuge visitors, but we believe the overall impact would be minor, as there are other areas in the vicinity of the refuge available for dog walking where dogs are allowed. Furthermore, the benefits associated with prohibiting this use on the refuge outweigh any adverse effects caused by discontinuing the use. Some visitors may be upset that some beach use activities would not be allowed, but others will appreciate that this restriction will result in less disturbance to wildlife and will improve the quality of the visitor engaged in wildlife-dependent activities.

Proposed Infrastructure—As we state in chapter 3, we propose to expand our facilities for environmental education and visitor services programs and make incremental progress in constructing new interpretation and information signs on the refuge. We predict that constructing these facilities would increase public awareness of, and visitation to, the refuge and would enable staff to provide better visitor service.

Constructing new interpretive and informational signs would provide opportunities for providing a conservation message to visitors, increasing their awareness, and possibly, their support of the refuge. The addition of a visitor contact station in the local community would further increase the effectiveness of an expanded visitor services program, as well as improve the refuge's exposure to new visitors who would receive information about the refuge.

We would expect a certain level of inconvenience during the construction of refuge facilities. Our use of practices that alert and safeguard refuge visitors should mitigate those effects somewhat. The adverse effects generally are short-term, and more than offset by the long-term gains in public education and appreciation.

Wildlife Observation and Photography—Wildlife observation and photography opportunities would increase under this alternative with installation of a critter cam, designated photography locations, and a concession-based operation that would provide interpretative natural and cultural history tours. We would also work to better orient, inform, and guide the visiting public, and help create a more fulfilling wildlife observation and photography experience through a variety of means, including additional roving interpreters, and trailheads. Opportunities for commercial photographers might be reduced, since we would ensure there is a direct benefit to the Service before issuing a special use permit. However,

amateur nature photographers would directly benefit from construction of an additional viewing platform or photography blind on Morris Island.

Environmental Education, Interpretation, and Outreach—Alternative B offers the greatest expansion of our environmental education and interpretive programs. Expanded programs would include developing formal programs of study to meet State and Federal education standards. This would enable more school groups to be accommodated and would likely result in a larger component of the regional population becoming aware of the refuge, its limited and vulnerable natural resources, and the need to protect Federal trust resources.

Opportunities for interpretation would also be increased and improved compared to alternative A. Alternative B would provide greater protection of beach, coastal dune, and intertidal habitats in balance with expanded opportunities for the five priority public uses. Expanded opportunities for the priority public uses, with an emphasis on wildlife observation and interpretation would be provided through a more coordinated Friends program, expanded refuge tours via a concessionaire, seasonal interpretive programs, and interpretive materials.

The visitor contact station interpretive materials would be redesigned using a formal storyline and professionally designed exhibits. These would be designed to be used in either the existing visitor contact station or a new, offsite center. We would place informational kiosks with current information on refuge mission, rules and regulations, and the Monomoy wilderness on Morris Island, and develop a self-guided interpretive brochure for the trail from Powder Hole to the Monomoy Point Light Station. A visitor contact station in Chatham or Harwich would provide additional opportunities for interpretation. We expect these actions to have an overall positive effect by increasing public understanding and awareness of the Service and refuge, and the need to protect habitats and wildlife.

More opportunities exist to provide public education and information for visitors. Those opportunities would foster more public understanding and appreciation of resource issues and needs, which could lead to increased support and funding, and positively affect fish and wildlife resources on the refuge. Increased outreach could also positively affect land use decisions by local governments and private landowners outside the refuge, leading to increased populations of fish and wildlife over a broader area.

Fishing and Shellfishing—The fishing impacts described for open water are the same as those described under "Impacts on Public Use and Access Common to All Alternatives." We would officially open the ponds on the South Monomoy to freshwater fishing during daylight hours. Under alternative B, fishing in the intertidal area, the refuge shoreline, or from refuge ponds may be affected by small expansions to existing seasonal closures to protect wildlife (e.g., shorebirds, waterbirds, seals, and horseshoe crabs).

Under alternative B, we will require commercial fishing guides to obtain a special use permit to ensure high quality opportunities are offered. The refuge expects these guides would help increase quality fishing opportunities for less experienced anglers by ensuring an added level of safety in a remote, exposed, and occasionally dangerous area. We would also conduct an annual fishing event to raise awareness of this recreational activity on the refuge and further help promote the Refuge System and Service.

Alternative B proposes to prohibit the harvest of shellfish that grow above the sediment line except for the recreational harvest of scallops using hand harvest methods only. We would allow only the harvest of subterranean species of shellfish (e.g., softshell clams, quahogs, and razor clams) and only using hand tools and no other artificial means, such as salt or chlorine. Mussels would not be allowed to be harvested. We would prohibit the activity of mechanical harvesting, (e.g., dredging) any where on the refuge.

Within the Monomoy wilderness, we would also prohibit the use of carts or any equipment with wheels. This restriction on the use of carts to move clams from harvest sites to boats would result in some clammers avoiding the refuge. In alternative B, we also take a more proactive approach to minimizing disturbance to migrating and staging birds on the intertidal flat which might affect access for shellfishing. We would conduct outreach and education to visitors to explain the sensitivity of the area and the need for active management. We would also more closely monitor the potential impacts of harvest levels and, should it be necessary, implement additional regulations that protect species and habitats of concern. We would obtain harvest records from the Town of Chatham Shellfish Warden and work more closely with the town and State to promote and ensure sustainability of the shellfish resource within the refuge. While the same areas are open to scallop harvesting under alternatives A and B, we would only allow hand harvesting of scallops under alternative B. This would eliminate opportunities for people who harvest scallops by other methods.

Waterfowl Hunting—Alternative B would be open to waterfowl hunting. This use would only occur in designated areas within the declaration of taking (open water boundary) and certain portions of the western shoreline of North Monomoy Island and South Monomoy, including Minimoy. Commercial waterfowl guides would be required to obtain a special use permit from the refuge prior to taking clients hunting on the refuge. The number of permits would be based on the refuge area, and permits are intended to minimize conflicts between users. If we receive comments or complaints about user conflicts, we would investigate and adjust refuge programs as needed.

Impacts on Public Use and Access of Alternative C (Natural Processes)

Benefits

Demand and Access—Alternative C would decrease opportunities for wildlife-dependent public use and access from both alternatives A and B. Under this alternative, we would no longer allow motorized transportation in the wilderness area, including intertidal waters. We would establish a concessionaire to provide non-motorized access to the refuge. Not allowing personal motor boats, nor commercially guided motorized watercraft within refuge wilderness waters, which includes the tidal waters out to mean low tide, would severely limit the public's access to North Monomoy Island and South Monomoy. This could adversely impact the relationship of the Service with the local community over the long term, though it might provide a new business opportunity for some entrepreneurs.

We anticipate that wilderness enthusiasts would benefit the most under this alternative. There would be significantly greater opportunities to experience the solitude of the Monomoy wilderness, since we expect that fewer individuals would engage in non-motorized access to the refuge. Impacts would be similar to those in alternative B if we choose to implement a wilderness access pass.

Implementing an entrance fee system may deter some visitors, but the effect is expected to be minimal. Impacts from seasonal closures are previously discussed.

Proposed Infrastructure—Impacts from proposed construction would be similar to those in alternative B.

Fishing and Shellfishing—Impacts would be the same as those under alternative B, except that we would eliminate the use of motorboats in the intertidal waters of the Monomoy Wilderness. This restriction would reduce the numbers of anglers fishing on or from the refuge shoreline, and could potentially push more anglers to Morris Island and its nearshore waters where motorboats would still be allowed. The restriction on motorboats would not impact fishing and shellfishing occurring in the open, subtidal waters above submerged lands, as these waters are outside designated wilderness. With regard to shellfishing,

the prohibition on the use of motorboats within the refuge wilderness, including the intertidal waters, would result in less shellfishing on the refuge, at least on the north and west sides of the Monomoy Islands. Similar to alternative B, wheeled carts would not be allowed in the wilderness area. However, without motorboats, clammers would need to walk further and transport their harvest by non-mechanized means to their boats, which would likely be anchored just off the flats in shallow, subtidal (nonwilderness) waters. This would increase competition for harvestable shellfish in other Chatham waters, and reduce harvests for some Chatham shellfish harvesters unless they can find alternate harvest locations.

Wildlife Observation and Photography—Wildlife observation and photography would be the same as in alternative B; however, access to these opportunities would be limited with the discontinuation of ferry services to the refuge.

Environmental Education, Interpretation, and Outreach—Impacts would be similar to those discussed in alternative B.

Waterfowl Hunting—Impacts would be the same as those under alternative B.

Effects on Socioeconomic Resources

In analyzing the socioeconomic consequences of the actions under the three alternatives, we evaluated our refuge revenue sharing, refuge visitor expenditures in the local economy, and refuge staff and work-related expenditures in the local economy.

Socioeconomic Impacts Common to All Alternatives

Under provisions of the Refuge Revenue Sharing Act, local towns receive an annual payment for lands that have been purchased in full fee simple acquisition by the Service. In Massachusetts, the payments are based on three-quarters of 1 percent of the appraised market value. The exact amount of the annual payment depends on the congressional appropriation, which in recent years have tended to be less than the amount to fully fund the authorized level of payments. For the 2011 fiscal year, the payment to the Town of Chatham was $22,533. The Service is not proposing any new fee simple acquisition, but the level of refuge revenue sharing will rise with increased land ownership in Chatham. We do not expect any major changes in the level of revenue sharing payments, unless Congress changes its annual appropriation for revenue sharing.

In the sections under each of the alternatives, the effects of visitors, commercial activities associated with the refuge, and refuge expenditures on the socioeconomic environment are assessed. For the purposes of this draft CCP/EIS, actual differences in dollars generated and lost under each of the alternative were not estimated, and only relative impacts were compared.

Wilderness Management
The socioeconomic impacts of designated wilderness areas include direct use benefits, such as recreation, community quality of life; scientific benefits, such as research and education; offsite benefits, such as increased property values; biodiversity conservation; ecological services; and passive benefits, such as conserving wild lands for future generations (Philips 2004). Often, there is general misunderstanding of the types of recreation and activities that can occur on Federal lands. These concerns and issues would be addressed in environmental education and interpretation programs about the refuge's wilderness management program. Furthermore, wilderness management activities proposed under all alternatives would have some direct beneficial impact on the socioeconomic environment of the region, as this would ensure that no development could occur on South Monomoy.

Impacts on Socioeconomic Resources of Alternative A (Current Management)

Refuge Visitor Expenditures—Refuge visitors benefit the local economy through their expenditures. Currently, about 33,000 visitors annually come to the refuge. They would continue to contribute to the local economy through consumption of goods and services, equipment rentals, and other expenditures associated

with recreational opportunities made available on the refuge. Total direct expenditures associated with refuge visits in the year 2012 accounted for more than $1 million in sales and services to the local economy. Over 95 percent of the stimulus came from non-resident expenditures. Non-consumptive activities, such as wildlife observation and beach recreation, accounted for about 85 percent of refuge activity expenditures.

Table 4.6 summarizes the total economic impact to the regional economy from expenditures related to the visitation at Monomoy NWR in 2012. The table shows that the grand total impact to the region in 2012 was over $1.5 million (Maillett 2013). These expenditures created approximately 15 jobs with an average salary of about $33,500. More than $250,000 was generated in tax revenues. General beach recreational visits accounted for the majority of the economic contributions.

Table 4.6. Total Economic Impacts of Refuge Visitation Expenditures to Monomoy NWR in 2012.

Activity	Resident Daily Expenditures	Non-Resident Daily Expenditures	Total Resident Expenditures	Final Demand	Jobs	Job Income	Tax Revenue
Consumptive Use							
Fishing: Saltwater	$11,181	$88,765	$99,946	$141,572	1.4	$47,696	$23,700
Non-Consumptive Use							
Visitor Contact Station	$6,566	$283,952	$290,518	$415,979	4.2	$139,809	$69,525
Wildlife Observation	$4,403	$190,389	$194,792	$278,913	2.8	$93,742	$46,616
Beach/Water Use	$11,170	$483,045	$494,215	$707,642	7.1	$237,836	$118,272
Total	**$33,320**	**$1,046,151**	**$1,079,471**	**$1,544,106**	**15.5**	**$519,083**	**$258,112**

Source: Division of Economics, U.S. Fish and Wildlife Service, February 2013 (Maillett 2013).

Refuge Administration—Alternative A maintains the current work force of three full-time employees. Refuge projects and base salaries would total approximately $180,000 annually. Recurring costs associated with salaries and annually completed refuge projects would total approximately $86,000 per year, and some percentage of this would be spent in the surrounding area.

The energy efficiency improvements made in 2011 at the refuge headquarters and dormitory helped to stimulate local employment and contribute to the economic recovery using funding provided under the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

Refuge Revenue Sharing—In fiscal year 2011, the Town of Chatham received about $22,500 in sharing monies. The refuge revenue sharing program (RRS) is one of two programs that distribute revenue to local governments hosting national wildlife refuges.[2] Revenue is funded by money earning operations on refuges, such as gas wells, haying, or timber harvesting, and congressional appropriations. The Refuge Revenue Sharing Act (16 U.S.C. § 715s) seeks to reimburse, "those units of local government which have incurred the loss or reduction of real property tax revenues by reason of the existence of" Fish and Wildlife Service units. The formula for the reimbursement amount is based on the number of acres of Service land in the local government unit.

[2] The payment in lieu of taxes program (PILT) is the other program and applies to Federal lands managed by several different agencies that are not subject to local property taxes. It is funded by an appropriation and operated by the Department of the Interior.

Impacts on Socioeconomic Resources of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))

Refuge Visitor Expenditures—In 2012, the refuge reported the total number of visitors to be 33,150. With an increase in visitation of 25 percent, the refuge could expect to see an additional 8,288 visitors, increasing total visitation to 41,438. Assuming that the increase in visitation is proportional among the types of visitor activities (e.g., fishing, wildlife observation, and general recreation), the expected total amount of direct expenditures associated with these visits would increase to $1.35 million, compared to the estimate 2012 direct expenditures of $1.08 million (Maillett 2013). Total expenditures (i.e., final demand) are estimated to increase to $1.93 million compared to the 2012 estimate of $1.54 million. Table 4.7 shows the breakdown of direct expenditures, final demand, jobs, job incomes, and tax revenues affiliated with a total visitation of 41,438 to the refuge.

Under this objective, the Service intends to develop and implement a recreational entrance fee program and require paid parking at the Morris Island parking lot. While both entrance fees and parking fees have yet to be established, the Service is intending for the parking fees to be required during the peak visitation season of June 1st through September 15th. During this period, a 4-hour parking limit would be enforced on a daily basis. Because alternative B does not offer any further information regarding the pricing of entrance or parking fees, an impact of the fees and associated revenue stream to the refuge cannot be estimated at this time.

Table 4.7. Total Economic Impacts Associated with Visitation to Monomoy NWR under Alternative B.

Activity	Resident Daily Expenditures	Non-Resident Daily Expenditures	Total Resident Expenditures	Final Demand	Jobs	Job Income	Tax Revenue
Consumptive Use							
Fishing: Saltwater	$13,976	$110,956	$124,932	$176,965	1.8	$59,620	$29,624
Non-Consumptive Use							
Visitor Center	$8,208	$354,940	$363,148	$519,974	5.2	$174,761	$86,906
Wildlife Observation	$5,503	$237,987	$243,490	$348,641	3.5	$117,177	$58,270
Beach/Water Use	$13,962	$603,806	$617,768	$884,553	8.9	$297,295	$147,840
Total	**$41,650**	**$1,307,689**	**$1,349,338**	**$1,930,132**	**19.4**	**$648,853**	**$322,640**

Source: U.S. Fish and Wildlife Service Division of Economics.

We would continue to support commercial guiding on the refuge, but would have a better understanding of how many guides are operating on the refuge, including when and where they are fishing (or waterfowl hunting) and what they are harvesting. Current special use permit holders that provide ferry service would not be able to continue to operate on the refuge, including the Monomoy Island Ferry, which operates out of the refuge headquarters. These local businesses as well as other individuals or organizations would be eligible to compete for a concessionaire permit, which could seasonally employ several individuals on a part-time or full-time basis each year.

Refuge Administration—Under this alternative, the draft CCP plans to increase current staffing to 10 positions, by proposing 7 additional full-time refuge employees to meet the refuge's proposed management requirements. An additional seven full-time staff would make a small contribution to employment and income in the local community. If fully funded, recurring salary and project costs would be approximately $700,000 annually. We would also need to purchase more vehicles, boats, fuel, office furniture, and supplies to support the additional staff. Many of these purchases can be made from local businesses.

We would expand the current facilities at Morris Island (headquarters/ visitor contact station, dormitory/maintenance building) through remodeling. Furthermore, we would explore opportunities for additional refuge staff onsite and offsite housing. Additionally, we would work to establish a visitor contact station in downtown Chatham or Harwich, which would include parking and a shuttle option to help increase exposure and reduce the parking issues at Morris Island. The current visitor contact station would be converted to serve predominantly administrative functions.

Impacts on Socioeconomic Resources of Alternative C (Natural Processes)

Refuge Visitor Expenditures—Alternative C has the same goal as alternative B, that is, the Service aims to increase the number of visitors by 25 percent. The economic impacts associated with a 25 percent increase in visitation over the reported 2012 number of visits would be the same as that calculated for alternative B.

Under alternative C, we would discontinue motorized ferry services to North Monomoy Island and South Monomoy. We acknowledge that this would result in the loss of revenue to the commercial entities currently providing these services under a special use permit. However, these businesses could compete for the concessionaire contract. Not allowing motorized access to the refuge would constitute a major change in the way the two current permittees operate; they would need to sell their equipment and obtain new equipment in order to provide non-motorized access to the refuge.

Alternative C also proposes to institute an entry fee that visitors must pay to enter the refuge. The entry fee proposed is $4 per car or $12 for an annual pass. The revenues from this fee would help the refuge improve visitor services. The fee would most likely be collected at the entrance to the Morris Island visitor contact station. Based on a recent survey of visitors conducted by the U.S. Geological Service, there were on average four persons in each group party visiting the refuge. Assuming that all 33,150 visitors drove into the refuge at Morris Island there would have been 8,288 vehicle trips. Again assuming that each party visited the refuge only once and paid the $4 entry fee, the total revenue collected by the refuge would be $33,150. Total revenue collection would likely be less, as a significant number of visitors visit the refuge more than once and would most likely pay for a $12 annual pass to save money. Because we lack data to estimate the number of parties visiting more than once and only have a count of total visitors, the economic analysis conservatively assumes that each visit reported is by a unique visitor visiting the refuge only once during the year.

View from the lighthouse

USFWS

Refuge Administration—Under alternative C, we would increase staffing to nine positions, by proposing six additional full-time refuge staff. This level of staffing would help ensure that the refuge could meet the objectives outlined under this alternative. Base salaries and refuge projects would be approximately $500,000 annually. We would need to acquire additional vehicles, boats, fuel, and office supplies, but less than that proposed under alternative B. Facility improvements or expansions would be the same as under alternative B.

Effects on Cultural, Historical, and Archaeological Resources

In protecting our cultural and historical resources, we are guided by specific executive orders, policies, laws, regulations, standards, and guidelines. We would comply with all appropriate legal mandates in our efforts to protect and manage the cultural resources on the refuge. Our actions that have the potential to affect archaeological and historic sites are routinely reviewed and assessed under provisions of section 106 of the National Historic Preservation Act. The most recent project requiring such review on the refuge was the rehabilitation and renovation of the historic Monomoy Point Light Station.

It is probable that unrecorded coastal archaeological sites exist on current refuge lands. Many of these are likely to include shipwrecks or Native American artifacts.

Chapter 2, Refuge Archaeological, Historical, and Cultural Resources describes in more detail the refuge's two Native American sites and 12 historic sites. Despite the presence of 14 known archaeological sites, there has been no comprehensive, professional cultural resources overview of Monomoy NWR. The likelihood of locating additional prehistoric or historic sites on the refuge is high, both due to the history of human settlement and land use on the refuge lands, and from tidal drift.

Impacts on Cultural, Historic, and Archaeological Resources Common to All Alternatives

Regardless of which alternative we select, we would protect known cultural, archaeological, and historical resources. We would continue our outreach and education and use of law enforcement, if necessary, to protect against the loss of or damage to those resources.

In all the alternatives, we would conduct evaluations before implementing any activity with the potential to affect these resources. Those evaluations would provide additional information to share in outreach and education programs.

The Service recognizes the importance of continued compliance with the National Historic Preservation Act and other Federal laws and mandates that guide the protection of these resources to ensure that known sites are protected and any sites that are found in the course of refuge management and public use are properly addressed. While no adverse impacts to cultural or historic resources are anticipated as a result of this CCP process, we will send this draft CCP/EIS to the State Historic Preservation Officer for review in compliance with section 106 of the National Historic Preservation Act. Regardless of which alternative is selected, we will consult with our regional archaeologist(s), State Historic Preservation Officer, and Tribal Historic Preservation Officer as needed to ensure compliance with National Historic Preservation Act and other applicable laws and regulations. In particular, we would continue to consult with the State Historic Preservation Officer and regional archaeologist(s) prior to conducting any ground-disturbing activities.

Refuge lands are vulnerable to artifact looting, despite our best efforts at outreach, education, and law enforcement. Refuge visitors may inadvertently or even intentionally damage or disturb known or undiscovered cultural artifacts or historic properties. We would continue our vigilance in looking for this problem, and use law enforcement where necessary. However, we also recognize we may not discover every incident. Erosion, especially along cliffs and dune beaches,

and sea level rise, are continual threats to cultural and archaeological resources on the refuge. We will promote awareness of the Archaeological Resources Protection Act and the prohibition against vandalism and removal of cultural artifacts from Federal land.

Impacts on Cultural, Historic, and Archaeological Resources of Alternative A (Current Management)

Under alternative A we would follow Service protocol to prevent the loss of cultural, historic, and archaeological resources, record items or sites as they are encountered, and comply with the provisions of the National Historic Preservation Act. We would also maintain the historic Monomoy Point Light Station. Maintenance and repairs to the light station and associated structures would help preserve those historical resources from weather damage. This alternative would not increase our knowledge of the history of the island per se; however, it would minimally ensure some action is taken to preserve what cultural resources exist on the refuge in compliance with Federal mandates.

Refuge activities have the potential to impact cultural resources either by direct disturbance during habitat and species management projects or maintenance and repair of facilities related to public use or administration and operations. Indirect impacts may occur by exposing artifacts during actions such as managing for early successional habitats or prescribed burning. Although the presence of a cultural resource in and of itself cannot stop a Federal undertaking, all undertakings are subject to section 106 of the National Historic Preservation Act and, at times, other laws. We would work to ensure compliance with section 106 during all stages of an undertaking, from planning and design through construction, to ensure the avoidance, preservation, and appropriate management of significant cultural resources.

We currently lack staff with training in the Archaeological Resources Protection Act and National Historic Preservation Act, or a refugewide cultural resources overview, cultural resources plan, and partnerships to cooperatively protect resources; this prevents us from being fully proactive in evaluating and protecting sites. Also, the limited law enforcement staff under this alternative would not allow us to adequately prevent or address Archaeological Resources Protection Act violations. We would continue to be unable to adequately maintain our historic structures, specifically the Monomoy Point Light Station, due to funding and limited staff, and probably could not address future maintenance and stabilization requirements. Increased information on the distribution and types of archaeological resources would help us better protect these sites. The light station would benefit from installation of a renewable (solar) electric-powered radiant heating system that would maintain the interior temperature and humidity levels during the winter season and help preserve the structural integrity and historical appearance of the wood-frame lightkeeper's house.

Impacts on Cultural, Historic, and Archaeological Resources of Alternative B (Enhanced Management of Habitat and Public Uses (Service-preferred))

The benefits for cultural and historic resources would increase in alternative B, because we would complete a cultural resources overview, maintain an inventory of known and newly found sites and structures, develop a cultural resources management plan, conduct archaeological surveys to determine the limits and integrity of the Whitewash Village archaeological site complex on South Monomoy, and assess the condition of the two known Native American sites on Morris Island.

This alternative would allow us to make an important, positive contribution toward meeting our cultural resource public trust responsibilities. We would have sufficient resources to survey, map, catalog, monitor, and protect archaeological and historic resources. We would establish a protocol with the Massachusetts Board of Underwater Archaeological Resources for the examination and assessment of historic shipwreck remains that may appear within or near the refuge's Declaration of Taking. The historic lighthouse would benefit from improvements to the interior structure that would reinforce it against the

destructive natural forces present on the island. The installation of solar panels would support a functional heating and ventilation system to preserve the historic structure against temperature and moisture damage.

Archaeological resources are best protected under this alternative, and cultural resources and important elements of Monomoy's heritage are best preserved and understood under this alternative. However, the risk of impacts seen in alternative A actually could be greater in alternative B, because of the increased acreage in active management. As in alternative A, we would conduct site assessments and surveys in consultation with our Regional Historic Preservation Officer prior to any ground-disturbing activity. In addition, we would notify our Regional Historic Preservation Officer immediately if we encountered unanticipated cultural materials or features during construction of any project.

Impacts on Cultural, Historic, and Archaeological Resources of Alternative C (Natural Processes)

In addition to the actions mentioned in alternative A, this alternative provides a moderate level of cultural resource protection from the effects of erosion. Under this alternative we would only conduct routine maintenance and repair of the Monomoy Light Station. If erosion poses an imminent threat to the site of the Monomoy Point Light Station in the next 15 years, we would develop a mitigation plan for the light station to implement an interpretive program of exhibits, documentary research, archaeological investigation, and possible relocation of structures, prior to the destruction of this National Register site by natural forces. We would conduct the cultural survey to thoroughly document the historical value of the resource in order to mitigate the effects of this action.

Adverse impacts to cultural and historic resources have the potential to be reduced under alternative C than under alternatives A and B. The natural processes habitat management approach in alternative C would result in less manipulation of refuge habitats, particularly in managing for early successional habitats, conducting wildlife projects, and prescribed burning.

Cumulative Impacts

According to the CEQ regulations on implementing NEPA (40 CFR 1508.7), a cumulative impact is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes the other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time. This cumulative impacts assessment includes the actions of other agencies or organizations, if they are interrelated and influence the same environment. Therefore, this analysis considers the interaction of activities at the refuge with other actions occurring over a larger spatial and temporal frame of reference. Potential impacts for the proposed alternatives are described below.

Air Quality

None of the proposed alternatives are expected to have significant cumulative adverse impacts on air quality in coastal Massachusetts or elsewhere in the region. Some short-term, local deterioration in air quality would be expected from management-ignited prescribed burns and from refuge visitors' automobile emissions. However, prescribed burns would only occur under the stipulations of the fire management plan (refer to appendix F); these stipulations are specifically designed to minimize air quality impacts. Further, while visitors would primarily access the refuge by automobile or motorized boat, most would drive less than 50 miles. Most of these visitors are already in the area on vacation and seek out the refuge for day trips. Monomoy refuge is rarely the primary destination for Cape Cod visitors; the presence of the refuge should only be accountable for a very small percentage of vehicle emissions generated in this area.

Some areas in Massachusetts periodically experience high ozone levels (MA DEP 2007); however, the coastal location of the refuge ensures relatively good local air quality. Although the refuge would continue to use prescribed fires for

maintaining grassland and maritime shrubland habitats, we anticipate that air quality impacts associated with those actions would be temporary and localized. The cumulative impacts of prescribed burning throughout a region may be short term and moderate (Zeng et al. 2008); the temporary and periodic nature of the proposed fire regime on Monomoy, coupled with its isolated location, minimizes any contribution to potential cumulative effects in the region.

Similarly, occasional herbicidal applications to refuge habitats are for the most part applied through backpack sprayers and are very target specific. This type of application would not be anticipated to have any impacts to air quality, as they would be directly applied to the target plants.

While wilderness designation may not essentially alter habitat management activities, it could potentially reprioritize management methods. This designation would create no adverse impacts, and may provide slight benefits to local and regional air quality through wilderness policy compliance.

We expect none of the activities on the refuge to contribute to any measurable incremental increase in ozone levels or other negative air quality parameters. We expect none of the alternatives to cause any greater than negligible cumulative adverse impacts on air quality locally or regionally.

Water Quality and Soils

None of the alternatives would produce significant adverse cumulative impacts on water quality or soils. We would continue to use best management practices and measures to control erosion and sediments in habitat management activities and any ground-disturbing operations to ensure impacts are minimal.

Monomoy NWR is exposed to the natural coastal processes of accretion and erosion, the deposition and removal, of sand along shorelines. Sand that is eroded, or removed, from one beach will be transported downdrift and will accrete, or be added, on another. These processes are influenced by many factors, which include currents, tides, winds, sea floor bathymetry, and human modifications. The dynamic nature of these systems means that the same beach can both accrete and erode seasonally within a given year, and can fluctuate between accretion and erosion over long periods of time. These movements of sand provide changing coastlines and habitats for many species of wildlife. The coastal dunes and barrier beaches are important in storm damage prevention and flood control. Working collaboratively to maintain this dynamic system is important in achieving cumulative benefits to water quality and soils.

Management actions would also respond to address climate change and sea level rise cumulative impacts on the physical environment. All three alternatives include beach nourishment of the eroding strip of U.S. land on the eastern shore of Morris Island, and alternatives A and B would evaluate the appropriateness of using dredge material from ongoing non-refuge projects or other habitat alteration techniques in non-wilderness areas to protect habitats from the effects of erosion and sea level rise.

In varying degrees, all the alternatives emphasize maintaining the biological integrity, diversity, and environmental health of lands within the refuge boundaries, which also contributes to conserving a scenic landscape.

Monomoy NWR is primarily surrounded by the Atlantic Ocean. The only source of fresh water on the island is from precipitation and infiltration. The waters immediately surrounding the refuge, in particular the Outer Cape Cod region, are designated as a No Discharge Area. Boats may not discharge any sewage, treated or otherwise, in these waters immediately adjacent to Monomoy refuge, to protect this ecologically and recreationally important area. Enforcing this restriction will continue to be important to protect quality of nearshore waters.

Alternative C would provide the greatest benefit to improving water quality within refuge waters by not allowing the use of motorized watercraft, thereby reducing the likelihood of catastrophic spills.

The greatest present adverse impacts on refuge soils occur from prescribed burns and invasive plant control. We would continue to use best management practices when maintaining or setting back succession in dune grassland and shrubland habitats, prescribed burning, or when selecting various chemical, biological, or mechanical methods to ensure cumulative beneficial impacts for soils. Under all alternatives, where we remove invasive plant species and restore native plant communities, we expect to also improve nutrient recycling, restore native soil biota, and soil fertility.

Biological Resources

All the alternatives would maintain or improve Service trust resources and biological integrity, diversity, and environmental health on the refuge and in the region, although to varying degrees.

All alternatives would strive to maintain or improve biological resources on the refuge. Key partners and nearby landowners, including the National Park Service, Massachusetts Natural Heritage and Endangered Species Program, and Massachusetts Audubon Society, also manage coastal habitats for wildlife conservation and recreation in compliance with Federal and State threatened and endangered species laws. The combination of our management actions with those of our key partners would result in beneficial cumulative effects by:

- Maintaining or increasing protection and management for federally listed and State-listed threatened and endangered species, and other species of high conservation concern.
- Improving coastal habitats that are regionally declining including reducing invasive, nonnative plants and animals.
- Increasing understanding of species and habitat relationships and limiting factors to conservation recovery.
- Using adaptive management and the best science available to manage and promote regionally important habitats and natural communities.

Additional information will facilitate structured decision-making with wide-ranging cumulative benefits for bird and wildlife populations. Collecting data about wildlife and vegetative populations and their response to conservation and wildlife management actions, plus enhancing monitoring studies, would add to the body of knowledge the Service will collect. Sharing this knowledge with other conservation partners would influence and improve natural resource decision-making, with cumulative benefits on the biological environment over a broader landscape.

In general, habitat and wildlife management would have considerable beneficial cumulative impacts on the environment, as we expect to contribute to biological integrity, diversity, and environmental health of coastal resources, which would support breeding and migrating shorebirds, nesting and staging terns, breeding and migrating land bird and waterbird species.

Native plant management, which includes a natural fire regime, cumulatively benefits the biological environment by increasing and enhancing healthy soil biota, restoring and enhancing native plant resources, increasing resident wildlife populations of mammals, fish, reptiles, and amphibians, and enhancing invertebrate production to sustain and perpetuate migratory bird resources.

Under each alternative, we would continue to allow activities that result in the direct loss of individual wildlife (fin and shell fishing); alternatives B and C would be open to a waterfowl hunt. While fishing falls under the priority public use category, we use temporary seasonal closures to ensure that non-target wildlife species are not significantly impacted. Another common concern is the reduction or alteration of the prey base important to fish and marine invertebrate-eating wildlife; however, State regulations address this concern to ensure that harvest levels do not cumulatively impact native fish resources to the point they are no longer self-sustainable.

Piping plover

Gene Niemien/USFWS

While a wilderness designation may not essentially alter habitat management activities, it would potentially reprioritize or pose more specific guidelines on management methods. Cumulative impacts from research activities are not expected but could occur if multiple research projects were occurring on the same resources at the same time or if the duration of the research was excessive.

Service staff recognize that all uses of refuge lands create some impact on refuge wildlife and their habitats. Those refuge uses, taken together, have the potential to accumulate impacts as the number of uses increases. Because of that potential, refuge uses are limited to those we have formally determined to be compatible with the purposes for which the refuge was established and the mission of the Refuge System. The refuge acknowledges that increasing public use could cumulatively impact biological resources and contribute to habitat degradation in the off-trail use zone where consumptive and non-consumptive use areas overlap. These uses that take place within the same general timeframe create an overall greater zone of disturbance than either use taken individually. When we review those formal compatibility determinations (every 10 to 15 years), we would consider possible accumulating affects that may have occurred in succeeding years, and would address them as necessary. We do not expect alternatives A, B, or C, to have major cumulative impacts.

Public Use

All alternatives with respect to public use would have cumulative impacts on biological resources because we expect the demand for all types of wildlife recreation would grow on the refuge as the amount of natural habitats and open space decreases off-refuge from increasing development pressures while the amount of refuge space and natural resources would remain relatively constant. The management objectives presented in alternatives B and C are our attempts to strike a feasible balance to ensure the refuge will remain a destination of choice for wildlife and people, while also protecting the biological environment for the long term and promoting wilderness character.

Three of the public use programs we offer, fin fishing, shell fishing, and waterfowl hunting, result in the direct loss of individual wildlife. We describe the site-specific impacts of our fishing and proposed hunting programs earlier in this chapter and in appendix D, Findings of Appropriateness and Compatibility Determinations. We would also complete a fishing plan and hunt plan that include an evaluation of cumulative effects. Based on current and anticipated levels of use, we do not think those programs have a significant cumulative effect on the respective populations of the wildlife species harvested.

Fin fishing and shellfishing seasons and limits are established by the State of Massachusetts and Town of Chatham, respectively, and adopted by the refuge. These restrictions ensure the continued well-being of overall populations of fin fish and shellfish. Fishing results in the taking of individuals within the overall

population, but restrictions are designed to safeguard adequate population and recruitment from year to year. Specific refuge regulations address equity and quality of opportunity for anglers, and help safeguard refuge habitat. Disturbance to other fish and wildlife does occur, but this disturbance is generally short-term and adequate habitat occurs in adjacent areas. Loss of plants or increases in water turbidity from boat motors is probably minor, or temporary, and is generally not concentrated since fishing pressure is well distributed.

Alternatives B and C would propose to open the refuge to waterfowl hunting. We will develop this in detail over the next 5 years, and conduct additional analysis and public review once details are available. We do not have enough detailed information to include them in this cumulative effects analysis.

We do not anticipate any significant cumulative effects on biological resources from other wildlife-dependent recreational activities, when those activities are conducted in accordance with refuge-established seasonal closures and regulations. Impacts caused by these activities can be found earlier in this chapter.

Socioeconomic Environment

We expect none of the three proposed alternatives to have a significant adverse cumulative impact on the overall economy of local towns or the county in which the refuge lies. We do not expect that any of the actions proposed under the alternatives, including fin fishing, would alter the demographic or economic characteristics of the local community. However, restrictions on fishing which results in disturbance of eelgrass beds or otherwise disturbs the sea bottom or involves the extraction of shellfish using motorized equipment or artificial means such as salt or chlorine proposed under this alternative would directly impact people engaged in these activities. The fish weir that is sometimes located within the Declaration of Taking area would not be allowed if the installation of that weir results in bottom disturbance. The actions we propose could impact the Town of Chatham's efforts to sustain a local fishing industry and have a financial impact on some individuals. While current conditions are not conducive to large-scale softshell clam harvest on the refuge, future conditions could be more favorable. In that case, if alternative C were selected, there would be a potentially significant impact on the softshell clam community if clammers decided that complying with wilderness regulations (no motorboats and no carts) imposed too much of a hardship and exited the fishery. This could damage or undermine fishing- related businesses or community organizations. All the alternatives would maintain the beauty and aesthetics of the refuge's natural landscape, enhance biological resources available for consumption, and provide wildlife experiences that promote a pleasurable quality of life for humans. All the alternatives could benefit the town through revenues generated directly or indirectly as a result of ecotourism visitation.

These varying alternatives would have cumulative impacts, because we expect the demand for nearly all recreation to grow while the amount of refuge space and natural resources stays relatively constant. In alternative A, current uses would continue without much change. Alternative B attempts to strike a reasonable balance to ensure the refuge remains a destination of choice for both wildlife and people. If successful, that integrated approach may prove more sustainable, with more positive, long-term impacts on natural resources on the refuge, and social and economic impacts on the communities beyond. Alternative C strikes a balance between the needs of wildlife and the public, with fewer staff providing fewer public use opportunities while reducing active management of refuge habitats.

Our working relationships with private landowners and others should improve in terms of responsiveness to inquiries and speed of joint projects under alternative B. That improvement mainly would result from increased staffing in key areas such as biology, public use, and maintenance. The overall coordination and communication with the public should improve under alternative B, because a new staff position would provide for enhanced visitor use and public information. Because some may oppose changes in one or more of the alternatives, or support them, the cumulative impact on the public perception of the refuge and the Service could be negative or positive.

Various objectives in alternatives B and C would have varying degrees of impact on the recreational use of the refuge. More emphasis on public education, outreach activities, and information in alternative B should foster greater understanding and appreciation of resource issues and needs, leading to increased support and funding, which would positively affect bird and wildlife resources on the refuge. The increased outreach of these alternatives could also positively affect land use decisions outside the refuge by local governments and private landowners, and lead to increased bird, fish, and wildlife populations over a broader area. There would be minor benefits affiliated with revenue sharing payments, refuge spending, and promoting ecotourism opportunities under alternative B. Fully funding the additional staff in alternatives B and C would also make a small, incremental contribution to employment and income in the local community.

Cultural, Historic, and Archaeological Resources

As stated previously in this chapter, we would comply with all applicable State and Federal laws and mandates protecting cultural and historic resources on the refuge. All the activities proposed in this document would comply with section 106 of the National Historic Preservation Act and other applicable regulations in order to avoid or minimize impacts to significant cultural resources. For these reasons, no cumulative impacts are expected.

Climate Change

Department of the Interior Secretarial Order 3226 (January 16, 2009) states that "there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making…This Order ensures that climate change impacts are taken into account in connection with Departmental planning and decision making." Additionally, this Secretarial Order calls for incorporating climate change considerations into long-term planning documents, such as this CCP.

To help meet the climate change challenge, the Service drafted a climate change strategic plan (USFWS 2009). The plan employs three key strategies to address climate change, adaptation, mitigation, and engagement, defined as follows:

- 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.

The Association of Fish and Wildlife Agencies developed guidance for states as they update and implement their respective wildlife action plans (AFWA 2009). This publication, *Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans and Other Management Plans*, also includes strategies that will help conserve fish and wildlife species, their habitats, and broader ecosystems as climate conditions change. The broad spatial and temporal

USFWS

Seals on South Monomoy

scales associated with climate change suggest that management efforts that are coordinated on at least the regional scale would likely lead to greater success.

Our review of proposed actions in this CCP suggests that two activities may contribute negligibly to stressors affecting regional climate change: our prescribed burn program, and our use of vehicles and equipment for refuge management and administration. We discuss the direct and indirect impacts of these activities elsewhere in chapter 4; we also discuss measures to minimize the impacts of both. With regard to our equipment and facilities, we are trying to reduce our carbon footprint wherever possible by using alternative energy sources and energy-saving appliances, driving hybrid vehicles, and using recycled or recyclable materials, along with reduced travel and other conservation measures. Alternative C outlines the most aggressive measures for addressing climate change by minimizing our carbon footprint and greenhouse gas emissions from management activities and maximizing resiliency of natural communities. In our professional judgment, most of the management actions we propose would not exacerbate climate change in the region or the refuge area.

The Service is taking a major role among Federal agencies in distributing and interpreting information on climate change. There is a Web site dedicated to this issue at: *http://www.fws.gov/home/climatechange/* (accessed February 2013), which links to the Service's recently released *Strategic Plan for Climate Change*. The strategic plan includes two key elements: landscape conservation cooperatives and a national Fish and Wildlife climate adaptation strategy. Both elements bring together conservation partners to address climate change in a concerted effort. Strategies for adapting to and mitigating climate change are included in this CCP. Specific steps taken by the refuge will help reduce our greenhouse gas emissions. These include using energy-efficient equipment and vehicles where feasible, building and maintaining structures using sustainable, green building technologies, and conducting energy audits. In addition, we will rely on the habitat and species vulnerability assessments and other climate change research developed by the Northeast Climate Impacts Assessment and the Manomet Center for Conservation Sciences.

Climate change poses significant challenges for the management of migratory species. National wildlife refuges have played a critical role in the protection of migratory birds, even as specific management activities are largely confined to the refuges themselves. Climate change is likely to have a significant impact on habitats within refuges, which underscores the importance of climate change adaptation as part of refuge management. However, climate change is also likely to pose considerable risks to many migratory species throughout their lives (Glick 2012). As Robinson et al. (2009) highlight, one reason is that the life cycle

of migrants is usually tied to seasonal events such as coastal upwelling and the availability of key food sources, the timing of which may be altered under climate change. Long-distance migratory birds may be especially vulnerable, as high-latitude regions are among the fastest warming places on earth. We will continue to monitor the red knot, which serves as a key indicator species for migratory species, to help reduce these threats.

Climate change may increase opportunities for invasive species to spread because of their adaptability to disturbance; if this spread occurs, it would decrease biological integrity and diversity on the refuge. Invasive species control, including extensive monitoring and control measures, will be essential in avoiding larger impacts. Reducing invasive species would increase the resilience of habitat and its ability to adapt to climatic change.

Refuge managers should monitor climate change and its effects on wildlife and their habitats and use this information to adjust management techniques and strategies. Given the uncertainty regarding climate change and its impacts on the environment, relying on traditional methods of management may become less effective as time goes on. We agree that an effective and well-planned monitoring program, coupled with an adaptive management approach, will be essential in dealing with the future uncertainty of climate change. We have built both aspects into our CCP. We would develop a detailed step-down inventory and monitoring plan designed to test our assumptions and management effectiveness in light of ongoing changes. With that information in hand, we will either adapt our management techniques, or re-evaluate or refine our objectives as needed.

Relationship Between Short-term Uses of the Human Environment and Enhancement of Long-term Productivity

NEPA section 102(C)(iv) (CEQ regulations part 1502.16) requires Federal agencies to disclose the relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity. The Service expects that the proposed alternatives would lead to long-term productivity through the life of the CCP (15 years). This discussion focuses on the tradeoffs between short-term environmental costs and long-term environmental benefits.

Under all three alternatives, our primary aim is to maintain or enhance the long-term productivity and sustainability of natural resources on the refuge, in the State of Massachusetts, and in New England and the North Atlantic region. All the alternatives strive to maintain or enhance the long-term productivity and sustainability of natural resources on the refuge and in the region, and migratory birds across all landscape scales. The alternatives strive to conserve our Federal trust species and the habitats they depend on. Outreach and environmental education are a priority in each alternative to encourage visitors to be stewards of our environment and ensure they are informed about our unique natural resources. Encouraging members of the public to support conservation efforts can ultimately lead to long-term benefits for the environment. We believe that our management actions, including controlling invasive plant species, managing for native vegetation, and enhancing habitats for conservation species such as the endangered roseate tern, threatened piping plover, and northeastern beach tiger beetle, may have short-term adverse impacts but would enhance long-term productivity of the refuge. Habitat management practices that mimic ecological and sustainable processes optimize the maintenance and enhancement of the biological diversity, integrity, and environmental health of those habitats for the long term.

In summary, we predict that the alternatives would contribute positively in maintaining and enhancing the long-term productivity of the refuge's natural resources, with sustainable beneficial cumulative and long-term benefits to the environment surrounding the refuge and minimal inconvenience or loss of opportunity for the American public.

Unavoidable Adverse Effects

Unavoidable adverse effects are the effects of those actions that could cause harm to the human environment and that cannot be avoided, even with mitigation measures. There would be some minor, localized unavoidable adverse effects under all the alternatives. For example, constructing a visitor contact station under alternatives B and C would produce minor, localized, adverse effects. Installing fencing, signs, and a kiosk has negligible adverse effects, which are more than offset by the benefits of protecting resources and guiding public uses. None of the identified adverse effects would rise to a considerable level, and all the actions listed would have long-term beneficial impacts. Furthermore, all those impacts would be mitigated with best management practices; our conclusion is that none of the alternatives would cause significant, unavoidable cumulative impacts.

Potential Irreversible and Irretrievable Commitments of Resources

NEPA section 102(C)(v) (CEQ regulations part 1502.16) requires Federal agencies to consider any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented.

Irreversible commitments of resources are those that cannot be reversed, except perhaps in the extreme long term or under unpredictable circumstances. An example of an irreversible commitment is an action that contributes to a species' extinction. Once extinct, it can never be replaced. No irreversible commitments of resources are predicted as a result of management activities on Monomoy refuge.

In comparison, irretrievable commitments of resources are those that can be reversed, given sufficient time and resources, but represent a loss in production or use for a period of time. In our professional judgment, there are a few actions proposed that could be considered irretrievable; these primarily relate to the construction of new infrastructure. They are considered irretrievable because, in the future, any facility we construct could potentially be dismantled and the site restored; however, while standing, they represent a loss in habitat productivity. We could consider kiosks and alternative energy facilities irretrievable commitments of resources. However, we can dismantle those facilities and restore the sites if resource damage is occurring. The construction of an offsite visitor contact station under alternatives B and C would result in irretrievable commitment of resources; however, given the limited footprint of such a facility, coupled with the benefits from engaging the community and visitors in learning about barrier-beach ecosystems, we do not believe a significant cumulative impact would result. The loss of the Monomoy Point Light Station due to a lack of funding to conduct occasional expensive repairs, such as a roof replacement or installation of a heating supply to protect the keeper's house from the adverse effects of humidity, would be an irretrievable loss of a national historic resource.

Environmental Justice

On February 11, 1994, President Clinton signed into Executive Order No. 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. It was designed to focus Federal attention on the environmental and human health conditions of minority and low-income populations, with the goal of achieving environmental protection for all communities. Agencies are required to ensure that these potential effects are identified and addressed.

The EPA defines environmental justice as, "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." In this context, fair treatment means that no group of people should bear a disproportionate share of negative environmental consequences resulting from the action.

Lastly, additional facilities proposed under alternatives B and C would be located on existing refuge lands, or newly acquired refuge lands, and are not expected

to be located in a way that would disproportionally affect minority or low-income persons.

We believe, based on our analysis of socioeconomic and environmental consequences, that none of the proposed alternatives would place a disproportionately high, adverse environmental, economic, social, or health burden on minority or low-income persons. Our programs and facilities are open to all who are willing to adhere to the established refuge rules and regulations, and we do not discriminate in our responses for technical assistance in managing private lands. The proposed parking and entrance fees may deter some low-income individuals from visiting the refuge. None of the socioeconomic and environmental impacts we have identified would be localized or focused primarily or unequally on minority and low-income communities or individuals residing near the refuge. The local town and county would experience only very minor adverse effects along with some significant beneficial effects if the refuge is managed under any of the three proposed alternatives. Adverse impacts, such as minor increases in traffic and related emissions due to increased visitation at the refuge would not disproportionately affect minority and low-income populations compared to other segments of the general population. The same is true of any negligible mobile-source air emissions from the operation of refuge equipment and vehicles. Beneficial impacts include maintaining natural vegetation that improves air and water quality; increased revenue sharing payments to the Town of Chatham to offset any property tax loses; and enhanced and free public uses of the refuge under all three alternatives.

Sunset on the refuge

Jennifer Goyette 2013

Table 4.8. Matrix of Environmental Consequences by Alternative.

Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred)	Alternative C: Natural Processes
Effects on Air Quality		
Current management activities neither substantially benefit nor adversely affect local and regional air quality. Minor long-term benefits in air filtration and carbon sequestration from shrubland, grassland, and aquatic vegetation. We would continue energy efficient practices and adopt additional practices as feasible, such as hybrid vehicles. Limited ground disturbance activities and limited introduction of new emission sources would contribute to short-term, temporary impacts. Negligible adverse effects from prescribed burning on up to 35 acres every 3 years to maintain native habitats and control invasive species. Anticipated increase in annual refuge visits by motor vehicles would cause a minor increase in air emissions in the long term and contribute minimally to potential cumulative effect.	Same energy efficient practices as in alternative A, which would extend to the Monomoy Point Light Station. Additions to the Morris Island trail, infrastructure, and other proposed projects would contribute to an increase in short-term adverse effects from vehicle and equipment emissions and dust during construction. An increase in annual visitation over the next 15 years would result in more motor vehicles and therefore higher local air pollutant emission levels than in alternative A over the longer term, and would increase the potential for cumulative effects. However, implementation of alternative transportation measures would reduce emissions directly at the refuge.	Long-term benefits to improved air quality would be similar to alternative B, with a small increase as a result of allowing natural succession take place. Same energy efficient practices as in alternative A. Elimination of all motorized boat transportation within the refuge boundary would benefit air quality. Similar effects as under alternative B from proposed construction projects. Similar to alternative B in predicted vehicle emissions based on expectation of increased levels of visitation.
Effects on Climate Change		
The natural carbon sequestration occurring on refuge lands and actions to reduce emissions from vehicles and facilities would have a small, but positive effect with respect to climate change.	Similar to alternative A, except that benefits may increase if refuge pursues beach renourishment to offset impacts of sea level rise and erosion. Alternative transportation measures would also have a positive effect on climate change.	Benefits to improve climate change would be greatest under this alternative as a result of not allowing motorized transportation within the wilderness waters of the refuge.

Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred)	Alternative C: Natural Processes
Effects on Water Quality		
Impacts Common to All Alternatives		
None of our proposed management activities would violate Federal or State standards for contributing pollutants to water sources; all three would comply with the Clean Water Act. We would use integrated pest management, utilizing a variety of mechanical, biological, or chemical means to control invasive species. When used appropriately, chemical products do not have direct or indirect negative impacts on water quality. We would use best management practices for any beach renourishment projects.		
Refuge-related activities that could impact water quality are oil or gas leaks from motorized boat use, refuge vehicles, or offshore boats, although the impacts to water quality are likely to be negligible from these activities. If the Monomoy Point Light Station is used to accommodate staff and visitors, there may be the potential for long-term impacts from activities such as waste disposal.	Under alternative B, invasive plant treatment would be more intense. We only use herbicides that are safe for aquatic habitats. There are higher risks of short-term adverse effects on water quality associated with renovation of existing facilities directly on the refuge and new construction of facilities offsite. Impacts from use of the light station would be the same as under alternative A. Under alternative B, there may be short-term temporary impacts from the use of dredge material.	Under alternative C, water quality impacts would be considerably lower compared with alternatives A and B since the refuge would only allow the use of nonmotorized personal watercraft within the wilderness waters in the refuge. The freshwater wetlands would be subject to natural processes, unless invasive species posed a direct threat to wetland integrity or became stand-replacing.
Effects on Soils		
Impacts Common to All Alternatives		
All three alternatives strive to maintain the dynamic nature of accretion and erosion and to adapt to the changing habitat conditions from these shifting sands. We will continue to maintain native vegetation cover on the refuge that stabilizes and minimizes soil losses through erosion. Regardless of which alternative is selected, we will continue to use best management practices, conduct all prescribed burns under a strict prescription and in optimal weather conditions, use approved herbicides to control invasive plants, and limit public use to designated areas.		
Impacts would be minor, short-term, localized soil compaction and long-term loss of productive soils where soils are removed or surfaced for installation of a wind turbine at the Morris Island headquarters, renovation projects, and an alternative energy facility at the Monomoy Point Light Station. The greatest adverse impacts to soils likely would occur under alternative A, given the level of public access and use coupled with the lack of enforcement and onsite Service presence.	Alternative B would provide more onsite Service presence; this would help restore and protect dunes by designating authorized trails and directing foot traffic away from sensitive areas. In addition to the impact on soils described under alternatives A and C, this alternative would cause some additional soil disturbance as a result of upgrading additional trail areas on Morris Island. A cultural resource overview is proposed, which may result in additional short-term soil disturbance activities. We anticipate minor, short-term impacts from the possible use of dredge material. We will follow MassDEP's Best Management Practices for Beach Nourishment to minimize any potential adverse impacts.	Under alternative C, we expect the greatest benefit to soils, as we consider limiting the number of visitors at one time in the Monomoy wilderness. We anticipate fewer visitors on the refuge under this alternative as a result of no longer allowing motorized transportation to the refuge; however, there could be increased soil compaction from the number of individuals hiking. Minor, short-term, localized adverse impacts to soils would be similar to alternative A from proposed construction projects, albeit on a smaller scale.

Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred)	Alternative C: Natural Processes
Effects on Dune and Beach Habitat		
Impacts Common to All Alternatives		
Regardless of which alternative we select, we will manage these habitats to benefit the federally listed piping plover, roseate tern, and northeastern beach tiger beetle, as well as other species of conservation concern. Minimizing human disturbance would increase nesting and foraging opportunities on overwash habitats to increase shorebird nesting productivity. Indirect benefits on shorebirds result from educating the public about special beach closures with news releases and other outreach mechanisms to engage the public to understand the needs of nest shorebirds. Under each alternative, we would continue to prohibit the use of all-terrain vehicles and over-sand vehicles on the refuge. All alternatives would incorporate actions, where possible and as funding allows, that monitor for any impacts to the refuge due to sea level rise. Direct impacts affiliated with increased visitation would include minor damage or loss of vegetation from off-trail use. Indirect impacts could result from the activity of visitors trampling dune and grassland vegetation, as well as potential impacts associated with habitat restoration or general service activities, including maintaining a field camp and conducting surveys.		
Continued protection of 30 acres of dune and beach habitat to benefit priority bird species and enhance 2 acres of nesting habitat for roseate terns. The spread of invasive species would potentially degrade the quality of the vegetated dune habitat for focal species, where invasive plants are left untreated. The presence of a seasonal camp poses some minor impacts to the surrounding vegetation due to trampling and high use. Predator management would benefit tern and other coastal bird species. Visitors would continue to utilize the existing and unmaintained footpaths created from extensive use near the lighthouse. Without sufficient law enforcement staff to enforce regulations, there is the continued potential for visitors to engage in activities deemed not appropriate with refuge purposes, such as camping or hiking.	In addition to the benefits derived from alternative A, an additional 45 acres of nesting habitat would be protected for common terns and an additional 8 acres of prime nesting habitat for roseate terns would be provided. More onsite refuge seasonal staff would provide greater protection to habitat through increased public awareness, enforcement of closures, and additional signs. In this alternative, we would increase management to protect nesting piping plovers in a manner consistent with preserving wilderness character by closing all available high-quality habitat to the public by mid-April. We would continue to rely on symbolic fencing, but with greater use of adaptive management and onsite presence to determine location and duration to protect habitat and dune processes. The quality of this habitat would improve as a result of a more regular burning regime and removal of woody and invasive plant species. Invasive species management would be more aggressive under alternative B by aiming for a target of less than 10 percent coverage refugewide of nonnative invasive plant species throughout the dune grasslands. This would benefit all nesting species in this habitat type. More proactive land protection efforts with partners would provide opportunities to permanently protect more coastal dune and shoreline habitats and create a larger area of continuous protection for species like the roseate and common tern, piping plover, least tern, American oystercatcher, and northeastern beach tiger beetle.	Under alternative C, we would protect only 10 acres of nesting habitat for common terns and maintain an additional 2 acres of prime nesting habitat for roseate terns. We would only conduct vegetation manipulation in this 10-acre area, therefore it is likely that woody species may begin to dominate in some areas and nonnative invasive plants would spread. We would continue to conduct annual inventories for focal species, but overall, our monitoring efforts would be focused on federally listed species. We would decrease vegetation monitoring to once every 15 years. This may limit our efforts to conduct habitat management. There may be fewer visitors under this alternative, as well as limited numbers at one time from implementation of a wilderness access pass, but impacts on the habitat and wildlife would be similar to those described under alternative B.

Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred)	Alternative C: Natural Processes
Effects on Maritime Shrubland		
Impacts Common to All Alternatives		
All alternatives would tolerate nonnative rugosa rose to remain on the refuge in areas where wading birds nest. This could potentially result in the spread of a nonnative plant species into adjacent habitats and subsequent loss of native beach dune grass habitat. We do not consider this to be a significant impact due to the self-regulating habitat of the salt water environment. All the alternatives would use temporary symbolic fencing to close nesting areas in areas of high seasonal public visitation to provide disturbance-free nesting opportunities for wading birds. There would be varying degrees of disturbance between the three alternatives, but the impacts would all be similar.		
Under alternative A, we would continue to minimally manage the approximately 500 acres of maritime shrubland to benefit wading and land birds, including the black-crowned night-heron and snowy egret. This habitat would continue to be degraded by invasive plants.	Under alternative B, we would actively manage the maritime shrubland habitat on the refuge to benefit wading and land birds, including black-crowned night-heron and snowy egret, in addition to evaluating the importance of native maritime shrubland habitat for neotropical migrant songbirds. We would utilize biological, mechanical, chemical, or fire management to reduce nonnative invasive species to no more than 5 percent of habitat composition. This habitat would further benefit from replanting native shrubs in areas where large stands of invasive plants are removed. Reintroduction of fire through prescribed burns would also benefit the quality of this habitat. Compared to alternative A, there may be a small expansion in public use closures in maritime shrubland habitats, if warranted by habitat changes, wildlife use changes, or level of visitation. We will also assess habitat on Nauset/South Beach. The benefit to nesting bird species would be the greatest compared with alternatives A and C.	Under alternative C, this habitat would fall under the umbrella management of BIDEH. Habitat management would be similar to alternative A, with the exception of controlling nonnative invasive species.
Effects on Intertidal Habitat		
Impacts Common to All Alternatives		
All the alternatives would employ seasonal closures to reduce human disturbance from public use activities. Under all the alternatives, we would continue our ban on horseshoe crab harvesting. Shellfishing for softshell clams and quahogs would continue to be allowed under all alternatives.		
Under alternative A, we would continue to passively oversee up to 2,500 acres of intertidal habitat to benefit marine mammals, such as seals, nesting waterbirds, and migrating shorebirds.	Under alternative B, we would expand our management within this habitat to protect up to 2,500 acres. The most significant adverse impacts of human disturbance include displacement of shorebirds from preferred resting areas and abandonment of nests. Compared to alternative A, there may be a small expansion in public use closures in intertidal habitats, if warranted by habitat changes, wildlife use changes, or level of visitation. We will also assess habitat on Nauset/South Beach. Additional portions of intertidal mudflat may be closed to all human access for several weeks if these areas are consistently highly productive and support large concentrations of foraging shorebirds. Compared to alternative A, the length of these closures may slightly expand if warranted by wildlife use or the level of visitation. In alternative B, we would allow only non-mechanized harvest of subterranean species (soft- shell clams, quahogs, and razor clams) and would prohibit harvest of mussels. By not allowing mussel harvesting, we are providing an added benefit to red knots and other migrating shorebirds who feed on these colonies.	Impacts will be the same as A, with the exception of only allowing the harvest of subterranean shellfish as under alternative B.

Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred)	Alternative C: Natural Processes
Effects on Salt Marsh		
Impacts Common to All Alternatives		
Under each of the alternatives, management of salt marsh would not change in a manner that would directly impact this habitat. We would continue to work to prevent the public from walking through these areas and potentially damaging plants. Temporary symbolic fencing would be used under all alternatives to protect salt marsh habitat and benefit nesting saltmarsh sparrows and American oystercatchers by reducing human disturbance.		
Under alternative A, we would continue to minimally manage about 250 acres of salt marsh with the use of seasonal closures to minimize trampling of vegetation and invertebrates, and benefit nesting saltmarsh sparrows and American oystercatchers. This habitat has been expanding over the last few years, so we do not anticipate any adverse impacts from our passive management. Under alternative A, the refuge would continue to issue special use permits for nuisance mosquito control. Direct impacts of monitoring and control include temporary disturbance to habitat and possible direct effects to non-target wildlife. Areas of vegetation may be crushed under foot, with impacts ranging from temporary in nature to loss of habitat over time. Invasive weeds may be introduced or spread by foot. Indirect effects associated with mosquito control include reducing mosquito populations and other non-target species that serve as the base of food chains for wildlife species.	Under alternative B, we would take a more proactive approach by actively managing at least 150 acres of coastal salt marsh to ensure that the quality and natural function of the marsh is sustained. Invasive species management would be more aggressive under alternative B by aiming for a target of less than 10 percent coverage of nonnative invasive plant species throughout the salt marsh. This habitat would benefit from information gathered through a regionwide study of salt marsh integrity, in addition to determining the presence and abundance of purple marsh crabs. Under this alternative, we would continue to issue special use permits for mosquito monitoring and control in accordance with Service policy.	Under alternative C, impacts from vegetation and habitat management would be the same as alternative B.

Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred)	Alternative C: Natural Processes
Effects on Wetland Habitat		
Under alternative A, there is no active management of this habitat. The freshwater ponds are used for fishing; we anticipate minimal vegetation trampling as a result. Fishing in the freshwater ponds is infrequent and does not pose an impact to the fish population of these ponds. The nonnative invasive plant species Phragmites is found on some of the freshwater ponds on South Monomoy; it has not been treated and will continue to exist.	Under alternative B, we would work to maintain the ecological integrity of approximately 150 acres of freshwater ponds and associated emergent and shrub wetlands to support breeding marshbirds and native plant communities. The removal of nonnative invasive plant species, predominantly common reed, would benefit wetland habitats and associated species. Potential impacts of fishing on open water and wetland habitats are expected to be similar to those described for alternative A.	Under alternative C, wetland impacts from management actions would be similar to alternative A, but would be evaluated through a BIDEH focus. This alternative would benefit from nonnative invasive species management similar to alternative B.
Effects on Nearshore Marine Open Water		
Impacts Common to All Alternatives		
The refuge would remain open to fin fishing (except using techniques that disturb the bottom); lobster, crab, and whelk pot fishing; and the hand harvest of scallops under all alternatives. Shellfishing has the potential to damage aquatic vegetation; however, hand tools are generally used in the intertidal zone where eelgrass does not occur. Activities that result in the disturbance of the bottom would not be allowed. This will prevent damage to existing eelgrass beds, the reestablishment of eelgrass beds, and benthic communities. Maintaining an undisturbed bottom supports aquatic life which in turn supports migratory birds and other refuge wildlife species.		

Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred)	Alternative C: Natural Processes
Effects on Wilderness Recommendations and Designation		
Impacts Common to All Alternatives		
None of the alternatives propose actions that would directly or indirectly jeopardize the roadless character, size, or outstanding ecological or scenic features of the Monomoy wilderness and the Inward Point and Powder Hole (currently non-wilderness) exclusions. Under all alternatives, the refuge's outstanding opportunities for solitude and primitive recreation would be preserved and available consistent with the seasonal closures. Motorized equipment, motorboats, and aircraft introduce noise disturbance may influence the distribution of wildlife and reduce the wilderness experience for public visitors. Under all alternatives, the refuge would continue to prepare minimum requirements analyses to evaluate refuge management actions and determine how they can be conducted in a way that minimizes their impact on wilderness character. Under all alternatives, continue managing the existing Monomoy wilderness, and the Inward Point and Powder Hole (currently non-wilderness) exclusions to maintain or enhance 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 accord with Service wilderness stewardship policy (610 FW).		
Resource management activities, such as the base camp near the tern colony, roseate tern attraction devices, use of blinds, etc. can have short-term impacts on wilderness character. Some birding groups exceed a maximum size of 20 and can impact the sense of solitude. There would be no changes in land use or land ownership and no new or expanded refuge management activities or refuge uses that would significantly alter the existing physical landscape of the islands. Solitude within the Monomoy wilderness would temporarily be interrupted during the construction of an alternative energy facility, as there would be a higher than normal amount of people on the island and increased noise during the construction phase of this project; it would return to normal once construction is completed.	Under alternative B, the refuge expects the greatest increase in public use. This could have impacts on the wilderness values of solitude and primitiveness, but we do not anticipate that it would significantly detract from the overall wilderness character of the refuge or Monomoy wilderness. Impacts from the proposed alternative energy facility would be the same as described under alternative A.	Under this alternative, we would not install any form of alternative energy at the Monomoy Point Light Station and motorized transportation to the refuge uplands and tidal flats would be replaced with nonmotorized forms. This would bring the greatest benefit to sustaining wilderness characteristics of solitude, primitive recreation, and being affected primarily by the forces of nature

Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred)	Alternative C: Natural Processes
Effects on Public Uses and Access		
Impacts Common to All Alternatives		
Under all alternatives, we would continue to provide compatible wildlife-dependent activities that can be supported with respective staff and budget projections. We would maintain our infrastructure to support those activities and provide safe access. We would continue to conduct outreach to visitors and the local communities to instill an appreciation of the Refuge System and the refuge, its resources, and our priorities for management.		
We would maintain the existing programs for five of the six priority public uses. Adequate opportunities for wildlife observation and photography would continue to be provided. Under alternative A, we would continue to provide at least the current level of interpretation and explore the appropriateness of virtual technology to conduct interpretation. Environmental education would not become more developed under this alternative. We would continue to allow Chatham residents and refuge visitors to harvest shell fish using traditional (non-mechanized) hand raking methods. The visitor contact station would not be expanded and would continue to be inadequate to meet the needs of the staff and environmental education and interpretation programs on the refuge.	Alternative B proposes that we work toward meeting the increased demand for opportunities to observe wildlife by constructing additional trails, observation areas, and photography blinds, and making the boardwalk Americans with Disabilities Act-compliant. The development of an alternative visitor contact station in either downtown Chatham or Harwich with shuttle services to Morris Island would allow the public greater access, reduce traffic congestion, and ease parking problems. We would increase and improve our environmental education and interpretation programs, which would provide the indirect benefit of a greater understanding by the public of the importance of the refuge and its management. Adverse impacts related to increased visitation would be greater under this alternative due to the increased number of education and interpretation opportunities. Paid parking may deter some visitors, but the effect is expected to minimal. Seasonal area closures to protect wildlife, as well as short-term closures during construction for the safety of our visitors, would continue to inconvenience some visitors. Constructing new interpretive and informational signs would provide opportunities for providing a conservation message to visitors, thus increasing their awareness, and possibly, their support of the refuge. The addition of a visitor contact station in the local community would further increase the effectiveness of an expanded visitor services program, as well as improve the refuge's exposure to new visitors who would receive information about the refuge. The installation of an alternative energy facility at the Monomoy Point Light Station would provide electricity and support the eventual use of this site for cultural history tours. Under this alternative, we would allow the harvest of subterranean shellfish species by using hand tools and no other artificial means, such as salt or chlorine. Hand harvest of scallops and the harvest of lobster, crab (not including horseshoe crab), and whelk would be allowed. We would prohibit the harvest of mussels. We would prohibit the activity of mechanical harvesting (i.e., dredging) above mean low tide, as well as the use of carts or any equipment with wheels within the Monomoy wilderness. Some individuals engaged in clam harvest will be inconvenienced by the restriction on carts; some may decide to harvest clams elsewhere. Some individuals may move to other areas in Chatham to harvest scallops, mussels and oysters. This could increase competition among individuals and result in some people not harvesting as many of those shellfish species.	Alternative C would decrease opportunities for wildlife-dependent public use and access from alternatives A and B. Under this alternative, we would no longer allow motorized transportation to the refuge and would establish a concessionaire to provide nonmotorized access to the refuge. We anticipate that wilderness enthusiasts would benefit the most under this alternative. There would be significantly greater opportunities to experience the solitude of the Monomoy wilderness, since we expect that fewer individuals would engage in nonmotorized access to the refuge. Implementing an entrance fee system may deter some visitors, but the effect is expected to minimal. Raising funds will enable refuge staff to provide services or public use facilities that it would not be able to do otherwise. Alternatives to those who harvest shellfish are the same as alternative B.

Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred)	Alternative C: Natural Processes
Effects on Socioeconomic Resources		
Impacts Common to All Alternatives		
Regardless of which alternative we select, we would continue to pay refuge revenue sharing each year to the Town of Chatham. Refuge management jobs, income, and expenditures would have negligible benefits to the local economy, but the expenditures of refuge visitors would continue to add some benefits for the local economy. The socioeconomic impacts of designated wilderness areas include direct use benefits, such as recreation, community quality of life; scientific benefits, such as research and education; offsite benefits, such as increased property values; biodiversity conservation; ecological services; and passive benefits, such as conserving wild lands for future generations.		
The expected increase in visitation of an average 1.5 percent annual rate of increase over the next 15 years would continue to contribute to the local economy through the consumption of goods and services, equipment rentals, and other expenditures associated with recreational opportunities made available on the refuge. Alternative A would maintain the current work force of three full-time employees. Refuge projects and base salaries would total approximately $180,000 annually.	The addition of seven full time staff would minimally increase benefits for the local economy in jobs, income, and expenditures. If fully funded, recurring salary and project costs would approximate $700,000 annually. Construction activities like renovation of the existing headquarters or a downtown visitor contact station would temporarily provide several construction jobs to the local area, although would have a minimal effect to the region's overall economy. Enhancing refuge programs, and using a concessionaire who could employ several individuals, would support an increase in visitors, thereby increasing their expenditures in the local economy.	The addition of five full-time staff would minimally increase benefits for the local economy in jobs, income, and expenditures. Benefits would be similar to those under alternative B, with an annual recurring cost estimated at $86,000.

Alternative A: Current Management	Alternative B: Enhanced Management of Habitat and Public Uses (Service-preferred)	Alternative C: Natural Processes
Effects on Cultural and Historical Resources		
Impacts Common to All Alternatives		
Regardless of which alternative we select, we would protect known cultural and historic resources. Further, under all scenarios, the refuge would communicate the importance of understanding and appreciating the area's rich cultural history and how it relates to our natural history. We would also continue to do section 106 compliance for all individual projects. Our habitat management activities have the potential risk of disturbing unknown sites, as well as the risk that some visitors may inadvertently or intentionally damage or disturb known or undiscovered sites.		
Under alternative A, we would follow Service protocol to prevent the loss of cultural, historic, and archaeological resources, record items or sites as they are encountered, and comply with the provisions of the National Historic Preservation Act. We would also maintain the historic Monomoy Point Light Station. Maintenance and repairs to the light station and associated structures would help preserve those historical resources from weather damage. We lack staff with training in the Archaeological Resources Protection Act and National Historic Preservation Act, a refugewide cultural resources overview, a cultural resources plan, and partnerships to cooperatively protect resources; this currently does not allow us to be fully proactive in evaluating and protecting sites.	In addition to the beneficial impacts as described under alternative A, we would maintain the historic Monomoy Point Light Station using volunteers and would foster a greater appreciation of its value by potentially opening it up to public visitation. The benefits for cultural and historic resources would increase in alternative B because we would complete a cultural resources overview, maintain an inventory of known and newly found sites and structures, develop a cultural resources management plan, conduct archaeological surveys, and assess the conditions of the two known Native American sites on Morris Island.	In addition to the actions mentioned in alternative A, this alternative provides a moderate level of cultural resource protection from the effects of erosion. If erosion poses an imminent threat to the site of the Monomoy Point Light Station in the next 15 years, we would develop a mitigation plan for the light station.

Chapter 5

USFWS

Federally threatened northeastern beach tiger beetle

Consultation and Coordination

- Introduction
- Planning to Protect Land and Resources
- Contact Information

Introduction

We presented in chapter 1, figure 1.1, the steps in the comprehensive conservation planning process and how it integrates NEPA requirements, including public involvement. This chapter describes how we engaged others in developing this draft CCP/EA and how we plan to continue consulting and coordinating with others in the future. In chronological order, it details our efforts to encourage the involvement of the public and conservation partners, the partnership of other Federal and State agencies, civic, public, and private conservation and education organizations, and user groups. It also identifies who contributed in writing the plan or significantly contributed to its contents.

It does not detail the dozens of informal discussions refuge staff have had over the last 10 years in which the CCP was a topic of conversation. Those involved a wide range of audiences, including congressional representatives or their staffs, local community leaders and other residents, refuge neighbors, refuge visitors, and other interested individuals. During those discussions, the refuge manager and staff often would provide an update on our progress and encourage comments and other participation.

A 60-day period for public review follows our release of this draft CCP/EIS. We encourage you to respond with your ideas about the plan. During that period, we will host open house public meetings at locations near the refuge to gather your opinions and answer your questions about our proposals. We will consider your responses carefully before we write the final CCP.

According to Service policy, we must review and update our final CCP at least once every 15 years, sooner in response to important new information that would markedly change management direction, or if our Director or Regional Director deems it necessary. If so, we will once again announce our revised planning and encourage your participation.

Planning to Protect Land and Resources

Our refuge planning began in 1999 when we initiated a CCP that would encompass all the refuges in the Eastern Massachusetts NWR Complex. We published a notice of intent (NOI) in the *Federal Register*, and began public scoping efforts. In February 1999, we held open houses in each unit for public comment on different issues including current and future management strategies, land protection, and public uses. We were pleased with the participation at many of our meetings, which ranged from 30 people to more than 100. We recognized that attending our open houses would be difficult for many, and designed an issues workbook to encourage additional comments for those unable to attend. Those workbooks allowed people to share what they valued most about the refuge, their vision for its future and the Service's role in their community, and any other issues they wanted to raise. More than 8,000 people representing a variety of interests received workbooks. Workbooks were also available at open houses and at the refuge headquarters. We received over 660 responses. The responses for Monomoy refuge were considered in the development of issues for this CCP.

In February 2001, we determined that writing a plan for eight refuges was too cumbersome, so we delayed our planning for Monomoy NWR and changed our focus on CCPs for the three northernmost refuges in the complex. In 2004, in an effort intended to initially "re-scope" the issues surrounding management of Monomoy refuge, we asked the independent, nonpartisan, nonprofit facilitator, the Consensus Building Institute (CBI), to conduct an assessment that would provide specific, detailed recommendations for stakeholder involvement and participation in the planning process. Between November 15 and December 23, 2004, CBI conducted 15 interviews with 19 individuals either in-person or over the phone. We sought to provide CBI with a diverse set of stakeholders who

might identify many, if not most, of the issues relevant to management of the refuge. Some interviewees suggested additional individuals to interview. CBI interviewed a selection of stakeholders, from local businesses and residents to elected and appointed officials. CBI received several comments via e-mail and phone.

Also in 2004, we decided to prepare a joint CCP for Nomans Land and Monomoy refuges, and subsequently convened a new core planning team. An NOI to prepare the Monomoy CCP and environmental impact statement was published in the *Federal Register* on December 13, 2004.

Public scoping meetings were held in April 2005 in Chatham, Sudbury, and Chilmark, Massachusetts. More than 300 people attended these meetings. Most of the planning effort during this period was focused on the CCP for the Monomoy refuge. We discussed management issues, drafted a vision statement and tentative goals, and compiled a project mailing list of known stakeholders, interested individuals, organizations, and agencies. However, work on writing the CCP stalled as research was conducted on Monomoy Island by Service staff and consultants hired by the town. Additionally, in 2007, the refuge planner coordinating the CCP transferred to a different position within the Service. In the summer of 2008, it was decided to conduct separate CCPs for Nomans Land Island and Monomoy NWRs.

After identifying additional data gaps, we contracted with the Provincetown Center for Coastal Studies to conduct a geomorphological analysis of the Monomoy barrier system. We also contracted for an analysis that estimated the impact of sea level rise on the refuge.

Throughout 2009 and 2013, the core planning team, consisting of refuge and regional staff, met in Chatham and Sudbury. Other members of the core planning team, including a representative from the Department of Fish and Game and Wampanoag Tribe of Gay Head (Aquinnah), did not participate in the meetings.

At each meeting, the objectives and strategies were discussed, as well as the issues identified by previous scoping efforts and the core planning team. We reworked a vision statement, revisited previously drafted goals and objectives, identified new issues, determined what additional resource information we needed to collect and summarize, and discussed what other experts we should consult to help us address planning issues. A summary of the planning process was presented, and people were encouraged to provide feedback and identify general concerns or issues they have about the refuge. We worked to develop our three alternatives and wrote the draft CCP/EIS, including 6 chapters, 10 appendices, and a bibliography and glossary and acronyms. In March 2013, we distributed a newsletter summarizing the alternatives in detail and updating our planning timeframes. In May 2013, we prepared the draft CCP/EIS for internal review.

During this time, we completed the Nomans Land Island NWR CCP and the Nantucket NWR CCP, and began working on the Mashpee NWR and Massasoit NWR CCPs, which are still in progress.

Updating Various Constituents on our Progress

The refuge has provided updates on the CCP process to the local community and other constituents through a variety of methods. Following the release of the NOI, the public was informed and public comments solicited through a variety of additional mechanisms. The CCP process information was posted on the CCP planning Web site. In addition, news releases requesting public input as part of the draft CCP/EA scoping process were sent to 49 local and regional newspapers.

A flyer requesting input and advertising the public meetings was made available at the refuge visitor contact station. Lastly, public scoping newsletters and public meeting invitations were sent via e-mail or U.S. Postal Service to more than 300 individuals (private citizens, interest groups, academia, and representatives of local, State, and Federal agencies, and tribes). Planning updates were sent to individuals and agencies on the CCP mailing list in Winter 2004, Summer 2005, Winter 2005, Fall 2006, Spring 2007, Fall 2007, Summer 2008, and March 2012.

Contact Information

Elizabeth Herland, Project Leader
Eastern Massachusetts National Wildlife Refuge Complex
73 Weir Hill Road
Sudbury, Massachusetts 01776
Phone: 978-443-4661, ext. 11
libby_herland@fws.gov
http://www.fws.gov/refuge/great_meadows

Carl Melberg, Natural Resource Planner
U.S. Fish and Wildlife Service
73 Weir Hill Road
Sudbury, Massachusetts 01776
Phone: 978-443-4661, ext. 32
http://northeast.fws.gov/planning

Chapter 6

USFWS

Hudsonian godwits

List of Preparers

- Members of the Core Planning Team
- Other Service Program Involvement
- List of Preparers

Members of the Core Planning Team

Elizabeth Herland, *Project Leader,* Eastern Massachusetts NWR Complex

Tom Eagle, *Deputy Project Leader,* Eastern Massachusetts NWR Complex

Carl Melberg, *Natural Resource Planner,* Planning Team Leader, Eastern Massachusetts NWR Complex

Dave Brownlie, *Refuge Manager,* Monomoy NWR

Stephanie Koch, *Wildlife Biologist,* Eastern Massachusetts NWR Complex

Susan J. Russo, *Visitor Services Manager,* Eastern Massachusetts NWR Complex

Matthew Boarman, *Fish and Wildlife Biologist,* Monomoy NWR

Kate Iaquinto, *Wildlife Biologist,* Monomoy NWR

Nick Ernst, *Wildlife Biologist,* Monomoy NWR

Brian Willard, *Supervisory Law Enforcement Officer,* Eastern Massachusetts NWR Complex

Edward Maillet, *Economist,* USFWS Division of Economics, Headquarters Office

D.J. Monette, *Native American Liaison,* USFWS, Division of External Affairs, Region 5 Regional Office

Bret Stearns, *Wampanoag Tribe of Gay Head (Aquinnah)*

Bettina Washington, *Tribal Historic Preservation Officer,* Wampanoag Tribe of Gay Head (Aquinnah)

Quan Tobey, *Natural Resources Department,* Mashpee Wampanoag Tribe

Chuckie Green, *Natural Resources Department,* Mashpee Wampanoag Tribe

Jason Zimmer, *District Manager,* MA Division of Fisheries and Wildlife

Paul Caruso, *Fisheries Biologist,* MA Division of Marine Fisheries

Other Service Program Involvement

Bill Perry, *Refuge Planner,* USFWS Refuge System, , Region 5 Regional Office

Nancy McGarigal, *Refuge Planner,* USFWS Refuge System, Region 5 Regional Office

Meredith Bixby, *Assistant Refuge Planner,* USFWS Refuge System, Region 5 Regional Office

Timothy Binzen, *Archaeologist,* USFWS Refuge System, Region 5 Regional Office

John Wilson, *Archaeologist,* USFWS Refuge System, Region 5 Regional Office

Shelley Small, *Cultural Resources Specialist,* USFWS Refuge System, Region 5 Regional Office

Rick Schauffler, *Biologist/GIS Specialist,* USFWS Refuge System, Great Bay NWR

Michael Hayden, *Regional Land Surveyor,* USFWS Refuge System, Region 5 Regional Office

Jan Taylor, *Regional Refuge Biologist,* USFWS Refuge System, Region 5 Regional Office

Laura Eaton, *Assistant Regional Biologist,* USFWS Refuge System, Great Bay NWR

Suzanne Paton, *Biologist,* USFWS Coastal Program, Southern New England-New York Bight

Caleb Spiegel, *Wildlife Biologist,* Division of Migratory Birds, Region 5 Regional Office

Nancy Roeper, *Wilderness Coordinator,* USFWS, Headquarters Office

Rick Vollick, *former Regional Fire Planner,* USFWS Refuge System, Region 5 Regional Office

Peggy Hobbs, *former Administrative Officer,* Eastern Massachusetts NWR Complex

Pamela Carota, *former Office Assistant,* Eastern Massachusetts NWR Complex

Chris Kelly, *Refuge Complex Law Enforcement,* Eastern Massachusetts NWR Complex

Michael Brady, *former Monomoy NWR Refuge Manager*

Monica Williams, *former Wildlife Biologist,* Monomoy NWR

Robin Lepore, *USFWS Regional Solicitor's Office*

Marla Hamilton, *Biological Pathways Employee,* Monomoy NWR

Susi von Oettingen, *Wildlife Biologist,* USFWS Ecological Services New England Field Office

Yianni Laskaris, *former Volunteer Intern,* Monomoy NWR

List of Preparers

Amanda Hemmerich, *Environmental Resources Planner,* Dynamac/CSS Corporation

Oliver van den Ende, *former Environmental Resources Planner,* Dynamac/CSS Corporation

Karen Terwilliger, *President and Natural Resource Consultant,* Terwilliger Consulting, Inc.

Vanasse Hangen Brustlin, Inc., Watertown, Massachusetts

Bill Thompson/USFWS

Short-eared owl

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USFWS

Winter on the refuge

Acronyms and Glossary

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Acronyms

Acronym	Full Name
ACJV	Atlantic Coast Joint Venture
ADA	Americans with Disabilities Act
AHWP	Annual habitat work plan
AOI	Area of interest
AP	Atlantic population (Canada geese)
ARPA	Archeological Resources Protection Act of 1960
ATV	All-terrain vehicle
BBS	Breeding bird survey
BCC	Birds of conservation concern
BCR	Bird Conservation Region
BMP	Best Management Practice
BP	Before present
CAA	Clean Air Act
CATEX	Categorical exclusion
CBI	Consensus Building Institute
CD	Compatibility determination
CCMP	Comprehensive conservation and management plan
CCP	Comprehensive conservation plan
CCSP	U.S. Climate Change Science Program
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMR	Code of Massachusetts Regulations
CWA	Clean Water Act
CVI	Coastal vulnerability index
CWCS	Comprehensive wildlife conservation strategy
DDT	Dichlorodiphenyltrichloroethane (pesticide)
DO	Dissolved oxygen
EA	Environmental assessment
EE	Environmental education
EIS	Environmental impact statement
ENSP	Endangered and Nongame Species Program

Acronym	Full Name
EOD	Explosive ordnance disposal
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of no significant impact
FTE	Full-time equivalent
FUDS	Formerly used defense site
FWS	U.S. Fish and Wildlife Service
FY	Fiscal year
GCN	Greatest conservation need
GHG	Greenhouse gas
GIS	Geographic information system
GS	General schedule
HMP	Habitat management plan
IBA	Important Bird Area
IMP	Inventory and monitoring plan
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated pest management
IPMP	Integrated pest management plan
LCC	Landscape conservation cooperative
LE	Law Enforcement
LWCF	Land and Water Conservation Fund
LPP	Land protection plan
MA DEP	Massachusetts Department of Environmental Protection
MANEM	Mid-Atlantic/New England/Maritimes region
MAPS	Monitoring avian productivity and survivorship
MBCF	Migratory Bird Conservation Fund
MBTA	Migratory Bird Treaty Act
MDFW or MassWildlife	Massachusetts Division of Fisheries and Wildlife
MEC	Munitions and explosives of concern
MHW	Mean high water

Acronym	Full Name
MLW	Mean low water
MOA	Memorandum of agreement
MOU	Memorandum of understanding
MRA	Minimum requirement analysis
MRDG	Minimum requirements decision guide
MWWS	Mid-winter waterfowl survey
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NAC	North Atlantic coast
NAGPRA	Native American Graves Protection and Repatriation Act
NAI	National Association for Interpretation
NAS	National Audubon Society
NAWCP	North American Waterbird Conservation Plan
NAWMP	North American Waterfowl Management Plan
NEPA	National Environmental Policy Act of 1969
NGO	Non-governmental organization
NHESP	Natural Heritage and Endangered Species Program
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NOA	*Federal Register* Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	*Federal Register* Notice of Intent
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWR	National Wildlife Refuge
NWLON	National Water Level Observation Network
NWPS	National Wilderness Preservation System
NWRS	National Wildlife Refuge System
ORV	off-road vehicle
ORW	Outstanding resource waters

Acronym	Full Name
PARC	Partners in Amphibian and Reptile Conservation
PCB	Polychlorinated biphenyl (pesticide)
PDA	Personal digital assistant
PIF	Partners in Flight
RNA	Research natural area
RONS	Refuge Operations Needs System
SAMMS	Service Assist Maintenance System
SAMP	Special area management plan
SGNC	Species of greatest conservation need
SET	Salt marsh elevation table
SHC	Strategic habitat conservation
SHPO	State Historic Preservation Officer
SLAMM	Sea level affecting marshes model
SUP	Special use permit
SWG	State Wildlife Grant Programs
SWQS	Surface water quality standards
THPO	Tribal Historic Preservation Officer
TMDL	Total maximum daily load
TNC	The Nature Conservancy
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VC	Visitor center
WCS	Water control structure
WG	Wage grade
WMA	Watershed management area
WSA	Wilderness study area
WSHRN	Western Hemispheric Shorebird Reserve Network

Glossary

accessibility — the state or quality of being easily approached or entered, particularly as it relates to complying with the Americans With Disabilities Act (ADA)

accessible facilities — structures accessible for most people with disabilities without assistance; facilities that meet Uniform Federal Accessibility Standards; ADA-compliant parking lots, trails, pathways, ramps, picnic and camping areas, restrooms, boating facilities (docks, piers, gangways), fishing facilities, playgrounds, amphitheaters, exhibits, audiovisual programs, and wayside sites

adaptation — adjustment to environmental conditions

adaptive management — focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable ecosystems

Adaptive management:

- helps science managers maintain flexibility in their decisions, knowing that uncertainties exist, and provides managers with the latitude to change direction
- will improve understanding of ecological systems to achieve management objectives
- is about taking action to improve progress toward desired outcomes

(Source: Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2007. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.)

aggregate — many parts considered together as a whole

agricultural land — non-forested land (now or recently orchards, pastures, or crops)

alternative — a reasonable way to fix an identified problem or satisfy a stated need [40 CFR 1500.2 (cf. "management alternative")]

appropriate use — a proposed or existing use on a refuge that meets at least one of the following three conditions:

- the use is a wildlife-dependent one
- the use contributes to fulfilling the refuge purpose(s), the System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the National Wildlife Refuge System Improvement Act was signed into law
- the use has been determined appropriate as specified in section 1.11 of that act

approved acquisition boundary — a project boundary that the Director of the U.S. Fish and Wildlife Service approves upon completion of the planning and environmental compliance process. An approved acquisition boundary only designates those lands which the Service has authority to acquire or manage through various agreements. The approval of an acquisition boundary does not grant the Service jurisdiction or control over lands within the boundary, and it does not make lands within the refuge boundary part of the National Wildlife Refuge System. Lands do not become part of the System until the Service buys them or they are placed under an agreement that provides for their management as part of the System.

anadromous fish — from the Greek, literally "up-running;" fish that spend a large portion of their life cycle in the ocean and return to fresh water to breed

aquatic — growing in, living in, or dependent upon water

aquatic barrier — any obstruction to fish passage

area of biological significance — see "special focus area"

avian — of or having to do with birds

avifauna — all birds of a given region

barrens — a colloquial name given to habitats with sparse vegetation or low agricultural productivity

barrier — see "aquatic barrier"

basin — the land surrounding and draining into a water body (cf. "watershed")

benthic — living at, in, or associated with structures on the bottom of a body of water

best management practices — land management practices that produce desired results

[N.B. Usually describing forestry or agricultural practices effective in reducing nonpoint source pollution, like reseeding skidder trails or not storing manure in a flood plain. In their broader sense, practices that benefit target species.]

biological diversity or biodiversity — the variety of life and its processes; includes the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur

biological integrity — biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities

bird conservation region — regions that encompass landscapes having similar bird communities, habitats, and resource issues; used as an administrative tool to aid in the conservation of birds and their habitats

biota — the plant and animal life of a region

breeding habitat — habitat used by migratory birds or other animals during the breeding season

buffer species — alternate prey species exploited by predators when a more preferred prey is in relatively short supply, e.g., if rabbits are scarce, foxes will exploit more abundant rodent populations

buffer zones — land bordering and protecting critical habitats or water bodies by reducing runoff and nonpoint source pollution loading; areas created or sustained to lessen the negative effects of land development on animals, plants, and their habitats

candidate species plants and animals for which the U.S. Fish and Wildlife Service (FWS) has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act (ESA), but for which development of a proposed listing regulation is precluded by other higher priority listing activities (Source: *http://www.fws.gov/endangered/factsheets/candidate_species.pdf*)

categorical exclusion (CE, CX, CATEX) pursuant to the National Environmental Policy Act (NEPA), a category of Federal agency actions that do not individually or cumulatively have a significant effect on the human environment [40 CFR 1508.4]

CFR the Code of Federal Regulations

community the locality in which a group of people resides and shares the same government

community type a particular assemblage of plants and animals, named for its dominant characteristic

compatible use "The term 'compatible use' means a wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge."—National Wildlife Refuge System Improvement Act of 1997 [Public Law 105-57; 111 Stat. 1253]

compatibility determination a required determination for wildlife-dependent recreational uses or any other public uses of a refuge

comprehensive conservation plan (CCP) mandated by the 1997 Refuge Improvement Act, a document that provides a description of the desired future conditions and long-range guidance for the project leader to accomplish purposes of the refuge system and the refuge. CCPs establish management direction to achieve refuge purposes. [P.L. 105-57; FWS Manual 602 FW 1.4]

concern see "issue"

connectivity community occurrences and reserves have permeable boundaries and are subject to inflows and outflows from the surrounding landscape. Connectivity in the selection and design of nature reserves relates to the ability of species to move across the landscape to meet basic habitat requirements. Natural connecting features within the ecoregion may include river channels, riparian corridors, ridgelines, or migratory pathways

conservation managing natural resources to prevent loss or waste

[N.B. Management actions may include preservation, restoration, and enhancement.]

conservation agreements written agreements among two or more parties for the purpose of ensuring the survival and welfare of unlisted species of fish and wildlife or their habitats or to achieve other specified conservation goals. Participants voluntarily commit to specific actions that will remove or reduce threats to those species.

conservation easement a non-possessory interest in real property owned by another imposing limitations or affirmative obligations with the purpose of returning or protecting the property's conservation values

conservation status — assessment of the status of ecological processes and the viability of species or populations in an ecoregion

consultation — a type of stakeholder involvement in which decision-makers ask stakeholders to comment on proposed decisions or actions

cooperative agreement — a usually long-term habitat protection action, which can be modified by either party, in which no property rights are acquired. Lands under a cooperative agreement do not necessarily become part of the National Wildlife Refuge System.

critical habitat — according to U.S. Federal law, the ecosystems upon which endangered and threatened species depend

cultural resources — these consist of above-ground, architectural resources (structures), below-ground, archaeological resources (Native American or historical sites), artifacts, and other resources to which the criteria of eligibility for listing in the National Register of Historic Places may be applied. These resources are subject to protection under the National Historic Preservation Act (NHPA) and other applicable laws and regulations.

cultural resource overview — a comprehensive document prepared for a field office that discusses, among other things, project prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement of how program objectives should be met and conflicts resolved

[N.B. An overview should reference or incorporate information from a field office's background or literature search described in section VIII of the Cultural Resource Management Handbook (FWS Manual 614 FW 1.7).]

database — a collection of data arranged for ease and speed of analysis and retrieval, usually computerized

degradation — the loss of native species and processes due to human activities so that only certain components of the original biodiversity persist, often including significantly altered natural communities

designated wilderness area — an area designated by Congress as part of the National Wilderness Preservation System [FWS Manual 610 FW 1.5 (draft)]

desired future condition — the qualities of an ecosystem or its components that an organization seeks to develop through its decisions and actions

digitizing — the process of converting maps into geographically referenced electronic files for a geographic information system (GIS)

distribution pattern — the overall pattern of occurrence for a particular conservation target; in ecoregional planning projects, it is often referred to as the relative proportion of the target's natural range occurring within a given ecoregion (e.g. endemic, limited, widespread, disjunct, peripheral)

disturbance — any relatively discrete event in time that disrupts ecosystem, community, or population structure, and changes resources, substrate availability, or the physical environment

donation a citizen or group may wish to give land or interests in land to the Service for the benefit of wildlife, aside from the cost factor, these acquisitions are not different from any other means of land acquisition; gifts and donations have the same planning requirements as purchases

early successional species, assemblages, structures, and processes associated with pioneering natural communities that have recently experienced significant disturbance

ecological integrity native species populations in their historic variety and numbers naturally interacting in naturally structured biotic communities. For communities, integrity is governed by demographics of component species, intactness of landscape-level ecological processes (e.g., natural fire regime), and intactness of internal community processes (e.g., pollination)

ecological processes a complex mix of interactions among animals, plants, and their environment that ensures maintenance of an ecosystem's full range of biodiversity; examples include population and predator-prey dynamics, pollination and seed dispersal, nutrient cycling, migration, and dispersal

ecoregion a territory defined by a combination of biological, social, and geographic criteria, rather than geopolitical considerations; generally, a system of related, interconnected ecosystems

ecosystem a natural community of organisms interacting with its physical environment, regarded as a unit

ecotourism visits to an area that maintains and preserves natural resources as a basis for promoting its economic growth and development

edge effect the phenomenon whereby edge-sensitive species are negatively affected near edges by factors that include edge-generalist species, human influences, and abiotic factors associated with habitat edges. Edge effects are site-specific and factor-specific, and have variable depth effects into habitat fragments

electric fence made by Premier 1, powered by a solar panel connected to a 12-volt battery; each section of fencing is 150 feet long, 4 feet high and supported with doubled spiked PVC post

emergent wetland wetlands dominated by erect, rooted, herbaceous plants

endangered species a federally or state-listed protected species in danger of extinction throughout all or a significant portion of its range

endemic a species or race native to a particular place and found only there

environment the sum total of all biological, chemical, and physical factors to which organisms are exposed

environmental assessment (EA) a public document that discusses the purpose and need for an action and its alternatives, and provides sufficient evidence and analysis of its impacts to determine whether to prepare an environmental impact statement or a finding of no significant impact (q.v.) [cf. 40 CFR 1508.9]

environmental education curriculum-based education aimed at producing a citizenry that is knowledgeable about the biophysical environment and its associated problems, aware of how to help solve those problems, and motivated to work toward solving them

environmental health the composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment

environmental impact statement (EIS) a detailed, written analysis of the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources [cf. 40 CFR 1508.11]

estuaries deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from land

eutrophic a body of water (lake, pond, etc.) rich in mineral and organic nutrients that supports an abundance of plant life, particularly algae, which reduces the dissolved oxygen content and may cause the extinction of other organisms

evaluation examination of how an organization's plans and actions have turned out, and adjusting them for the future.

exclosure consisting of 1.3 m tall galvanized wire fencing, with a 5×10 cm mesh size and a 10 m circumference, exclosures are buried at least 20 cm into the sand and secured with rebar posts woven through the fencing and hammered into the ground to, at, or below the top of the fencing; the top of exclosures are covered with polypropylene, 2 cm mesh nylon bird netting (USFWS 1996b)

exotic species a species that is not native to an area and has been introduced intentionally or unintentionally by humans; not all exotics become successfully established

extinction the termination of any lineage of organisms, from subspecies to species and higher taxonomic categories from genera to phyla; extinction can be local, in which one or more populations of a species or other unit vanish but others survive elsewhere, or total (global), in which all the populations vanish

extirpated status of a species or population that has completely vanished from a given area but that continues to exist in some other location

fauna all animal life associated with a given habitat, country, area, or period

federal land public land owned by the Federal Government, including national forests, national parks, and national wildlife refuges

federally listed species a species listed either as endangered, threatened, or a species at risk (formerly, a "candidate species") under the Endangered Species Act of 1973, as amended

fee title acquisition the acquisition of most or all the rights to a tract of land; a total transfer of property rights with the formal conveyance of a title. While a fee-title acquisition involves most rights to a property, certain rights may be reserved or not purchased, including water rights, mineral rights, or use reservation (e.g., the ability to continue using the land for a specified time period, such as the remainder of the owner's life)

finding of no significant impact (FONSI) supported by an environmental assessment, a document that briefly presents why a Federal action will have no significant effect on the human environment, and for which an environmental impact statement, therefore, will not be prepared [40 CFR 1508.13]

fire regime the characteristic frequency, intensity, and spatial distribution of natural fires within a given ecoregion or habitat

flora all the plants found in a particular place

floodplain flat or nearly flat land that may be submerged by floodwaters; a plain built up or in the process of being built up by stream deposition

flyway any one of several established migration routes of birds

focal species a species that is indicative of particular conditions in a system (ranging from natural to degraded) and used as a surrogate measure for other species of particular conditions; an element of biodiversity selected as a focus for conservation planning or action. The two principal types of targets in conservancy planning projects are species and ecological communities

focus areas see "special focus areas"

forest land dominated by trees

fragmentation the disruption of extensive habitats into isolated and small patches; fragmentation has two negative components for biota: the loss of total habitat area, and the creation of smaller, more isolated patches of remaining habitat

geographic information system (GIS) a computerized system to compile, store, analyze, and display geographically referenced information; e.g., GIS can overlay multiple sets of information on the distribution of a variety of biological and physical features

grant agreement the legal instrument used when the principal purpose of the transaction is the transfer of money, property, services, or anything of value to a recipient in order to accomplish a public purpose of support or stimulation authorized by Federal statute and substantial involvement between the Service and the recipient is not anticipated (cf. "cooperative agreement") (Grants and Cooperative Agreement Act at 31 U.S.C. § 6305)

grassland a habitat type with landscapes dominated by grasses

groundwater water in the ground that is in the zone of saturation, from which wells and springs and groundwater runoff are supplied

habitat the place or type of site where species and species assemblages are typically found or successfully reproduce

[N.B. An organism's habitat must provide all of the basic requirements for life, and should be free of harmful contaminants.]

habitat conservation protecting an animal or plant habitat to ensure that the use of that habitat by the animal or plant is not altered or reduced

habitat fragmentation the breaking up of a specific habitat into smaller, unconnected areas

[N.B. A habitat area that is too small may not provide enough space to maintain a breeding population of the species in question.]

historic conditions the composition, structure, and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human-related changes to the landscape

hydrologic or flow regime characteristic fluctuations in river flows

hydrology the science of waters of the earth: their occurrences, distributions, and circulations; their physical and chemical properties; and their reactions with the environment, including living beings

impoundment a body of water, such as a pond, confined by a dam, dike, floodgate, or other barrier, which is used to collect and store water for future use

indicator species a species used as a gauge for the condition of a particular habitat, community, or ecosystem. A characteristic or surrogate species for a community or ecosystem.

indigenous native to an area

indigenous species a species that, other than as a result of an introduction, historically occurred or currently occurs in a particular ecosystem

integrated pest management (IPM) sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks

interpretive facilities structures that provide information about an event, place, or thing by a variety of means, including printed, audiovisual, or multimedia materials, e.g., kiosks that offer printed materials and audiovisuals, signs, and trail heads

interpretive materials any tool used to provide or clarify information, explain events or things, or increase awareness and understanding of the events or things, e.g., printed materials like brochures, maps or curriculum materials; audiovisual materials like video and audio tapes, films, or slides; interactive multimedia materials, CD-ROM or other computer technology

intertidal the area of land along a shoreline that is exposed to air during low tide but covered by water during high tide

inundation water covering normally dry land; coastal inundation due to sea level rise

invasive species an alien species whose introduction causes or is likely to cause economic or environmental harm or harm to human health

inventory a list of all the assets and liabilities of an organization, including physical, financial, personnel, and procedural aspects

invertebrate any animal lacking a backbone or bony segment that encloses the central nerve cord

issue — any unsettled matter that requires a management decision [e.g., a Service initiative, an opportunity, a management problem, a threat to the resources of the unit, a conflict in uses, a public concern, or the presence of an undesirable resource condition.]

[N.B. A CCP should document, describe, and analyze issues even if they cannot be resolved during the planning process (FWS Manual 602 FW 1.4).]

land protection plan — (LPP) a document that identifies and prioritizes lands for potential Service acquisition from a willing seller, and also describes other methods of providing protection. Landowners within project boundaries will find this document, which is released with environmental assessments, most useful

land trusts — organizations dedicated to conserving land by purchase, donation, or conservation easement from landowners

landform — the physical shape of the land reflecting geologic structure and processes of geomorphology that have sculpted the structure

landscape — a heterogeneous land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout

landscape approach — an approach to managing for species communities that focuses on landscape patterns rather than processes, and manages landscape elements to collectively influence groups of species in a desired direction; this approach assumes that by managing a landscape for its components, the naturally occurring species will persist.

late-successional — species, assemblages, structures, and processes associated with mature natural communities that have not experienced significant disturbance for a long time

lethal — capable of causing death

letterboxing — involves the placement of a cache containing a stamp and an inkpad that participants use to document that they have discovered a specific location. Participants find the location by following clues offered on the Web site (*www.letterboxing.org*) involving map coordinates or compass bearings; letterboxing does not require leaving or removing caches as part of the challenge

limiting factor — an environmental limitation that prevents further population growth

limits of acceptable change — a planning and management framework for establishing and maintaining acceptable and appropriate environmental and social conditions; monitoring used to track key indicators of environmental impacts resulting from recreation and other uses

management alternative — a set of objectives and the strategies needed to accomplish each objective [FWS Manual 602 FW 1.4]

management concern — see “issue” and “migratory nongame birds of management concern”

management opportunity — see “issue”

management strategy — a general approach to meeting unit objectives

[N.B. A strategy may be broad or may be detailed enough to guide implementation through specific actions, tasks, and projects (FWS Manual 602 FW 1.4).]

maritime relating to the ocean

marshlands areas interspersed with open water, emergent vegetation (hydrophytes), and terrestrial vegetation (phreatophytes)

matrix forming (or matrix community) communities that form extensive and contiguous cover may be categorized as matrix (or matrix-forming) community types. Matrix communities occur on the most extensive landforms and typically have wide ecological tolerances. They may be characterized by a complex mosaic of successional stages resulting from characteristic disturbance processes (e.g., New England northern hardwood-conifer forests). Individual occurrences of the matrix type typically range in size from 2,000 to 500,000 hectares. In a typical ecoregion, the aggregate of all matrix communities covers, or historically covered, as much as 75 to 80 percent of the natural vegetation of the ecoregion. Matrix community types are often influenced by large-scale processes (e.g., climate patterns, fire), and are important habitat for wide-ranging or large area-dependent fauna, such as large herbivores and birds

mechanical transport any device for moving people or material on, over, or through land, water, or air that has moving parts, provides a mechanical advantage to the user, and is powered by a living or nonliving power source. This includes, but is not limited to sailboats, hang gliders, parachutes, bicycles, carts, and wagons, but does not include wheelchairs when used by those whose disabilities require wheelchairs for locomotion, skis, snowshoes, rafts, canoes, sleds, travois, or similar devices.

mesic a type of habitat characterized by a moderate or well-balanced supply of moisture

mesotrophic a body of water (lake, pond, etc.) having a moderate amount of plant growth

migratory birds species that generally migrate south each fall from breeding grounds to their wintering grounds and vice versa in the spring

migratory nongame birds of management concern species of nongame birds that are believed to have undergone significant population declines, have small or restricted populations, or are dependent on restricted or vulnerable habitats

minimum tool an activity determined to be necessary to accomplish an essential task that makes use of the least intrusive tool, equipment, device, force, regulation, or practice that will achieve the wilderness management objective

(N.B. This is not the same as the term "primitive tool," which refers to the actual equipment or methods that make use of the simplest available technology, i.e., hand tools. (Source: *http://www.fs.fed.us/r1/recreation_r1/trails/final_minimum_decision_guide.pdf*)

mission statement a succinct statement of the purpose for which the unit was established; its reason for being

mitigation actions to compensate for the negative effects of a particular project, e.g., wetland mitigation usually restores or enhances a previously damaged wetland or creates a new wetland

motorized equipment machines that use or are activated by a motor, engine, or other power source. This includes, but is not limited to motorized portable tools, chain saws, aircraft, snowmobiles, generators, motorboats, and motor vehicles, but does not include small, handheld portable devices such as shavers, wristwatches, flashlights, cameras, stoves, cellular telephones, radios, GPS units, or other similar small equipment or motorized wheelchairs when used by those whose disabilities require wheelchairs for locomotion.

National Environmental Policy Act of 1969 (NEPA) requires all Federal agencies to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in planning and implementing environmental actions

[N.B. Federal agencies must integrate NEPA with other planning requirements and prepare appropriate NEPA documents to facilitate better environmental decision-making (cf. 40 CFR 1500).]

National Wildlife Refuge System (Refuge System) all lands and waters and interests therein administered by the Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas managed to preserve a national network for the conservation and management of fish, wildlife, and plant resources of the United States, for the benefit of present and future generations (National Wildlife Refuge System Improvement Act, 16 U.S.C. § 668dd)

native a species that, other than as a result of an introduction, historically occurred or currently occurs in a particular ecosystem

native plant a plant that has grown in the region since the last glaciation, and occurred before European settlement

natural disturbance event any natural event that significantly alters the structure, composition, or dynamics of a natural community, e.g., floods, fires, and storms

natural range of variation a characteristic range of levels, intensities, and periodicities associated with disturbances, population levels, or frequency in undisturbed habitats or communities

non-consumptive, wildlife-oriented recreation wildlife observation and photography and environmental education and interpretation (see "wildlife-oriented recreation")

non-lethal not resulting in or capable of causing death

non-native species see "exotic species"

nonpoint source pollution a diffuse form of water quality degradation in which wastes are not released at one specific, identifiable point but from a number of points that are spread out and difficult to identify and control

notice of availability (NOA) an announcement we publish in the *Federal Register* that we have prepared an environmental impact statement or an environmental assessment and that it is available for public review and comment

notice of intent (NOI) an announcement we publish in the *Federal Register* that we will prepare and review an environmental impact statement [40 CFR 1508.22]

objective see "unit objective"

obligate species a species that must have access to a particular habitat type to persist

outdoor education educational activities that take place in an outdoor setting

outdoor education project any cooperative venture that combines financial and staff resources to develop outdoor education activities like labs, field trips, surveys, monitoring, or sampling

palustrine wetlands "the Palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0%" —Cowardin et al. 1979

Partners for Wildlife Program a voluntary, cooperative habitat restoration program among the Service, other government agencies, public and private organizations, and private landowners to improve and protect fish and wildlife habitat on private land while leaving it in private ownership

partnership a contract or agreement among two or more individuals, groups of individuals, organizations, or agencies, in which each agrees to furnish a part of the capital or some in-kind service, e.g., labor, for a mutually beneficial enterprise

passive management protecting and monitoring key resources and conducting baseline inventories to improve our knowledge of the ecosystem

payment in lieu of taxes cf. Revenue Sharing Act of 1935, Chapter One, Legal Context

picnicking when the primary purpose of a visitor coming to the refuge is to have an outing that includes eating a meal with others. Visitors are allowed to have a snack and replenish themselves while participating in wildlife-dependent recreational uses, but the refuge is not intended to be a destination for outdoor eating

point source a source of pollution that involves discharge of waste from an identifiable point, such as a smokestack or sewage-treatment plant (Eckhardt, 1998)

population an interbreeding group of plants or animals; the entire group of organisms of one species

population monitoring assessing the characteristics of populations to ascertain their status and establish trends on their abundance, condition, distribution, or other characteristics

preferred alternative the alternative determined by the decision-maker that best achieves the refuge's purpose, vision, and goals; contributes to the Refuge System mission; addresses the significant issues; and is consistent with principles of sound fish and wildlife management

prescribed fire the application of fire to wildland fuels, either by natural or intentional ignition, to achieve identified land use objectives [FWS Manual 621 FW 1.7]

priority (general) public use a compatible wildlife-dependent recreational use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation

private land land owned by a private individual, group, or non-government organization

private organization any non-government organization

proposed wilderness an area of the Refuge System that the Secretary of the Interior has recommended to the President for inclusion in the National Wilderness Preservation System

protection mechanisms like fee title acquisition, conservation easements, or binding agreements with landowners that ensure land use and land management practices will remain compatible with maintaining species populations at a site (cf. "long-term ~")

public individuals, organizations, and non-government groups; officials of Federal, State, and local government agencies; Native American tribes, and foreign nations—includes anyone outside the core planning team, those who may or may not have indicated an interest in the issues, and those who do or do not realize that our decisions may affect them

public involvement offering an opportunity to interested individuals and organizations whom our actions or policies may affect to become informed; soliciting their opinions. We thoroughly study public input, and give it thoughtful consideration in shaping decisions about managing refuges

public involvement plan long-term guidance for involving the public in the comprehensive planning process

public land land owned by the local, State, or Federal Government

rare species species identified for special management emphasis because of their uncommon occurrence within a watershed

rare community types plant community types classified as rare by any State program; includes exemplary community types

recharge refers to water entering an underground aquifer through faults, fractures, or direct absorption

recommended wilderness areas studied and found suitable for wilderness designation by both the Director (FWS) and Secretary (DOI), and recommended by the President to Congress for inclusion in the National Wilderness System [FWS Manual 610 FW 1.5 (draft)]

record of decision (ROD) a concise public record of a decision by a Federal agency pursuant to NEPA

[N.B. A ROD includes:

- the decision
- all the alternatives considered
- the environmentally preferable alternative
- a summary of monitoring and enforcement, where applicable, for any mitigation
- whether all practical means have been adopted to avoid or minimize environmental harm from the alternative selected (or if not, why not).]

red tide common name for a phenomenon more currently known as algal bloom that causes reddish discoloration of coastal ocean waters.

refuge goals "descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose but do not define measurable units" (Writing Refuge Management Goals and Objectives: A Handbook, FWS January 2004)

refuge purposes "the terms 'purposes of the refuge' and 'purposes of each refuge' mean the purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit" (National Wildlife Refuge System Improvement Act of 1997)

refuge lands lands in which the Service holds full interest in fee title or partial interest, like an easement

relatively intact — the conservation status category indicating the least possible disruption of ecosystem processes. Natural communities are largely intact, with species and ecosystem processes occurring within their natural ranges of variation

relatively stable — the conservation status category between vulnerable and relatively intact, in which extensive areas of intact habitat remain but local species declines and disruptions of ecological processes have occurred

restoration — management of a disturbed or degraded habitat that results in the recovery of its original state, e.g., restoration may involve planting native grasses and forbs, removing shrubs, prescribed burning, or reestablishing habitat for native plants and animals on degraded grassland

riparian — referring to the interface between freshwater habitats and the terrestrial landscape

riparian habitat — habitat along the banks of a stream or river [cf. note above]

riverine — within the active channel of a river or stream

riverine wetlands — generally, all the wetlands and deepwater habitats occurring within a freshwater river channel not dominated by trees, shrubs, or persistent emergents

runoff — water from rain, melted snow, or agricultural or landscape irrigation that flows over a land surface into a water body (cf. "urban runoff")

scale — the magnitude of a region or process; refers to both spatial size, for example, a relatively small-scale patch or a relatively large-scale landscape, and a temporal rate, for example, relatively rapid ecological succession or relatively slow evolutionary speciation

Service presence — Service programs and facilities that it directs or shares with other organizations; public awareness of the Service as a sole or cooperative provider of programs and facilities

shrublands — habitats dominated by various species of shrubs, often with many grasses and forbs

sink population — a breeding group that does not produce enough offspring to maintain itself in future years without immigrants from other populations

site improvement — any activity that changes the condition of an existing site to better interpret events, places, or things related to a refuge, e.g., improving safety and access, replacing nonnatives with native plants, refurbishing footbridges and trailways, renovating or expanding exhibits

source population — a population in a high-quality habitat where the birth rate greatly exceeds the death rate and the excess individuals emigrate

spatial frame — within an ecoregion, natural terrestrial communities may be categorized into three functional groups on the basis of their current or historical patterns of occurrence, as correlated with the distribution and extent of landscape features and ecological processes; these groups are identified as matrix communities, large patch communities, and small patch communities

special focus area — an area of high biological value

[N.B. We normally direct most of our resources to SFA's that were delineated because of

- the presence of federally listed endangered and threatened species, species at risk (formerly, "candidate species"), rare species, concentrations of migrating or wintering waterfowl, or shorebird stopover habitat
- their importance as migrant landbird stopover or breeding habitat
- the presence of unique or rare communities
- the presence of important fish habitat.]

species — the basic category of biological classification intended to designate a single kind of animal or plant; any variation among the individuals may be regarded as not affecting the essential sameness that distinguishes them from all other organisms.

species assemblage — the combination of particular species that occur together in a specific location and have a reasonable opportunity to interact with one another

species at risk — a general term referring to species listed under the Endangered Species Act (ESA), as well as for unlisted species that are declining in population; sometimes the term is used interchangeably with "species of concern." Such species, unless already listed under ESA, receive no legal protection and use of the term does not necessarily imply that a species will eventually be proposed for listing (Source: *http://www.fws.gov/endangered/glossary.html*)

species of concern — an informal term referring to a species that might be in need of conservation action; this may range from a need for periodic monitoring of populations and threats to the species and its habitat, to the necessity for listing as threatened or endangered under the Endangered Species Act. Such species receive no legal protection and use of the term does not necessarily imply that a species will eventually be proposed for listing (Source: *http://www.fws.gov/endangered/glossary.html*)

species diversity — usually synonymous with "species richness," but may also include the proportional distribution of species

species richness — a simple measure of species diversity calculated as the total number of species in a habitat or community (Fiedler and Jain 1992)

stakeholder — individuals, groups, organizations, or agencies representing a broad spectrum of interests offering business, tourism, conservation, recreation, and historical perspectives

state agencies — natural resource agencies of State governments

state land — state-owned public land

state-listed species — a species listed as endangered, threatened, or a species of concern by a state

step-down management plan — a plan for dealing with specific refuge management subjects, strategies, and schedules, e.g., cropland, wilderness, and fire [FWS Manual 602 FW 1.4]

stopover site habitat where birds rest and feed during migration

strategy a specific action, tool, technique, or combination of actions, tools, and techniques for meeting unit objectives

strategic management the continual process of inventorying, choosing, implementing, and evaluating what an organization should be doing

succession the natural, sequential change of species composition of a community in a given area

surface water all waters whose surface is naturally exposed to the atmosphere, or wells or other collectors directly influenced by surface water

sustainable development the attempts to meet economic objectives in ways that do not degrade the underlying environmental support system

[N.B. There is considerable debate over the meaning of this term…we define it as "human activities conducted in a manner that respects the intrinsic value of the natural world, the role of the natural world in human well-being, and the need for humans to live on the income from nature's capital rather than the capital itself."]

symbolic fencing consisting of posts spaced approximately 50 feet apart, each post holds a 3-sided triangular sign (to discourage perching by avian predators) or a 4-sided rectangular sign that reads "Area Closed" or "Beach Closed." No physical barriers connect the posts and they are removed at the end of each season.) Fiberrod posts (½-inch diameter) and string are used in the Monomoy Wilderness

terrestrial living on land

territory an area over which an animal or group of animals establishes jurisdiction

threatened species a federally listed, protected species that is likely to become an endangered species in all or a significant portion of its range

tiering incorporating by referencing the general discussions of broad topics in environmental impact statements into narrower statements of environmental analysis by focusing on specific issues [40 CFR 1508.28]

tributary a stream or river that flows into a larger stream, river, or lake, feeding it water

trust resource a resource that the Government holds in trust for the people through law or administrative act

[N.B. A Federal trust resource is one for which responsibility is given wholly or in part to the Federal Government by law or administrative act. Generally, Federal trust resources are nationally or internationally important no matter where they occur, such as endangered species or migratory birds and fish that regularly move across state lines. This also includes cultural resources protected by Federal historic preservation laws and nationally important or threatened habitats, notably wetlands, navigable waters, and public lands, e.g., state parks and national wildlife refuges.]

turbidity refers to the extent to which light penetrates a body of water; turbid waters are those that do not generally support net growth of photosynthetic organisms

unexploded ordnance explosive weapons that did not explode when they were employed and still pose a risk of detonation

unit objective desired conditions that must be accomplished to achieve a desired outcome

[N.B. Objectives are the basis for determining management strategies, monitoring refuge accomplishments, and measuring their success. Objectives should be attainable, time-specific, and stated quantitatively or qualitatively (FWS Manual 602 FW 1.4).]

upland dry ground (i.e., other than wetlands)

urban runoff water from rain, melted snow, or landscape irrigation flowing from city streets and domestic or commercial properties that may carry pollutants into a sewer system or water body

virtual geocaching utilizes handheld GPS devices, but the goal of the activity is different, and the activity can be enjoyed without placing a physical cache. Virtual caching provides GPS coordinates to existing points of interest, such as a facility, cultural feature, wayside exhibit, or object in a public area

vision statement a concise statement of what the unit could achieve in the next 10 to 15 years

watchable wildlife program a tool for meeting wildlife conservation goals while at the same time fulfilling public demand for wildlife-dependent recreational activities (other than sport hunting, sport fishing, or trapping

[N.B. A watchable wildlife program is one that helps maintain viable populations of all native fish and wildlife species by building an active, well-informed constituency for conservation.]

watershed the geographic area that describes an area where all the water (subsurface and surface) converges in the same place, such as a particular river, stream, or body of water; a watershed includes both the land and the body of water into which the land drains

watershed networks systems for sharing in a geographic area (see "watershed") educational information, such as curriculum development projects, student activities, and ongoing data gathering; a combination of telecommunications and real-life exchanges of information

wetlands transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. These areas are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted to life in saturated soil conditions. (Source: Cowardin et al. 1979)

wilderness A wilderness, in contrast with those areas where humans and their own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by humans, where humans are visitors who do not remain. An area of wilderness is further defined to mean in the Wilderness Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which generally appears to have been affected primarily by the forces of nature, with the imprint of human work substantially unnoticeable; has outstanding opportunities for solitude or a primitive and unconfined type of recreation; has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value

wilderness study areas lands and waters identified by inventory as meeting the definition of wilderness and being evaluated for a recommendation to be included in the Wilderness System (cf. "recommended wilderness")

[N.B. A wilderness study area must meet these criteria

- generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable
- has outstanding opportunities for solitude or a primitive and unconfined type of recreation
- has at least 5,000 contiguous, roadless acres, or sufficient size to make practicable its preservation and use in an unimpaired condition. (FWS Manual 610 FW 1.5 (draft)).]

wildfire a free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands [FWS Manual 621 FW 1.7]

wildland fire every wildland fire is either a wildfire or a prescribed fire [FWS Manual 621 FW 1.3]

wildlife-dependent recreational use a use of a national wildlife refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation (National Wildlife Refuge System Administration Act of 1966)

wildlife management manipulating wildlife populations, either directly by regulating the numbers, ages, and sex ratios harvested, or indirectly by providing favorable habitat conditions, and alleviating limiting factors

wildlife-oriented recreation recreational activities in which wildlife is the focus of the experience

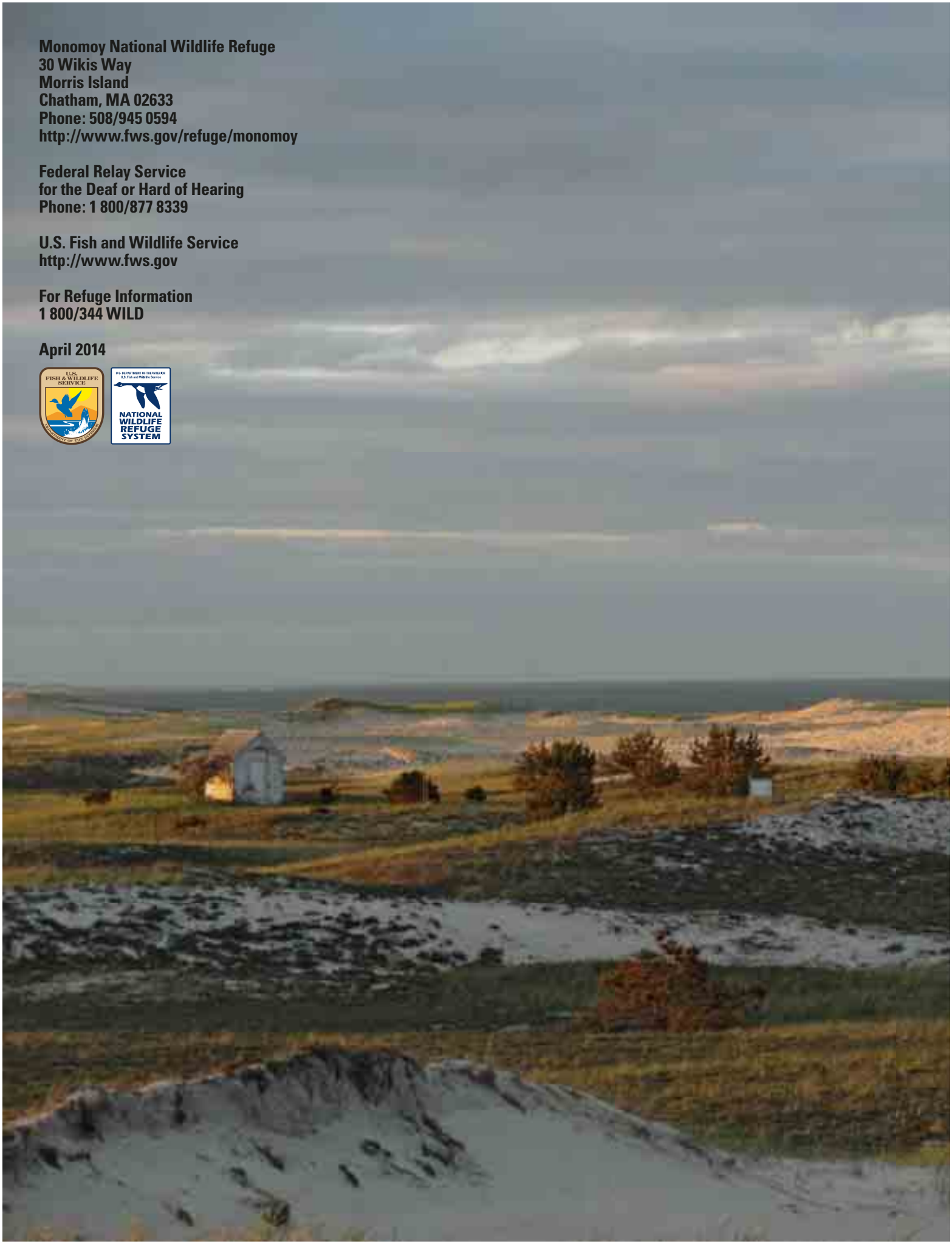
["The terms 'wildlife-dependent recreation' and 'wildlife-dependent recreational use' mean a use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation."—National Wildlife Refuge System Improvement Act of 1997]

wind turbine a machine for converting the kinetic energy of wind into mechanical energy, which is then converted to electricity.

Monomoy National Wildlife Refuge
30 Wikis Way
Morris Island
Chatham, MA 02633
Phone: 508/945 0594
http://www.fws.gov/refuge/monomoy

Federal Relay Service
for the Deaf or Hard of Hearing
Phone: 1 800/877 8339

U.S. Fish and Wildlife Service
http://www.fws.gov

For Refuge Information
1 800/344 WILD

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