



U.S. Fish & Wildlife Service

Monomoy National Wildlife Refuge

Comprehensive Conservation Plan

March 2016



Front and back covers:

Monomoy National Wildlife Refuge
Kate Iaquinto/USFWS

Insets:

Northeastern beach tiger beetle
USFWS

American oystercatcher
Kaiti Titherington/USFWS

Roseate tern (bottom right)
Kirk Rogers/USFWS

Piping plover (bottom center)
Gene Niemien/USFWS

Horseshoe crab (bottom left)
Gregory Breese/USFWS



*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

*Comprehensive Conservation Plan
March 2016*

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U.S. Fish & Wildlife Service

Monomoy National Wildlife Refuge

Comprehensive Conservation Plan

March 2016

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

Comprehensive Conservation Plan *March 2016*

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
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This final comprehensive conservation plan (CCP) for the 7,921-acre Monomoy National Wildlife Refuge (NWR, refuge) is the culmination of a planning effort involving Massachusetts state agencies, Federal partners, regional and local conservation partners, and the town of Chatham and its residents. This plan establishes 15-year goals and objectives for wildlife and habitats, wilderness resources, public use, administration, and facilities.

This CCP sets forth the management direction that we think best achieves the refuges' purposes, vision, and goals, and responds to public issues raised during the planning process. Under this plan, we will protect, manage, and restore habitats for species of conservation concern, protect wilderness resources, support compatible public uses, and increase our information and resource base in order to better respond to the dynamic ecological conditions typical of this landscape.

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Chapter 1



USFWS

Intertidal habitat on the refuge

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

Introduction

Monomoy National Wildlife Refuge (Monomoy NWR, refuge) stretches for 8 miles off the elbow of Cape Cod in the town of Chatham (Town), Barnstable County, Massachusetts. The refuge was established in 1944 as a sanctuary for migratory birds. Approximately 7,921 acres are managed as refuge including North Monomoy Island, South Monomoy Island, Minimoy Island, 40 acres on Morris Island where the headquarters and visitor contact station are located, and all waters within the Declaration of Taking (map 1.1 and map 1.2). 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 (WHSRN) regional site, an Important Bird Area (IBA), and a Marine Protected Area (MPA). The decommissioned Monomoy Point Light Station (lighthouse and keeper's house) on South Monomoy Island are listed on the National Register of Historic Places (NRHP).

The refuge boundary includes those areas above the MLW line on the eastern boundary and all lands and waters to the Declaration of Taking on the western boundary (map 1.1). Years of accretion on the eastern shoreline of South Monomoy Island, where Nauset and 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. As the precise location of the eastern boundary is uncertain, we entered into a Memorandum of Understanding (MOU) with the Town in June 2015 to administratively determine a management boundary on Nauset/South Beach. We describe this management boundary in chapter 3.

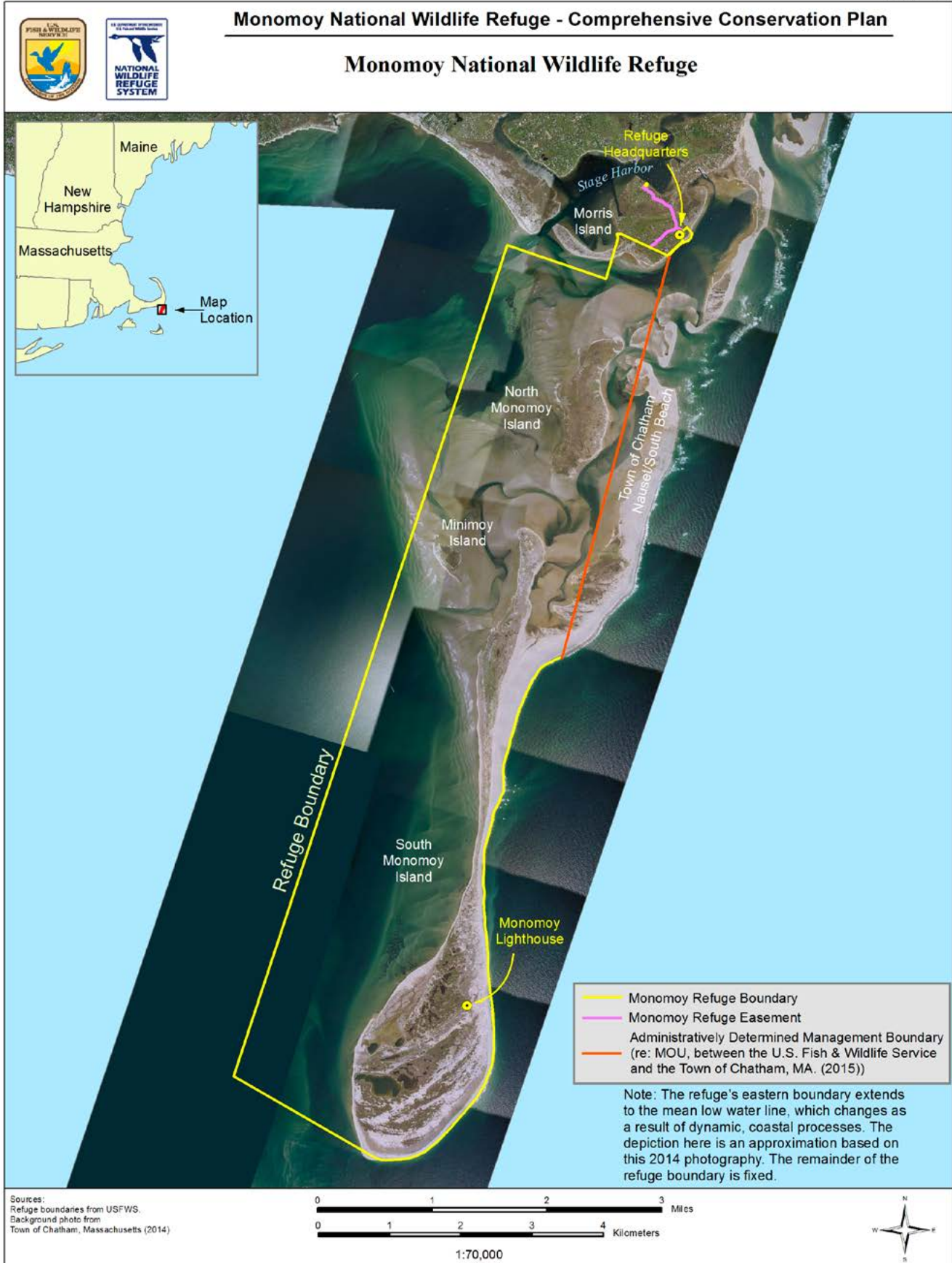
Monomoy NWR is one of eight refuges that make up the Eastern Massachusetts NWR Complex, which is headquartered in Sudbury, Massachusetts (map 1.4). The barrier islands are part of a dynamic coastal zone, characterized by an ever-changing landscape. Salt and freshwater marshes, dunes, and ponds provide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

This Comprehensive Conservation Plan (CCP) describes the U.S. Fish and Wildlife Service (Service, USFWS) management direction for Monomoy NWR. This CCP is the incorporates changes from the review of the final CCP/ environmental impact statement (EIS) which combined two documents required by Federal law:

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

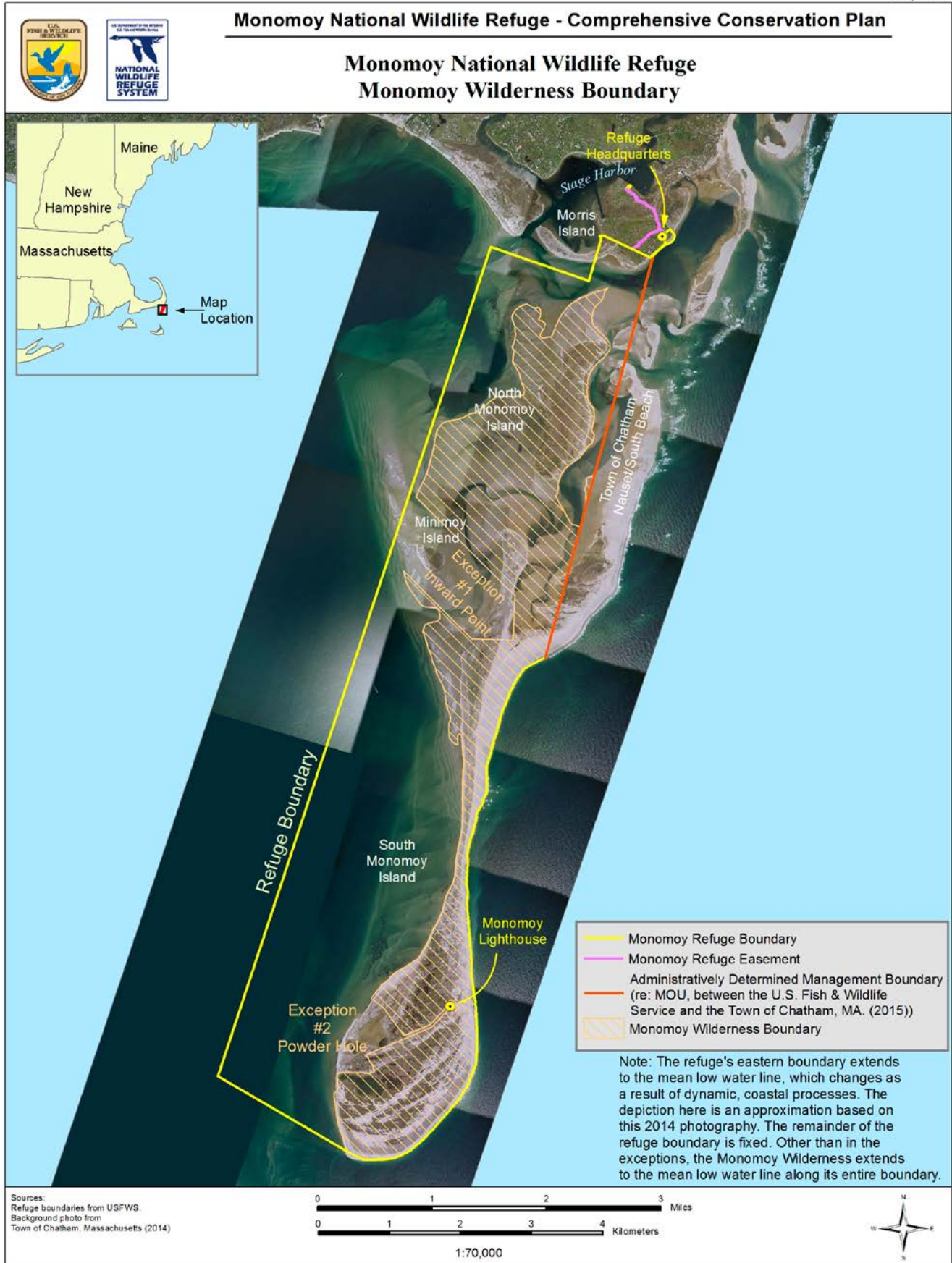
Comments received on the draft CCP/EIS, and our responses to them, can be found in appendix K. In appendix K, we also summarize all significant changes and modifications from the draft CCP/EIS to the final CCP/EIS. Our Northeast Regional Director made a decision based on the Service and National Wildlife Refuge System (Refuge System) missions, the purposes for which the refuge was established, other legal mandates, and public and partner comments on the CCP/EIS. The final decision identifies the desired combination of species protection, habitat management, public use and access, and administration for the refuge, as explained in the Record of Decision (ROD). The ROD, found in appendix N, presents and explains the decision, certifies that we have met agency compliance requirements, and notifies the reader that implementing the CCP will achieve the purposes of the refuge and help fulfill the Refuge System mission. We will notify

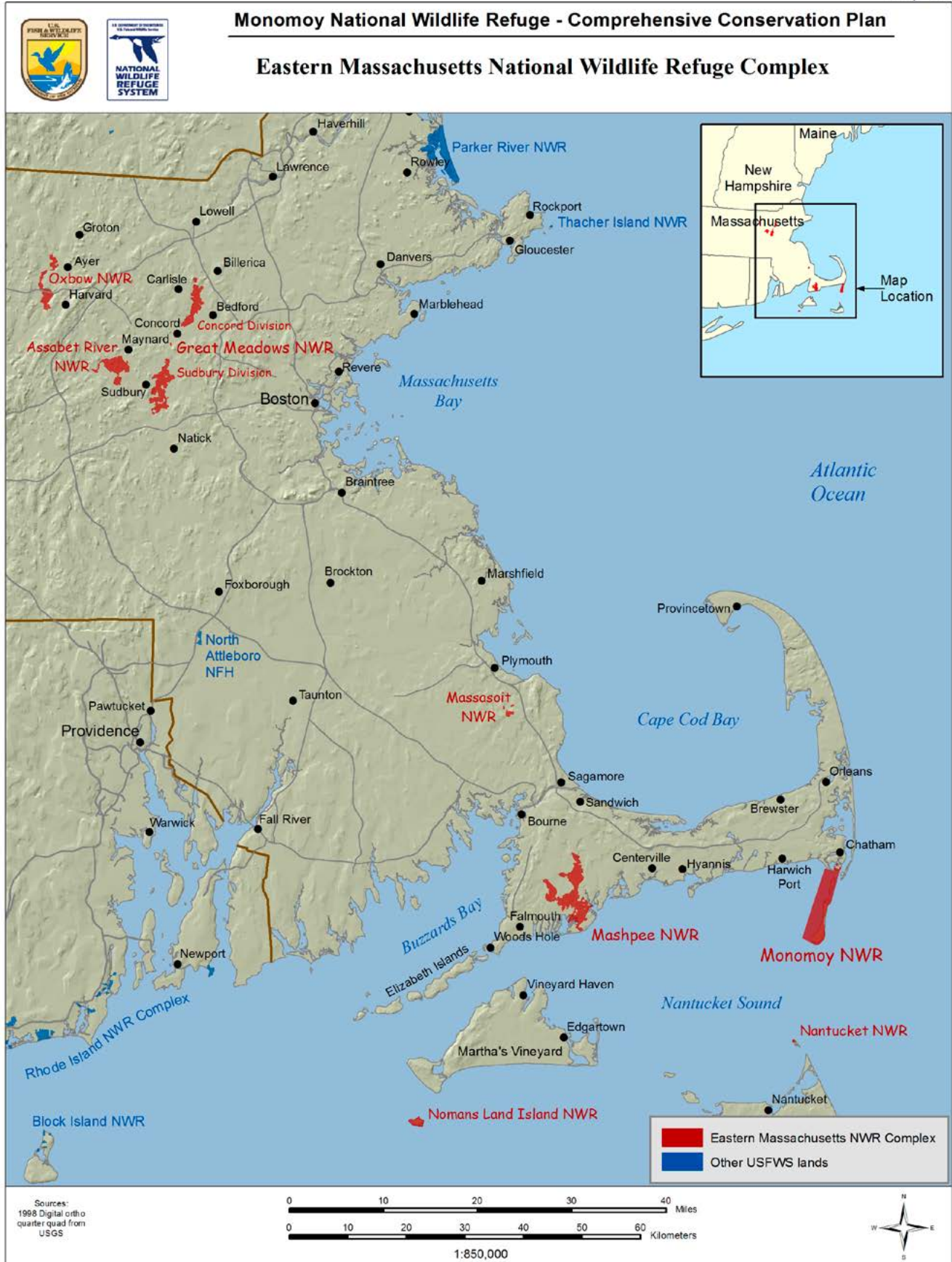
Map 1.1





Map 1.3





the public in the *Federal Register* of the availability of the ROD and the CCP, after which implementation can begin. This 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.

This CCP has 6 chapters and 14 appendices. 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 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.

Nesting common tern



Peter Paton 2013

Chapter 2, Comprehensive Conservation Planning, describes our planning process and its compliance with NEPA regulations and identifies public issues or concerns that surfaced during plan development. This chapter also contains a wilderness review.

Chapter 3, Existing Environment, describes the physical, biological, cultural, and socioeconomic environments of the refuge.

Chapter 4, Management Direction and Implementation, describes refuge goals, objectives and strategies which, when implemented, are designed to achieve our desired outcomes.

Chapter 5, Consultation and Coordination, summarizes how the Service involved the public and its partners in the planning process.

Chapter 6, List of Preparers, credits Service and non-Service contributors to all the documents that culminated in the development of the CCP.

Fourteen appendices, 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 have prepared 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 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, we evaluated a reasonable range of management alternatives and described their foreseeable impacts on the socioeconomic, physical, cultural,

and biological environment. Each alternative was designed 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 Refuge 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; pressures for public access have continued to grow; and new ecosystem and species conservation plans bearing directly on refuge management have been identified.

Third, the refuge has 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. 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 Service administers the Refuge System. The Service is an agency within the U.S. Department of the Interior (Department). 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 at <http://www.fws.gov/policy/manuals> (USFWS 2011a; accessed January 2016), contains the standing and continuing directives on implementing our authorities, responsibilities, and activities. The 600 series of the Service Manual addresses land use management. 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: <https://www.law.cornell.edu/cfr/text/50>; accessed November 2015.

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, over 560 refuges are part of the 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 Refuge 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 CCPs. 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.”—Refuge 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 which, 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 (NWPS) 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 Refuge 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).

Policy on Compatibility

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 CD. Other guidance in that chapter is as follows:

- The Refuge 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.”

Common tern



Peter Paton 2013

- 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 CD, 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 NWPS which 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 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 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 CCP.

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'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 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 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 Refuge Improvement Act requires the CCP for each refuge to identify archaeological and cultural values. All Service policies can be found at: <http://www.fws.gov/policy> (accessed January 2016).

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 Service Tribal Consultation Guide (Monette et al 2013).

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



Lighthouse

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 (NPS) 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 (NHPA).

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 federally 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 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 NRHP 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 NRHP. 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 Northeast regional historic preservation officer in Hadley, Massachusetts, oversees compliance with the NHPA and consultations with State Historic Preservation Offices (SHPOs).

The 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 Northeast 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.

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

Through the SHC approach, we will coordinate and link actions that various programs within the Service, other Federal agencies, and our State, nonprofit and private conservation partners take at individual sites, so the combined effort of all our work will enable the realization of biological outcomes at the larger landscape, regional, or continental scale. Inherent in the process is a continual evaluation of biological outcomes and approaches, with the intent to adapt the overall conservation strategy to respond to changing circumstances and new information. 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 NALCC 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 NALCC covers land in 12 of the 13 Northeast states and the District of Columbia. The goal of the NALCC 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 NALCC 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 (SO) 3289, issued on March 11, 2009, establishes a commitment by the Department 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: <http://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 ESA of 1973.”

White winged scoter



Bill Thompson/USFWS

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 three 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://nawmprevision.org/> (accessed December 2015).

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 3 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://acjv.org/documents/ACJV_StrategicPlan_2009update_final.pdf (accessed December 2015).

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 under goal 1. You may review the ACJV 2005 Waterfowl Implementation Plan at: <http://www.acjv.org/planning/waterfowl-implementation-plan> (accessed December 2015).

**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 3.1). 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 BCR 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 appendices on waterbird populations, including occurrence, status, and conservation needs; waterbird habitats and locations within the Mid-Atlantic region that are crucial for waterbird sustainability; MANEM partners and regional experts 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.waterbirdconservation.org/manem.html> (accessed January 2016).

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 for Conservation Science under a partnership of individuals and organizations throughout the United States. The plan develops conservation goals for each United States (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, and whimbrels, that would be greatly impacted by continued habitat degradation or catastrophic chemical or petroleum spills.

High priority birds identified in this plan that are found at Monomoy NWR include piping plovers, American oystercatchers, semipalmated sandpipers, red knots, ruddy turnstones, sanderlings, and dunlins. The habitat goal under the North Atlantic Regional Shorebird Plan identifies 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, and 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.shorebirdplan.org/wp-content/uploads/2013/01/NATLAN4.pdf> (accessed January 2016). 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, 9 of which occur regularly on Monomoy NWR. 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 3.1), 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. More information about PIF is available at: <http://www.partnersinflight.org> (accessed December 2013).

Massachusetts Wildlife Action Plan (Updated October 2015)

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 Department of Fish and Game (MA DFG) 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 1.
- (3) Descriptions of problems that may adversely affect species identified in element 1 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 1 and their habitats, for monitoring the effectiveness of the conservation actions proposed in element 4, 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.

MA DFG submitted its SWAP in October 2005. It was updated in 2015. You may view the 2015 plan at: <http://www.mass.gov/eea/agencies/dfg/dfw/wildlife-habitat-conservation/state-wildlife-conservation-strategy.html> (accessed January 2016).

Natural Heritage BioMap2

The MA DFG Natural Heritage and Endangered Species Program and The Nature Conservancy's (TNC) 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 SWAP to prioritize and guide biodiversity conservation in Massachusetts in the 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 areas.



Bill Thompson/USFWS

Piping plover

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, we consulted three species-specific recovery plans 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. This would be achieved through 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> (accessed October 2015). The piping plover was included in a cursory 5-year review (USFWS 2009a); no change in status was recommended. The 5-year review can be found at: http://ecos.fws.gov/docs/five_year_review/doc3009.pdf (accessed October 2015).

The piping plover status in the Commonwealth of Massachusetts and on Monomoy NWR is described in chapter 3.

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> (accessed December 2015).

The northeastern beach tiger beetle status in the Monomoy NWR is described in chapter 3.

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 (accessed December 2015).

The status of roseate terns on Monomoy NWR is described in chapter 3.

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 the Town, reduce traffic and parking congestion around Monomoy NWR and within the Town, 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 to implement components of the study that are detailed below and in chapter 4. The award from the USDOT to the Service for year 1 of a planned 3-year, public-private partnership demonstration project at Monomoy NWR and in Town was to 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 route markers and signage to the Monomoy NWR facilities and Lighthouse Beach, satellite parking areas, and other Town parking to facilitate public access to the refuge.
- 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.

After the Service received these funds, the Town declined the Federal funding and decided not to include a shuttle stop at the refuge as part of their proposed shuttle system. We may still purchase a shuttle and operate it with staff,

volunteers, or other partners, and we will continue to work with the Town on wayfinding and causeway improvements.

The interventions listed below, grouped into five categories, were used in formulating the management options and the transportation decisions presented in chapter 4.

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 and 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

- (7) Relocate the Monomoy NWR visitor contact station.
- (8) 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> (accessed December 2015)
- American Oystercatcher Focal Species Business Plan, summary available at: <http://amoywg.org/wp-content/uploads/2011/11/AMOY-Business-Plan.pdf> (accessed December 2015)

Regional Plans

- Western Hemispheric Shorebird Reserve Network Regional Site: Monomoy NWR; available at: <http://www.whsrn.org/site-profile/monomoy-nwr> (accessed December 2015)

State Plans

- Massachusetts Important Bird Areas Program; Monomoy NWR and South Beach; available at: <http://iba.audubon.org/iba/viewState.do?state=US-MA> (accessed December 2015)
- Massachusetts Natural Communities (Swain and Kearsley 2001); available at: <http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/natural-communities/> (accessed December 2015)
- Our Irreplaceable Heritage—Protecting Biodiversity in Massachusetts; available at: http://www.researchgate.net/publication/238291998_Our_Irreplaceable_Heritage_Protecting_Biodiversity_in_Massachusetts (accessed January 2016)

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,” 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 MLW 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 3 under “Refuge Administration.” With the latest change, the refuge now includes a small part of Nauset/South Beach and encompasses approximately 7,921 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 NWPS, 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 MLW 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 land to the west of the administratively determined management boundary line on Nauset/South Beach 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 NWR, the original establishing refuge purpose of “management and protection of migratory birds,” was expanded to include “management and protection of wilderness character and values.”

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, with some positions currently vacant. 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. One permanent staff person, a visitor services specialist, is located at the Assabet River NWR. Monomoy maintains three onsite positions: refuge manager, wildlife refuge specialist, and wildlife biologist. Seasonal biological technician and term staff positions and volunteer intern positions vary each year depending on funding. In addition, volunteers and a Friends group 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 CCP incorporates by reference all the refuge step-down plans that are currently up to date. Chapter 4 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 2015
- Fire Management Plan (FMP)—completed in 2003; will be updated in 2016
- Hurricane Action Plan—updated annually; updated in 2015
- 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 4):

- Habitat Management Plan
- Annual Habitat Work Plan
- Inventory and Monitoring Plan
- Fishing Plan
- Wilderness Stewardship Plan
- Integrated Pest Management Plan
- Visitor Services Plan
- Avian Disease Contingency Plan
- Cultural Resources Management Plan

Complex and Refuge Vision Statements

Eastern Massachusetts NWR Complex Vision Statement

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

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

The refuge 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 refuge 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

We developed the following 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 Service.

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

Goal 5: Protect cultural resources that exist on 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.

Chapter 2



USFWS

Piping plover nest

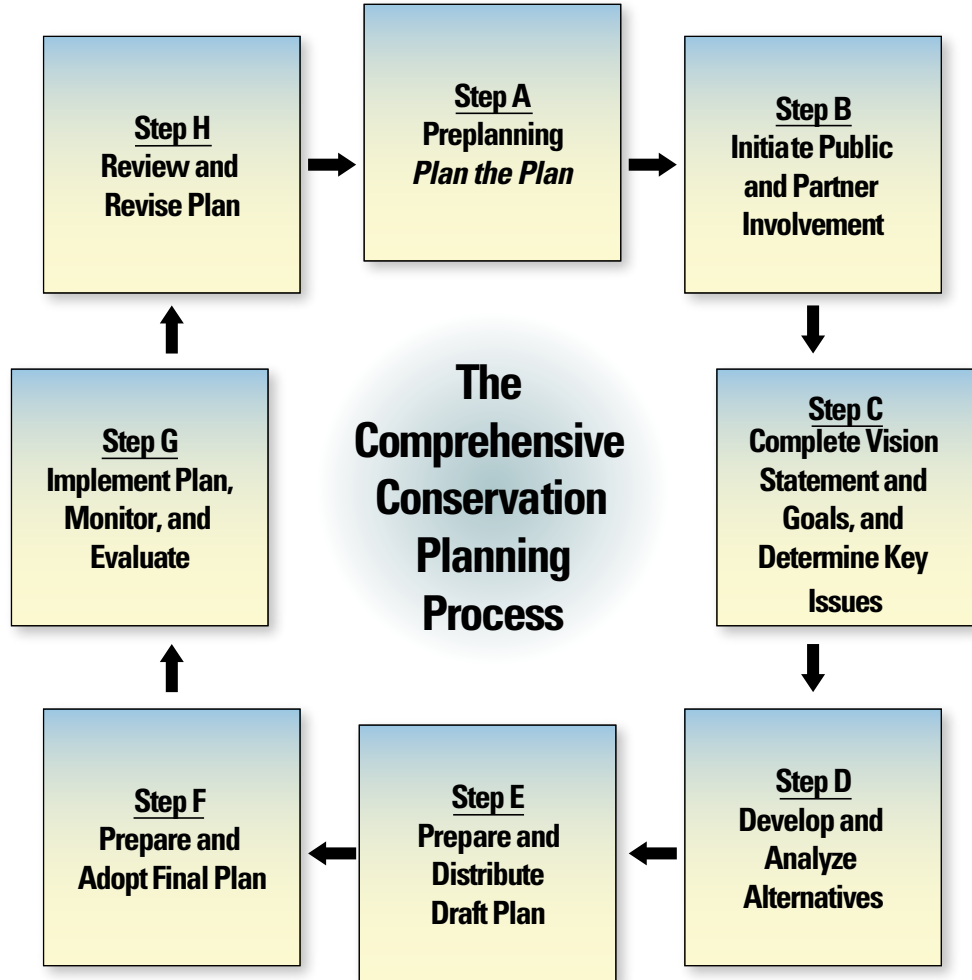
The Comprehensive Conservation Planning Process

- The Comprehensive Conservation Planning Process
- Wilderness Review
- Issues, Concerns, and Other Opportunities
- Significant Issues

The Comprehensive Conservation Planning Process

Service policy (602 FW 3) establishes an eight-step planning process that also facilitates compliance with NEPA (figure 2.1). 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 2.1. 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 NWR 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. The results of these interviews were summarized in a brief report.

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, Northeast regional Refuge System staff, representatives from the Wampanoag Tribe of Gay Head (Aquinnah), and the MA DFG.

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 NWR. 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; we continued scientific research and coordination with the Town for the Monomoy CCP. 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.

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 completed Step E, “Prepare Draft Plan and NEPA document,” in 2014 by publishing a Notice of Availability (NOA) in the *Federal Register* announcing the release of the draft CCP/EIS and distributing it for public review on April 10, 2014. The draft CCP/EIS had three alternatives, all of which were compliant with Service and Refuge System missions, purposes for which the refuge was established, and other legal mandates. Alternative B was identified as the preferred alternative. The initial 60-day public comment period (through June 9), was extended to 180 days (October 10, 2014). During the 180-day period of public review, we held a public hearing and four public information workshops in Chatham to obtain written and oral comments. In addition to the public hearing comments, we received comments by regular mail, email, and personally delivered letters to the Monomoy NWR office. We received 255 written comments, 39 oral comments, and two petitions signed by about 2,225 individuals. Following the public comment period, we reviewed and summarized all the comments received and developed our responses. These are found in appendix K.

A final CCP/EIS was prepared as part of “Step F: Prepare and Adopt a Final Plan.” The Service preferred alternative identified in the final CCP/EIS remained alternative B, reflecting the desired combination of species protection, habitat management, public use and access, and administration for the refuge, but it was modified to incorporate changes resulting from public review and comments received on the draft CCP/EIS. The final CCP/EIS was made available for a 37-day review period from October 30 through December 7, 2015. We notified everyone on the CCP mailing list by postcard or email, and the availability of the final CCP/EIS was announced in an NOA in the October 30, 2015 *Federal Register*. During this latter review period, we received additional comments from 34 individuals, principally from those who commented on the draft plan.

Following review of comments on the final CCP/EIS, our Northeast Regional Director signed a ROD on March 18, 2016, 2016 which documented the decision to adopt alternative B. The availability of the ROD was announced in another NOA in the *Federal Register* on March 30, 2016 completing Step F. We adopted alternative B, incorporating any new or substantive information received during the review period into this CCP. Our management direction, presented in chapter 4 of this CCP, will guide refuge management decisions over the next 15 years. 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,” begins once we notify the public of the ROD issuance in the *Federal Register*. Most actions will be implemented in a phased manner over a number of years, and some will only be implemented once additional funds are obtained.

Future modifications of the CCP are possible following the procedures in the Service Manual (602 FW 1, 3, and 4) and in compliance with 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 Refuge System lands and waters that merit inclusion in the NWPS. 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 CCP has been finalized.

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. The wilderness inventory determined that none of the current non-wilderness portions of South Monomoy Island, 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 determined that no current non-wilderness portions of Monomoy NWR possess wilderness character sufficient for WSA 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, and/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 the drivers for our analysis and comparison of alternatives in the draft and final plans. Most of these issues are described as they were of concern in 2005, when we began again working on this CCP. In 2016, some of the issues are not as pressing, but we include them here, as they were considered in the development of this CCP. We addressed three categories of issues in the CCP:

- (1) Significant issues—these issues formed the basis for the development and comparison of different management alternatives in the draft and final CCP/EISs. Significant issues are discussed in detail below.
- (2) Other issues and management concerns—these issues and management concerns were also presented in the draft and final CCP/EISs, but were not considered “significant.” These issues are also discussed below.
- (3) Issues and concerns outside the scope of this analysis—the resolution of these issues falls outside the scope of this CCP or outside the jurisdiction or authority of the Service. These issues are addressed at the end of this chapter.

Significant Issues

Addressing the significant issues below will help us achieve some of the goals described previously. Chapter 4 describes how we 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 MLW line on the eastern shore of the refuge to an area within Nantucket Sound identified by latitude and longitude coordinates on the western side (i.e., the eastern refuge boundary is defined as MLW 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 prohibiting horseshoe crab harvesting, 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, particularly fisheries, might be regulated by the Service within these waters has been expressed by Town and State 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, NPS, and the Town signed a MOU in 2007/2008 that established a management 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 MOU has subsequently expired. In June 2015, the Service and the Town entered into a new 15-year MOU that addresses this eastern boundary. This is described in more detail in chapter 3.

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, razor clams, sea (surf) 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, the Massachusetts Division of Marine Fisheries, State legislators, and local residents to allow unencumbered access and fishing in Nantucket Sound and the waters east of the Monomoy Islands and west of Nauset/South Beach, known locally as 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 differed 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. This CCP addresses predator management as an important management tool to minimize losses to listed waterbird and shorebird populations utilizing the refuge.
- **Mosquito Control.** Currently, the Cape Cod Mosquito Control Project controls mosquitoes on Morris Island including on Monomoy NWR. *Bacillus thuringiensis israelensis* (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.
- **Habitat Management of Nesting Seabirds and Shorebirds.** Most interviewees noted that this is the primary natural resource of the refuge. Most interviewees considered 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 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 NWR 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 sightings 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, U.S. Army Corps of Engineers (USACE), 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 Quittneset 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. There is still a desire by some to continue access at this site, but our use of this lot has increased in recent years and parking and dinghy storage by others interferes with refuge operations.
- **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 (SUPs) 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 any ferry service operating at refuge headquarters. 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 allow 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 because the beach provides habitat for the federally endangered northeastern beach tiger beetle. With the February 2013 breach across Nauset/South Beach, access to South Monomoy Island by OSV is less of a concern.

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.

- Quitnesst Neighborhood. Some interviewees noted issues regarding the refuge's impact on abutting properties and the Quitnesst 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 has permission to operate from refuge headquarters.
- Town of Chatham. Some interviewees noted that the Town 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 trips (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 on 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 never visibly 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 boating has become too pervasive, has adverse impacts to seals, and may be dangerous to those who approach seals too closely. Motorboats are normally excluded from wilderness waters but

have been allowed to continue in Monomoy NWR waters because a provision in the 1970 Monomoy wilderness designation referred back to a section 4(d) of the Wilderness Act which allows motorized boating to continue if already established.

- Moorings. The Town issues boat moorings in Stage Harbor. Since the Stage Harbor mooring field is near capacity, there will be more demand/pressure from 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 eelgrass beds.
- Kite Boarding (also known as kitesurfing). The refuge staff has observed this activity disturbing beach-nesting birds, as well as birds foraging in shallow waters.
- Personal Watercraft (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, foraging, and staging birds. Interviewees stated that the NPS ban of personal watercraft in the Cape Cod National Seashore has had a positive impact at the refuge, particularly in the Southway.
- 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.

Other Issues

The following issues are narrower in scope or interest than the significant issues, but nevertheless were important to the public in 2005 and beyond. They are addressed in the management direction set forth in chapter 4.

- 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 NPS. Some noted that regular users tend to be self-policing and have informally assisted the Service in monitoring activities.
- 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.

- Trespassing 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 striped bass, blue fish, and others. Some said that although they saw no problem with the activity, there could be issues where fishermen traverse the island, cutting through the grassy areas where birds nest. Fishermen and other users also traverse the salt marsh. Fishermen often leave their gear within posted closures on elevated areas in the salt marsh—areas where oystercatchers and terns often nest.
- Horseshoe Crab 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 individuals 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 these resources and does not have the personnel to prevent beachcombers and others from removing such artifacts.
- 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.
- Colonial Ordinance. During scoping and in comments received on the draft and final CCP/EIS, a number of commenters, including the Town and members of the Massachusetts legislature, asked about the applicability of the public trust doctrine and the Colonial Ordinances of 1641 and 1647. Subject to duly enacted State and Federal regulations, these state law doctrines give the public certain rights below the mean high water line, which include the right to “fish, fowl, and navigate.” Pursuant to the Supremacy Clause of the Constitution, State law must give way to federal law where the two are in actual conflict. Accordingly, these state-law public rights of “fishing, fowling, and navigation” are subject to regulation by the Federal Government, where it has duly exercised its authority to regulate the areas in which the public has these rights. Therefore, as long as these areas remain part of the Monomoy NWR and/or designated as wilderness, these state law rights may only be exercised if not prohibited by the Federal laws governing national wildlife refuges and wilderness areas designated under the Wilderness Act.
- Visual impact. Some people noted that extensive activity on Nauset/South Beach could detract from the relative isolation and wilderness experience of the refuge. We have entered into an agreement with the town of Chatham that established a management boundary in which lands east of this boundary will be managed by the town. Therefore, these lands are now outside Service management.
- Cape Wind Project. This project in Nantucket Sound does not involve refuge lands. The purpose of this CCP is to develop management direction for refuge lands. Additionally, the permitting of the Cape Wind project is not within the jurisdiction of refuge staff. Other divisions within the Service have responsibility for the issuance of Federal permits.

Issues Outside the Scope of the Plan or Not Completely Within the Jurisdiction of the Service

Chapter 3



USFWS

Monomoy Lighthouse

Existing 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 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 Chatham, Massachusetts (maps 1.1 and 3.1). It is one of eight refuges in the Eastern Massachusetts NWR 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 7,921-acre refuge is composed primarily of North Monomoy Island and South Monomoy Island. 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 MLW, 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, grass-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 NWR'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 2015 count, based on aerial photography conducted in May 2011, numbered 19,166 individual gray seals hauled out on the refuge (Josephson, personal communication 2016). 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 previously served as an introduction site for the federally threatened northeastern beach tiger beetle. The refuge provides ideal habitat, and the project is contributing significantly 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 which 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 1/2-acre lot, gently sloping from the road to a sandy shoreline on Stage Harbor. This lot is used for administrative purposes only, namely for refuge staff to use for boat access. The Service holds a right-of-way on privately owned roads to access this lot.

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 Island and Nauset/South Beach

South Monomoy Island 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 Island, 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 Island (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 Island, 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. The size of this part of Nauset/South Beach has changed since 2013 as the northern part near the break migrates to the west and sand continues to fill in the Southway. A June 2015 MOU between the Service and the Town administratively determined a management boundary at Nauset/South Beach. Lands west of this boundary are managed by the Service, but the majority of Nauset/South Beach lies to the east and is managed by the Town.

Minimoy Island

Minimoy Island, a small island located west of the northern tip of South Monomoy Island, 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. Cape Cod 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 MA EOEEA, 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.

You may view this information at: <http://www.mass.gov/eea/waste-mgmt-recycling/water-resources/preserving-water-resources/mass-watersheds/cape-cod-watershed.html> (accessed February 2015).

On a larger scale, the Monomoy Islands are included in the Cape Cod and Islands watershed (U.S. Geological Survey [USGS] Hydrologic Unit Code [HUC] 01090002), which encompasses Martha's Vineyard, Nantucket (including Muskeget and Tuckernuck Islands), and other small islands south of Cape Cod (U.S. Environmental Protection Agency [EPA], <http://water.usgs.gov/lookup/getwatershed?01090002>; accessed January 2016).

Geographical Setting and Landscape Context

Biophysical Ecoregion—North Atlantic Coast

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 3.1). 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 Cape Cod, 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 ACJV 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

SHC is the conservation approach the Service 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 USFWS 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

*View from top of
Monomoy Light*



Yianni Laskaris/USFWS

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 nationwide through a geographic network of LCC’s. 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 SHC 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 do not 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).

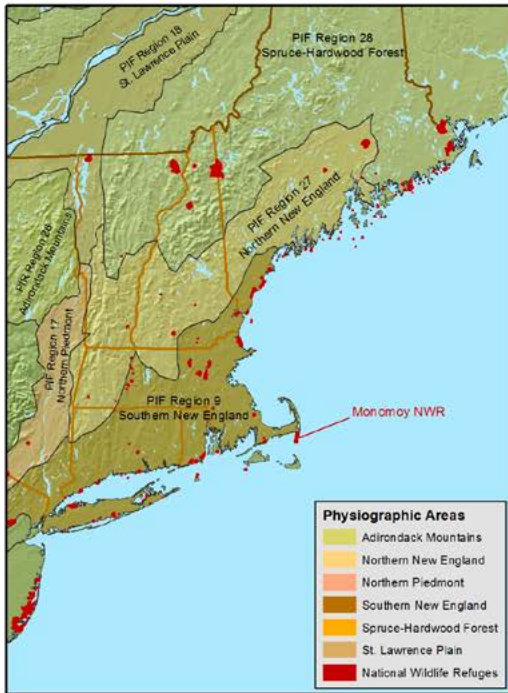
Monomoy NWR is located in the NALCC, which combines BCRs 14 (Northern Atlantic Forest) and 30 (New England/Mid-Atlantic coast), and contains 12 of 13 Northeast states as well as the District of Columbia (map 3.1). It includes a diverse array of ecosystems, from high elevation spruce-fir forests to coastal islands. Near Monomoy NWR, there are many conserved lands along Cape Cod and the associated islands (map 3.1) with which the refuge can partner.

The NALCC “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 NALCC, go to: <http://www.northeastatlanticlcc.org/> (accessed January 2013).

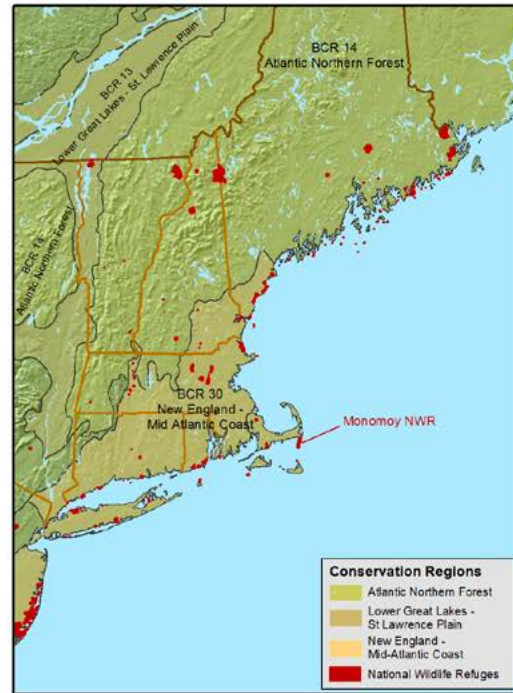


Monomoy National Wildlife Refuge - Comprehensive Conservation Plan

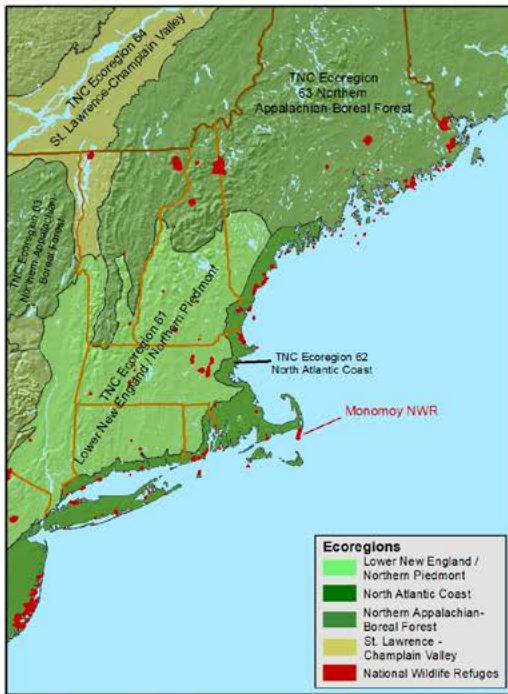
Service and Partner Conservation Regions



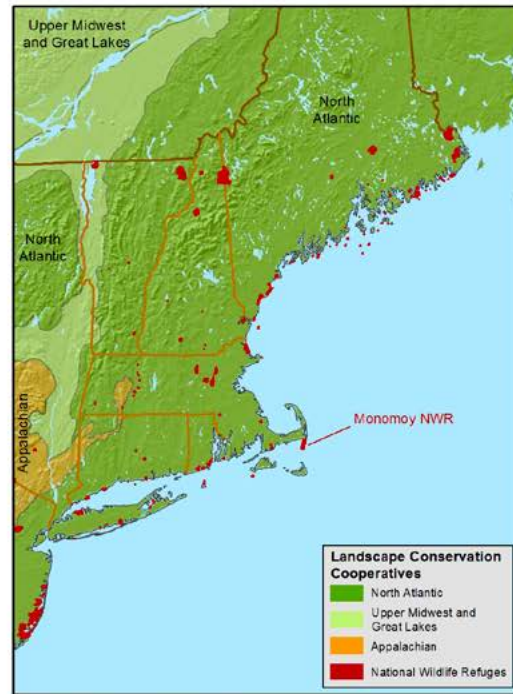
Partners in Flight Physiographic Areas
1:9,000,000



Bird Conservation Regions
1:9,000,000



The Nature Conservancy Ecoregions
1:9,000,000



USFWS Landscape Conservation Cooperatives
1:9,000,000

Western Hemisphere Shorebird Reserve Network

In 1995, Monomoy NWR was listed fourth among 96 sites meeting the 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 WHSRN 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 9 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 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 NWR, 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 NWR as a WHSRN 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 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/our-conservation-work/wildlife-research-conservation/statewide-bird-monitoring/massachusetts-important-bird-areas-iba> (accessed December 2015).

Marine Protected Area

Monomoy NWR is also designated as a National MPA as defined under EO 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://oceanservice.noaa.gov/ecosystems/mpa/>; accessed December 2015).

EO 13547—Stewardship of the Ocean, Our Coasts, and the Great Lakes—established a national policy to ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lake ecosystems and resources (<https://www.whitehouse.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes>; accessed December 2015). The policies contained in this EO 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 (<https://www.cbd.int/sp/targets/>; accessed July 2013). Helping achieve this target is a global commitment on 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. 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.

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 Island is flanked by sandy beaches on the east and west, with north-south trending dunes between. The southern third of South Monomoy Island 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 (appendix I).

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 Islands 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 (appendix I). 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 Coastal Zone Management [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).

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 Island 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 according to the Massachusetts Ocean Resource Information System (MORIS) Shoreline Change Map; (http://maps.massgis.state.ma.us/map_ol/czm_shorelines).

Snowy owl



Bill Thompson/USFWS

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 Cape Cod'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 MLW 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, Massachusetts to Chatham, Massachusetts, terminated just south of Morris Island, and was parallel and due east of the refuge.

In the late 1950s, a causeway was constructed between Stage and Morris Islands, and the channel separating the two islands was filled with sand. In 1965, 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 known locally as East Harding Beach. Although the channel continues to be dredged, sand is no longer deposited on this Town-owned portion.

In 1958, a spring northeaster—a storm with northeast winds—cut through the northern reaches of Monomoy, separating the island from mainland Chatham at Morris Island (figure 3.1, 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

Island 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 3.1, box 2); the northern island came to be known as North Monomoy Island, and the southern known as South Monomoy Island. 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 (appendix I). 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 Island.

In 1987, a storm caused a break to form in front of the Chatham Lighthouse on Nauset Beach (figure 3.1, box 3); this break would continue to widen over the years. The new landmass (island) which formed to the south, stretching from the Chatham Lighthouse south to North Monomoy, 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 attached to the mainland, in a landform known as a tombolo (figure 3.1, box 4).

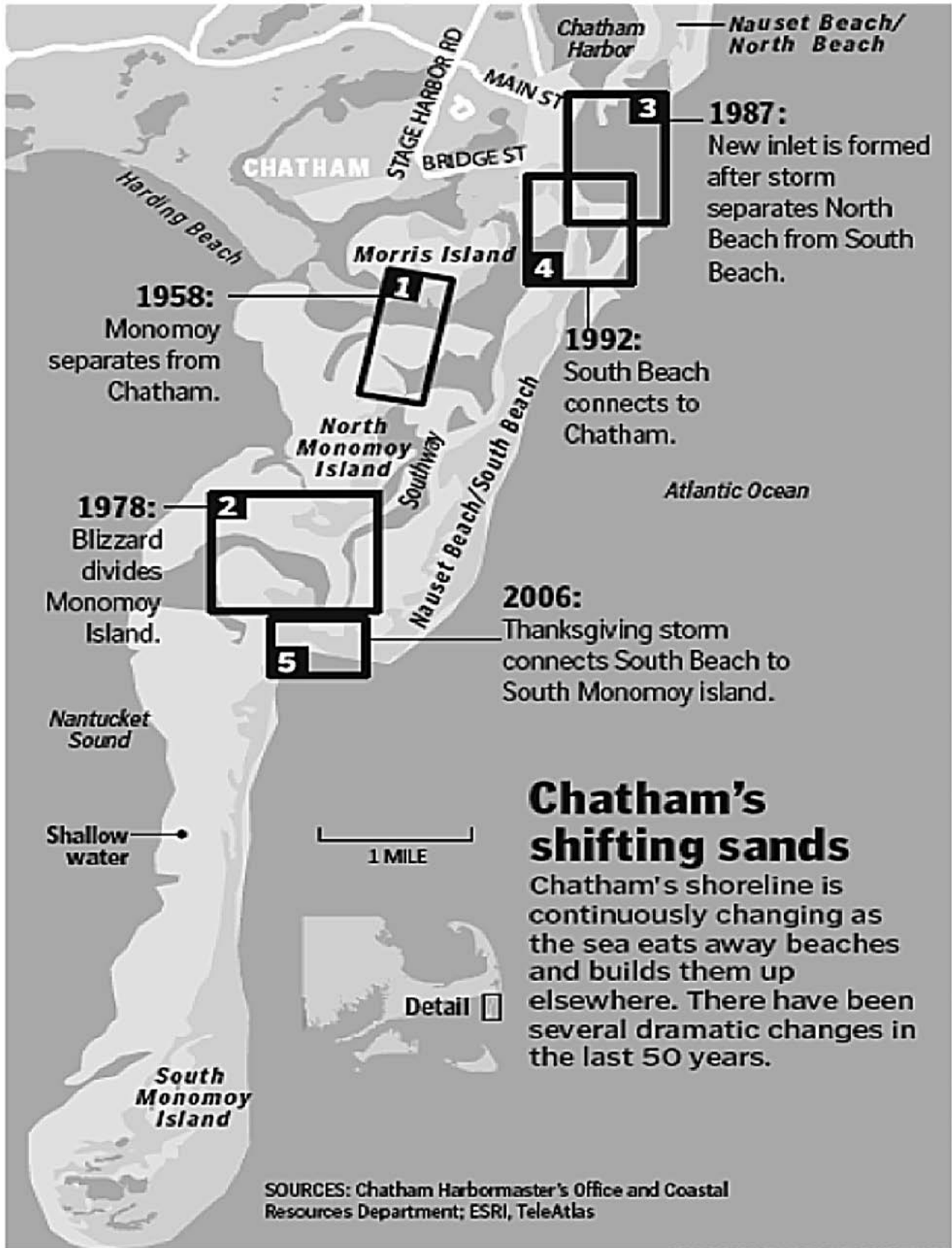
In the winters of 1998 and 1999, a 975-foot rock revetment was installed between the Monomoy NWR beachfront and four adjacent waterfront landowners to the west on Morris Island. Following the revetment construction, beach renourishment took place with the addition of 1,300 cubic yards of sand. In 2005, 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 Island, but instead curled back into the Southway and moved between North and South Monomoy Islands. The marshes on North Monomoy Island started to expand and the small cuts through the flats became difficult to navigate at low tide.

During this time, South Monomoy Island also started to erode on the east side, leaving its mid-point only 328 feet wide. The northern dunes on South Monomoy Island 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 nor'easter in 2006 caused the southern tip of Nauset/South Beach to attach as dry sand to the northern tip of South Monomoy Island (figure 3.1, box 5) above the high tide mark. This attachment allowed a person to walk from the Chatham Lighthouse to Monomoy Point Lighthouse, something not possible since 1958.

Like South Monomoy Island, 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 remains, and the waters to the west of the break are getting shallower as sand fills in the Southway.

Figure 3.1. Landform Changes in Monomoy NWR and the Eastern Coastline of Cape Cod prior to 2006.



**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. 1998, 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 Wampanoag 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 (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, 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 paleoecological

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 nine 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 2015, five prescribed burns were executed within the South Monomoy tern colony, the largest in October 2009 and 2012 and November 2015 when the same $35 \pm$ acres of primarily beach grass was burned to improve tern nesting habitat.

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

Monomoy shoreline



Claire Revokant, 2014

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 After Death (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, personal communication 2000).

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, personal communication 2000). In some cases, settlements were fortified 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-17th 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 Cape Cod 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 3.2). 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).

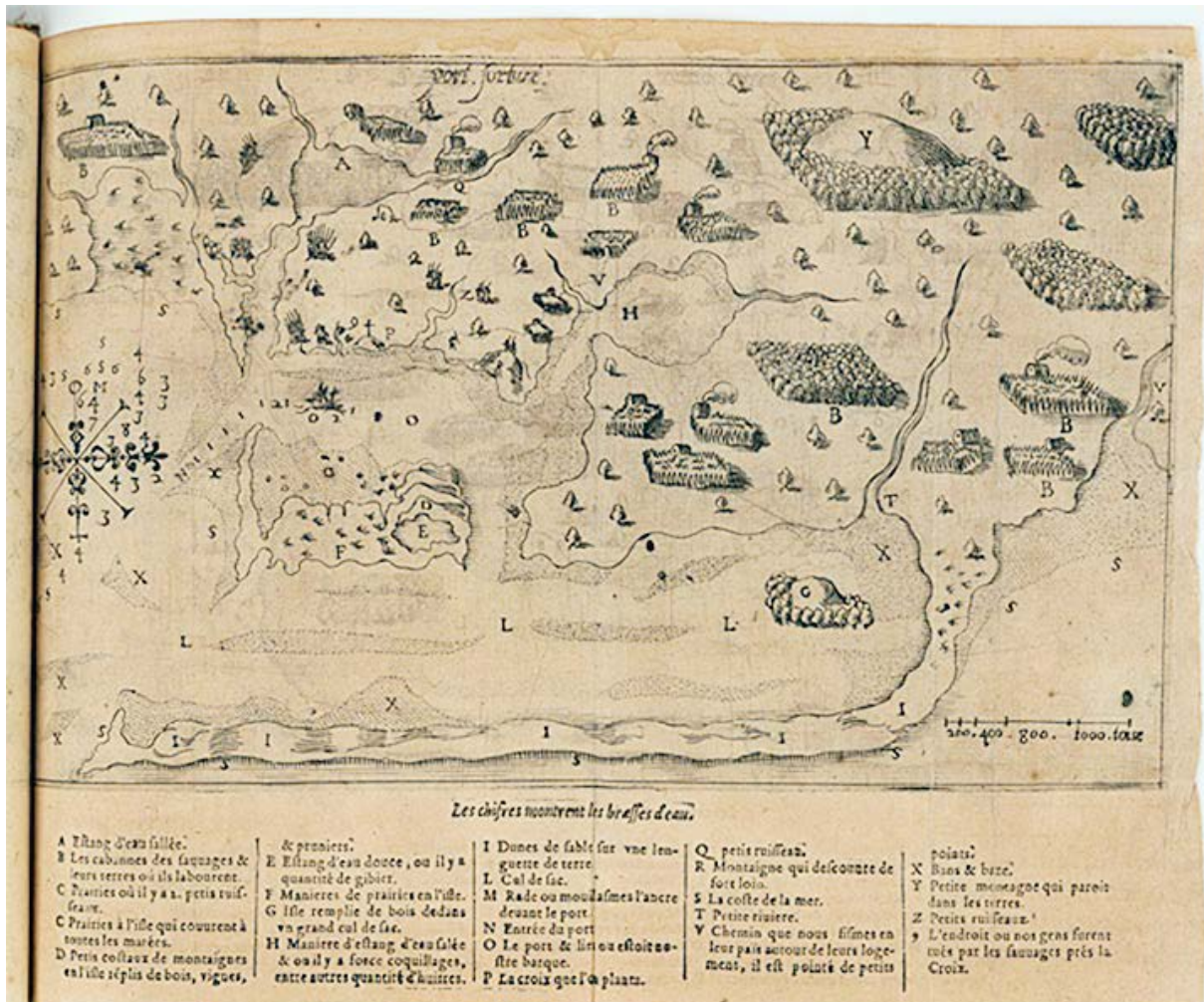


Figure 3.2. Champlain's Map of "Port Fortune" (Stage Harbor) in Chatham, Massachusetts, circa 1605 (Courtesy of the John Carter Brown Library, Brown University; also reproduced in Bragdon 1996). Note that the north arrow points to the right hand edge of the map; thus, the Monomoy peninsula is the narrow 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 two 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 Quitneset, 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).

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 18th 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 20th century. At its height, Whitewash Village housed about 200 residents and featured a public

school and an inn called the Monomoy 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 20th 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 (U.S. Coast Guard (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 obtained a SUP for seasonal use of the refuge 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 Island (figure 3.1, 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 USACE (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 nor during the 2009 to 2010 study. Subsurface and surface soil samples were collected and indicated the presence of 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 and 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, it 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 the bombing range or air-to-ground gunnery range. Although the FUDS is open to the public, it contains areas that are seasonally closed to minimize wildlife disturbance, and not because of any risk from its previous military use.

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 IPCC 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, are most at risk.

Climate change impacts in coastal regions include a higher frequency of intense hurricanes and storms, more severe impacts of lesser intensity storms, including nor’easters, 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.

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 Island 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 millimeters (mm) per year for the 20th 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 3.2). This is significantly higher than the average during the previous half century (Bindoff et al. 2007).

In figure 3.3, 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



Horseshoe crab shell on the beach

USFWS

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 NWLON, 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 3.4 equivalent to a rise of 0.97 feet in 100 years (NOAA 2009a). Within a 150-mile radius of the refuge, there are six 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 CCP, we focused our sea level rise discussion to a report specifically prepared for Monomoy NWR, (appendix I).

The report found in Appendix I shows that, at the current rate of sea level rise, sediment supply from Nauset/South Beach to Monomoy would be capable of maintaining the barrier complex, as well as supporting ongoing accretion along the southern tip of South Monomoy Island. Based on relative sea level rise in southern New England and global rates, the following general patterns are predicted 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 Island, and a reduced sediment load possibly deepening Monomoy Flats (appendix I).

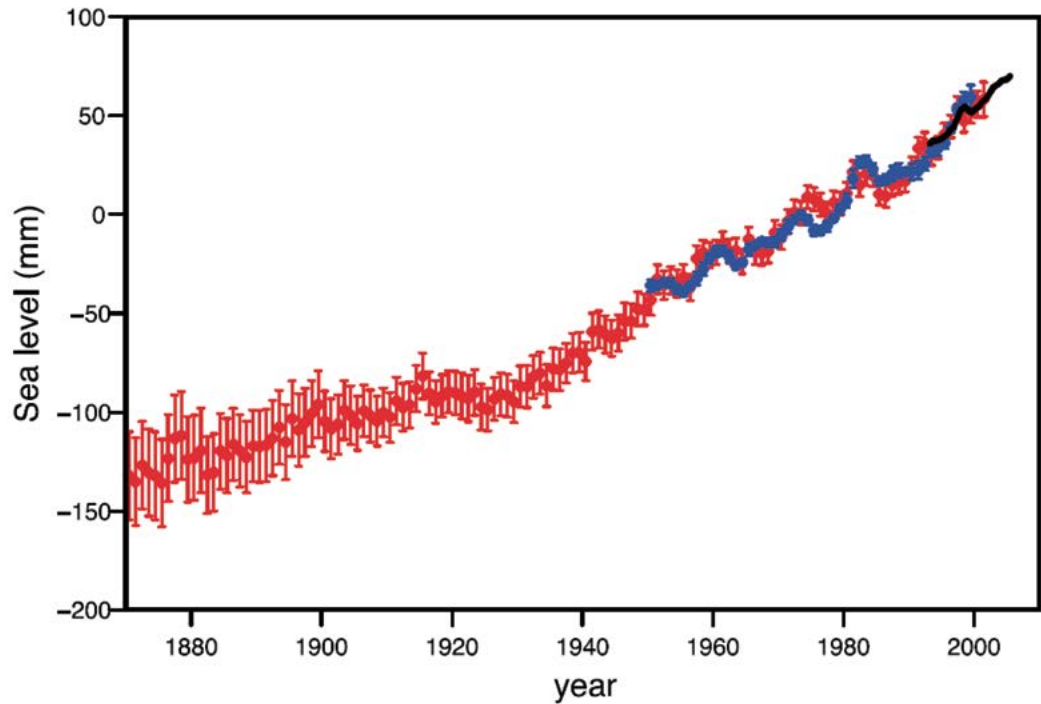


Figure 3.3. Annual Averages of the Global Mean Sea Level in Millimeters. (Error bars show 90 percent confidence intervals (Source: IPCC 2007). Dataset includes reconstructed sea level fields (red), coastal tide gauge measurements (blue), and satellite altimetry (black) data.)

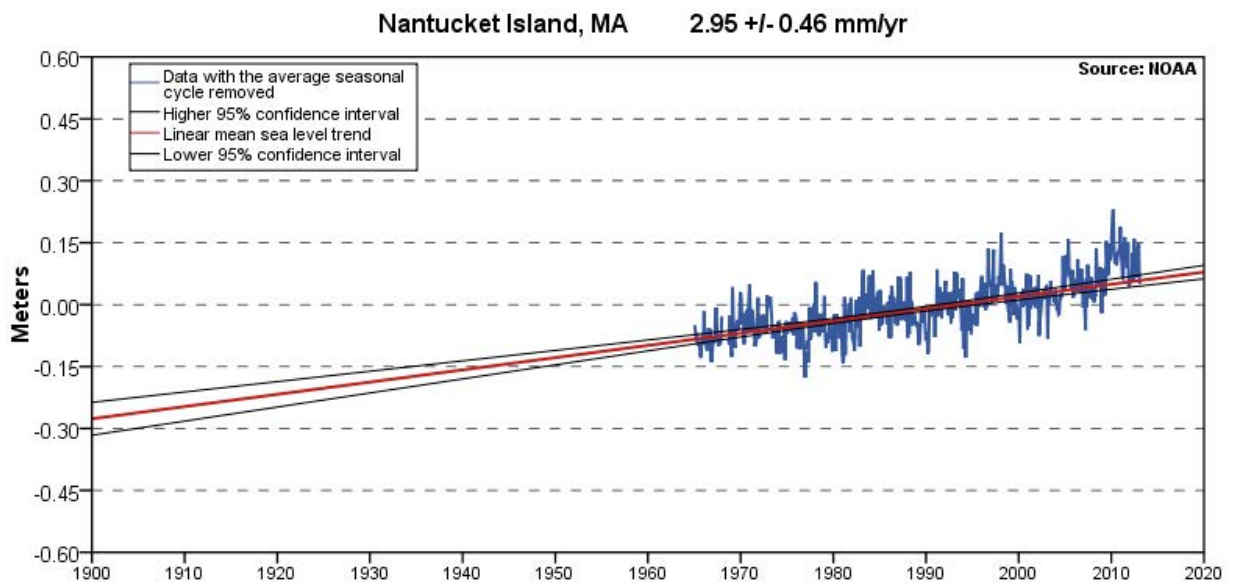


Figure 3.4. Mean Sea Level Trend at Nantucket Island, MA (Source: NOAA 2009a).

Air Quality

Under the Clean Air Act of 1990 (CAA), the 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).

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 parts per million (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



©Chuck Fullmer

Lichen (*Ramalina spp.*)

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 1,050 acres of barrier beach and dune habitat. It contains very little fresh water (Station Ponds on South Monomoy Island), and is not affiliated with any public well fields. Monomoy NWR 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 MLW) to the Cape Cod National Seashore (all ORWs), are classified as marine waters Class SA¹ or freshwaters Class B² (MA DEP 2002).

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 Code of Massachusetts Regulations (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, Dissolved Oxygen (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 MA 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 MA CZM 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 Island, 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 Island. 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 Island. 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 (MA DPH) received Federal funding to begin monitoring marine beaches throughout the State. Any public or semi-public beaches are tested daily or weekly for levels of the fecal indicator bacteria (FIB) enterococci, a group of bacterial species typically found in human and animal intestines and feces (WHOI 2012), 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 MA DPH 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 enterococci. In marine waters, the accepted level of enterococci for a single water sample 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, personal communication 2012).

State-Reported Impaired Waters

In 2010, the MA 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 MA DEP compiled those reports and submitted them to the EPA and Congress to satisfy the Federal reporting requirements under section 305(b) of the CWA.

Much of the data in this MA 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, Quality Assurance/Quality Control (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 (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 sounds on Monomoy NWR and tend to dilute many other sounds. An agreement between the Federal Aviation Administration (FAA) 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 (United States Department of Agriculture [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 3.1; <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 (SiO₂)

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 and currents. The MA CZM 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 3.1. 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 fall 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 NVCS, which is the Federal standard. This system classifies vegetation on a national scale for the United States and is linked to international vegetation classifications. 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 for 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 (see appendix C). Vegetation communities were described using a combination of 2010 aerial photography and ground-truthing by NatureServe, the Sewall Company, and refuge staff. Map 3.2 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

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/eelgrass.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.

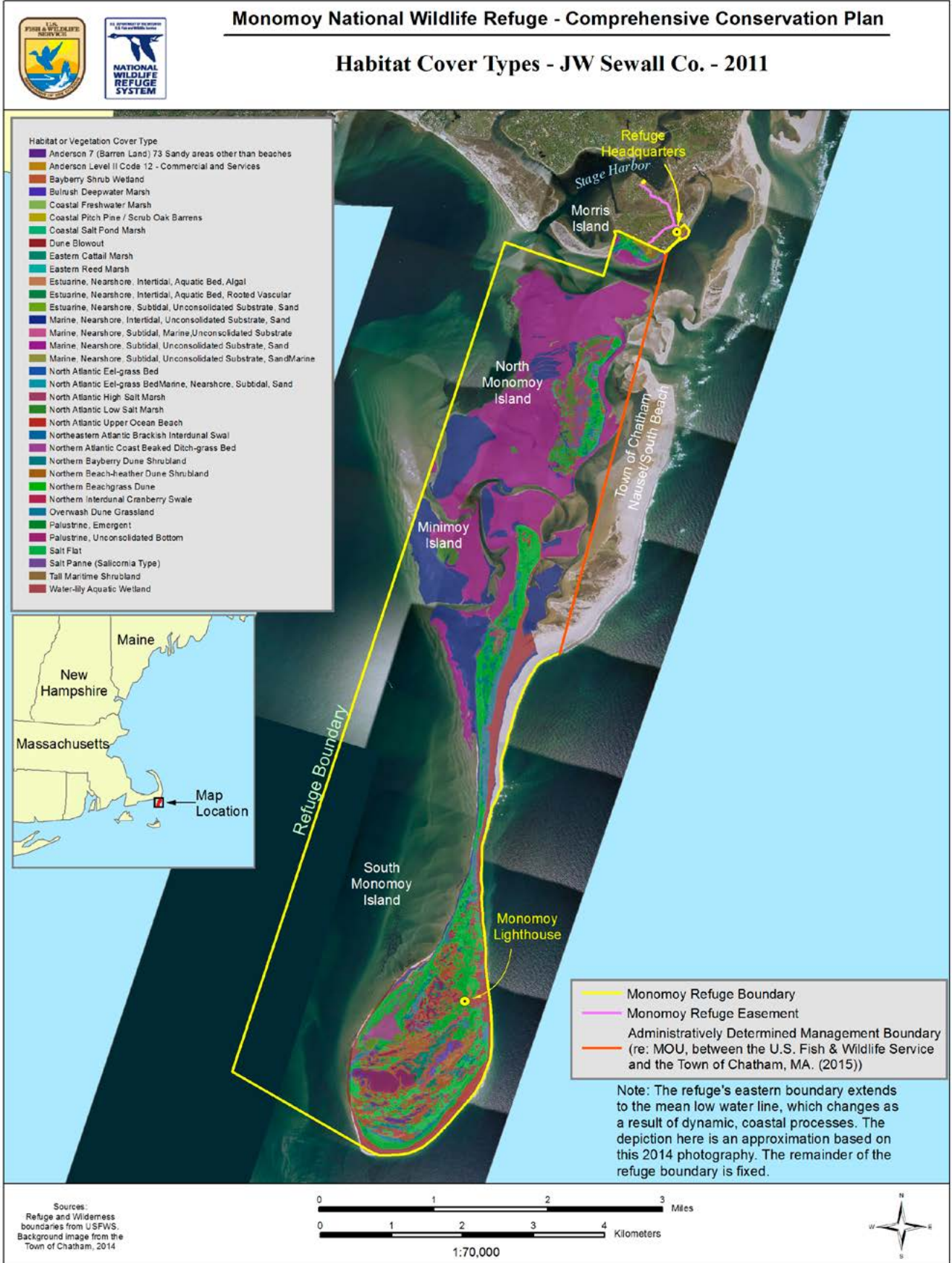
Eelgrass in the Southway



Holly Bayley 2013

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.

Morris Island and Stage Harbor embayments were 2 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[ha]) 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 m²) and large (greater than 5 to 10 m²) 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 (Outermost Harbor and the Southway) and Stage Harbor (Costello and Kenworthy 2011).

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 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 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 of the Stage Harbor embayment SAV area decline occurred between 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). The Massachusetts Division of Marine Fisheries “review of Google Earth images suggests there is a wide area of losses south of Inward Point which occurred gradually between 2003 and 2008 and has since remained essentially stable” (MA DFG 2014). They indicated the water depths in the area make “the use of large vessels and heavy fishing gear infeasible, and there is no evidence of scarring from trawls or boats, and finally that fish weirs are all located outside of the extent of the eelgrass meadow. There is evidence in the photos of shifting shoals” (MA DFG 2014).

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). A fourth federally listed species—the red knot (threatened)—uses Monomoy NWR during their long-distance migration, particularly when staging during the fall southbound migration. The following paragraphs describe the presence of these four species on Monomoy NWR. Over 35 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 is 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, recent numbers (44 pairs in 2014) are generally lower than the potential capacity estimated for Monomoy NWR (94 pairs; USFWS 1996b; see map 3.3). Table 3.2 shows the number of nesting piping plover pairs and productivity tabulated over the last 18 years (1996 to 2014).

Piping plover



Amanda Boyd/USFWS

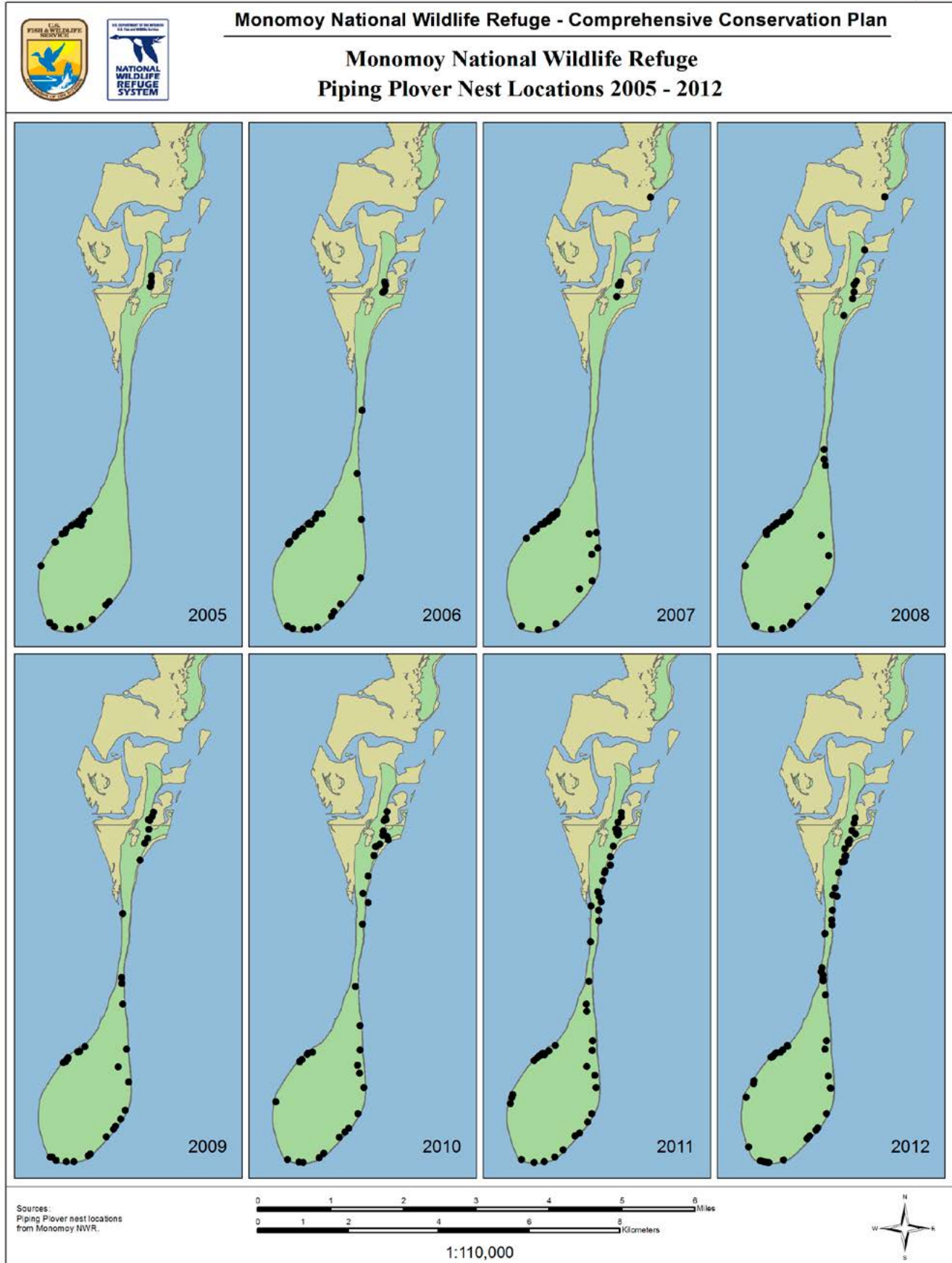


Table 3.2. Piping Plover Nesting and Productivity at Monomoy NWR (1996 to 2014).

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
2013	1; p = 1.00	50; p = 0.34	1; p = 1.00	52	0.37
2014	1; p = 0.00	41; p = 1.00	2; p = 2.00	44	0.98

*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 communication).

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

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 courtship and nesting sites and limit disturbance to incubating adults or adults with chicks. 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. 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-19th century, with hundreds of thousands of pairs reportedly nesting on Muskeget Island alone and several smaller colonies located on the mainland of Cape Cod which included colonies in Chatham and Wellfleet (Nisbet 1973). By the late 1800s, due to a combination of shooting and eggging 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 (Massachusetts Department of Fish and Wildlife [MA DFW] 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 1.0 fledged chick per nesting pair 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 communication). 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 is 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 decreasing 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. Roseate terns successfully nested near or within the structures and sound systems in 2011 through 2014. 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,

*Black-crowned
night-heron*



Gary M. Stoliz/USFWS

post-breeding staging counts, and habitat enhancement (e.g., use of nesting structures). Table 3.3 shows the number of nesting pairs and productivity of roseate terns at the refuge over the last 17 years (1996 to 2014).

Predator management is an important part of the roseate and common tern restoration efforts on South Monomoy Island. 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 3.3. Roseate Tern Nesting and Productivity at Monomoy NWR (1996 to 2014).

	Number of Nesting Pairs; Productivity (p)						Refugewide Total Count
	South Monomoy			Minimoy Island**			
	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; p = 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
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
2013	8; p = 1.13	0; p = 0.00	8	0; p = 0.00	0; p = 0.00	0	8
2014	8; p = 1.38	0; p = 0.00	8	0; p = 0.00	0; p = 0.00	0	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 communication).

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, Massachusetts. The successful establishment of a northeastern beach tiger beetle population is believed to require a long stretch of relatively wide beach with no OSVs and relatively light recreational impacts. It is difficult to find these characteristics along the Massachusetts coast.

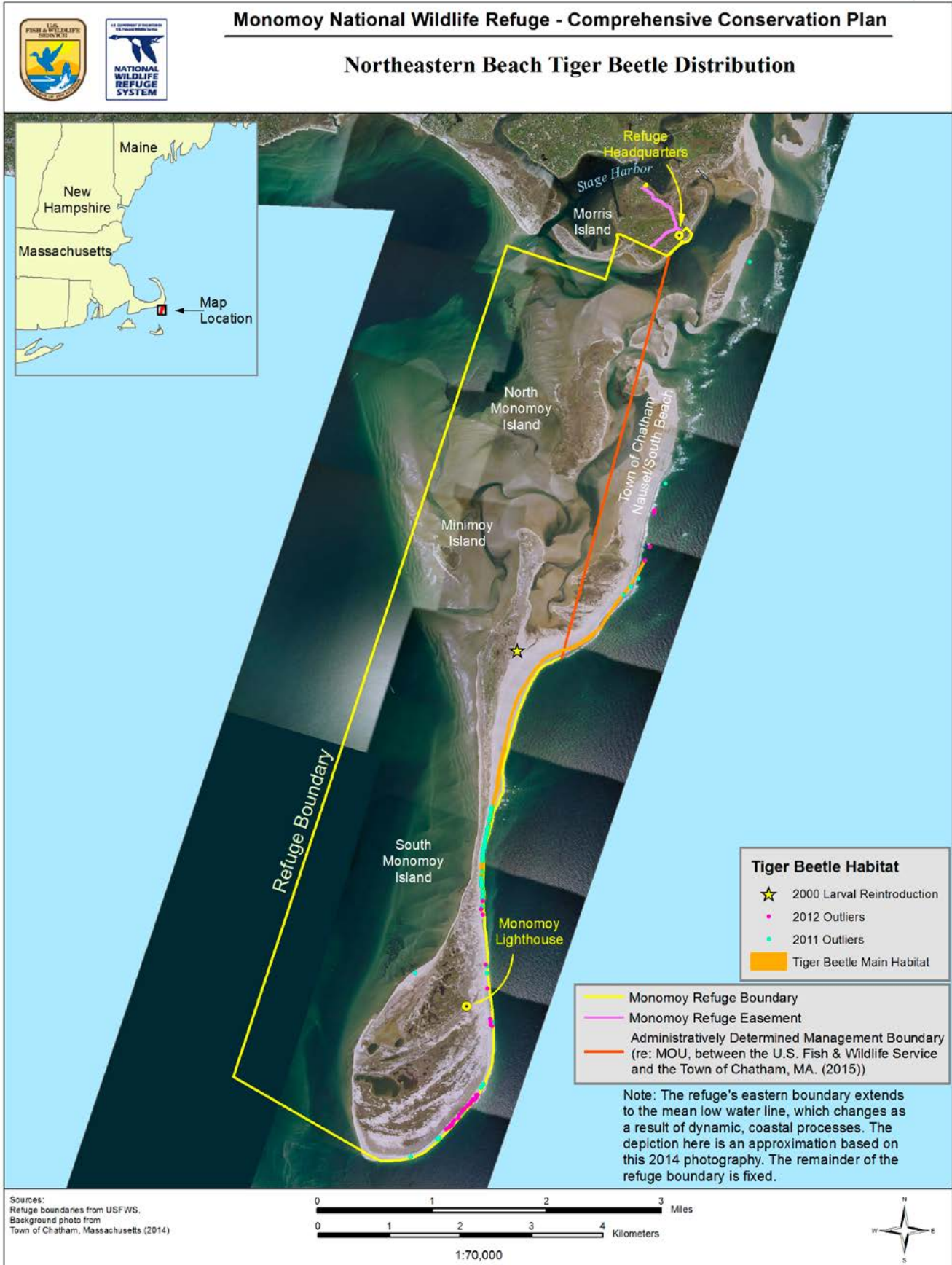
On beaches where they occur, adult northeastern beach tiger beetles are most active on warm, sunny days along the water's edge, where they are commonly seen feeding, mating, or basking (thermoregulation). The number of adult beetles active on rainy or cool, cloudy days is very low, probably because the 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, 5 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 3.4 shows the number of northeastern beach tiger beetle larvae translocated and the number of adults captured and marked on the refuge between 2000 and 2014.

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 2014. Map 3.4 shows the main tiger beetle habitat and the location of outliers from the main area in 2011 and 2012. The November 2006 land bridge joining Nauset/South Beach and Monomoy NWR developed at the center of the

Map 3.4



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 has been supportive of the refuge staff’s work concerning the beetles.

Table 3.4. Northeastern Beach Tiger Beetle Translocated and Marked at Monomoy NWR (2000 to 2014).

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	1,228**
2013*	0	0	4,855**
2014*	0	0	5,335**

*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 communication).

Red Knot

In December 2014, the red knot was designated as threatened (effective January 12, 2015). The Final Rule published in the *Federal Register* for the listing of the red knot can be reviewed here: http://www.fws.gov/northeast/redknot/pdf/2014_28338_fedregisterfinalrule.pdf (accessed March 2015). A supplemental document to the listing was also made available (Rufa Red Knot Background Information and Threats Assessment) and can be found here: http://www.fws.gov/northeast/redknot/pdf/20141125_REKN_FL_supplemental_doc_FINAL.pdf (accessed March 2015).

Red knots 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 NWR 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 NWR 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 NWR 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 NWR and other participating sites) have confirmed the importance of Monomoy NWR 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, or 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 NWR 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> [accessed October 2015]), 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 USFWS 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* (accessed October 2015) database.

State Listed Endangered, Threatened, and Special Concern Species

The Massachusetts Natural Heritage and Endangered Species Program (NHESP) has officially listed a total of 176 species of vertebrate and invertebrate animals and 256 species of plants as State-endangered, threatened, or special concern. “These are species considered to be at risk, or potentially at risk, of extirpation from Massachusetts, or at risk of global extinction. The three main criteria used to assess extinction risk are rarity in the State, population trend, and overall threat.” (<http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/esa-list/>; accessed February 2015). Additionally, “plant species of known or suspected conservation concern that do not meet the requirements for listing under the Massachusetts Endangered Species Act may be included on the plant Watch List. This is an unofficial, non-regulatory list of plants that the NHESP is interested in tracking. Determining whether or not a taxon is under threat or in danger of extirpation from Massachusetts involves careful consideration of many factors, and each taxon is considered on a case-by-case basis.” (<http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/rare-plants/>; accessed February 2015).

The State definitions for endangered, threatened, and special concern are included below (NHESP 2008) and more information about the listing process can be found at <http://www.mass.gov/eea/docs/dfg/nhesp/species-and-conservation/listing-criteria.pdf> (accessed February 2015).

Endangered—with reference to any species of plant or animal, means in danger of extinction throughout all or a significant portion of its range, or in danger of extirpation from Massachusetts, as documented by biological research and inventory (321 CMR 10.03).

Threatened—with reference to any species of plant or animal, means likely to become endangered within the foreseeable future throughout all or a significant portion of its range, or to be declining or rare as determined by biological research and inventory, and likely to become endangered in Massachusetts in the foreseeable future (321 CMR 10.03).

Special Concern—with reference to any species of plant or animal, means documented by biological research and inventory to have suffered a decline that could threaten the species if allowed to continue unchecked, or occurring in such small numbers, or with such a restricted distribution, or specialized habitat requirements, that it could easily become threatened within Massachusetts (321 CMR 10.03).

Monomoy NWR provides habitat for numerous State-listed species (some of which are also federally listed). In particular, the refuge is mapped as Priority and Estimated Habitat (13th edition of the MA Natural Heritage Atlas) for 10 State-listed species. “Priority Habitat is based on the known geographical extent of habitat for all State-listed rare species, both plants and animals, and is codified under the Massachusetts Endangered Species Act (MESA). Habitat alteration within Priority Habitats may result in a take of a State-listed species, and is subject to regulatory review by the NHESP. Estimated Habitats are a sub-set of the Priority Habitats, and are based on the geographical extent of habitat of State-listed rare wetlands wildlife and is codified under the Wetlands Protection Act (WPA), which does not protect plants. State-listed wetland wildlife species are protected under the MESA as well as the WPA.” (<http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/regulatory-review/regulatory-maps-priority-and-estimated-habitats/> (accessed February 2015).

Table 3.5. State-listed Species For Which Monomoy NWR is Designated Priority and Estimated Habitat.

Species	State Status	Federal Status
Roseate tern	Endangered	Endangered
Common tern	Special Concern	None
Arctic tern	Special Concern	None
Least tern	Special Concern	None
Northern harrier	Threatened	None
Piping plover	Threatened	Threatened
Pied-billed grebe	Endangered	None
Oysterleaf	Endangered	None
American sea-blite	Special Concern	None
Northeastern beach tiger beetle	Endangered	Threatened

The regional importance of the refuge to recovery of roseate terns, piping plovers, and northeastern beach tiger beetles has been discussed in detail in the previous section titled “Federally Listed Endangered or Threatened Species.” The importance of the refuge to common terns, arctic terns, and least terns are discussed in detail in the following section titled “Birds.”

The details of occurrence of northern harrier and pied-billed grebe on Monomoy NWR are less known. Breeding northern harriers decreased in Massachusetts beginning in 1955, likely due in part to loss of open field type habitats (Veit and Petersen 1993). Although there is some indication that this species is doing better than in recent years, numbers are still below their historic high points (MassAudubon 2013). Although northern harriers are known to nest on Monomoy NWR, the change in nesting numbers through time is unknown. Nesting northern harriers are not systematically surveyed, and staff take precautions to avoid walking through areas where northern harriers are suspected to be nesting (based on presence of adults) while conducting other work in an effort to minimize disturbance to nests and young. It is very likely, however, that protecting upland dune grass habitat benefits northern harriers by providing safe nesting space.

Breeding pied-billed grebes in Massachusetts have also declined since 1955 due to loss of freshwater marshes (Veit and Petersen 1993) and there is no evidence for recent increases in this population (MassAudubon 2011, 2013). Although pied-billed grebes historically nested on the refuge (MassAudubon 2003) their current nesting status is unknown. Refuge staff do not conduct standardized surveys for them. Pied-billed grebes are still observed on and around Monomoy NWR, including at the south end of South Monomoy Island, but most sightings are in late summer or fall, outside of the breeding season (www.ebird.org and <http://monomoybirds.org/bird-list/>; both accessed February 2015). Future protection of the freshwater ponds and marshes on the south end of South Monomoy Island may benefit this species by providing nesting habitat.

We similarly have little information for the occurrence and extent of oysterleaf and American sea-blite on Monomoy NWR because these species are not monitored by refuge staff. Oysterleaf is a perennial low-growing wildflower that grows in sparsely vegetated sandy coastal habitats, generally above the wrack line but below the highest high tide lines. Threats to this species include trampling and soil disturbance from heavy recreational use by pedestrians and/or OSV (<http://www.mass.gov/eea/docs/dfg/nhosp/species-and-conservation/nhfacts/mertensia-maritima.pdf>; accessed February 2015). Oysterleaf was first (and last) documented on the refuge by NHESP in 1999, when one mature plant with a flowering shoot was discovered (Tom French, personal communication 2015). It is possible that more plants inhabit the refuge given that plenty of suitable habitat exists.

American sea-blite is a tall, fleshy annual plant that grows in saline habitats including sandy edges of salt marshes and tidal flats. Threats to this species also include trampling and soil disturbance from recreational use (<http://www.mass.gov/eea/docs/dfg/nhosp/species-and-conservation/nhfacts/suaeda-calceoliformis.pdf>; accessed February 2015). American sea-blite was first documented on the refuge in 1971 and last documented in August 1989 when several hundred plants were observed (Tom French, personal communication 2015). It is possible that this species still occurs on the refuge as well.

In addition to the 10 State-listed species in Table 3.5 above, dozens of other State-listed species (mostly birds) have been documented using the refuge. A complete list of these species can be found in appendixes A and B.

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.

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 widgeon, 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, personal communication 2011).

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 NWR provide winter food for wintering and migrating Atlantic brant. Midwinter waterfowl surveys are conducted annually coast-wide and include waters surrounding Monomoy NWR. Table 3.6 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 3.6. Mid-winter Waterfowl Surveys (January) for Waters Surrounding Monomoy NWR and Coast-wide (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	1,033	1	31	0	8	0	19
2006	683	52	64	293	1,746	67	67	2	40	0	0
2007	497 (20,280)	0 (1,417)	133 (7,663)	120 (11,144)	25,859 (37,831)	0 (15,85)	0 (1,68)	0 (5,324)	61 (8,125)	0 (1,161)	623 (8,707)
2008	795 (18,346)	0 (2,272)	18 (6,116)	433 (10,316)	578 (78,856)	16 (4,659)	0 (273)	0 (4,629)	51 (3,676)	0 (3,741)	8 (21,654)
2009	103 (18,877)	32 (1,908)	28 (9,312)	32 (11,105)	6,584 (65,676)	0 (1,037)	21 (1,437)	0 (3,288)	52 (4,316)	18 (3,524)	1 (12,337)
2010	522 (18,599)	0 (1,572)	70 (5,790)	126 (8,229)	108 (46,097)	0 (1,092)	0 (239)	2 (2,452)	14 (8,940)	0 (4,273)	2 (5,450)
2011	245 (16,589)	0 (1,213)	2 (2,032)	211 (11,299)	25014 (46,198)	0 (835)	0 (148)	0 (1,808)	4 (4,643)	0 (2,382)	26 (4,817)
2012	906 (30,591)	40 (15,50)	0 (3,860)	580 (16,579)	603 (41,076)	5 (5,587)	5 (698)	0 (3,153)	51 (15,025)	0 (4,534)	333 (7,111)

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). In March 1999, the refuge was designated as a WHSRN regional site based on a maximum 1-day count of approximately 21,000 shorebirds (WHSRN 2006; see 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 BCR 30 (ACJV 2005; http://www.acju.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 Service.

Monomoy NWR is an especially important stopover site for southward migrating shorebirds because of its location in the landscape and combination of high quality foraging and roosting habitats (Koch and Paton 2009, Koch and Paton 2013). 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 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 provides foraging and roosting habitats (Koch and Paton 2009).

Conservation of stopover sites that provide abundant food and a relatively disturbance-free environment is critical to the long-term future of many shorebird populations, especially those that concentrate at just a few stopover sites (Myers 1983, Senner and Howe 1984, Myers et al. 1987). Additionally, protection of high tide roosting sites is extremely important as undisturbed space is limited at high tides when tidal flats are covered with water. This is especially true in New England during peak southward migration (July and August) when shorebirds are vulnerable to disturbance from an increased presence of beach enthusiasts (Pfister et al. 1992; Koch and Paton 2009).

Migratory shorebirds that use Monomoy NWR as a stopover site forage during low tides on the expansive flats and in salt marsh habitats surrounding North, South, and Minimoy Islands and South Beach. Shorebirds that use the refuge during daytime high tides, or overnight, roost in the higher elevations of salt marsh and beach berm on the northeast and south sides of Minimoy Island, North Monomoy Island, and the area surrounding the land connection between South Beach and South Monomoy Island (Koch and Paton 2014; USFWS unpublished data). Shorebirds that forage at non-refuge sites during lower tides (such as red knots using the northern part of Pleasant Bay) also rely on the refuge for roosting habitat during higher tides when foraging habitat is inaccessible (Koch and Paton 2009; Harrington et al. 2010b; Brian Harrington, personal communication April 2014; USFWS unpublished data). For example, shorebirds can be seen bypassing North Beach and North Beach Island (which likely have higher rates of human disturbance) on route from foraging areas in northern Pleasant Bay to roosting areas at Monomoy NWR during higher tides. Monomoy NWR is also an important nocturnal roost site for shorebirds, including for hundreds of whimbrels (USFWS unpublished data).

Although exact movements of migratory shorebirds between refuge and non-refuge lands are not systematically quantified, and may not be consistent between or even within years, we recognize the great interchange of shorebirds that occurs among the sites, and the importance of Monomoy NWR for both foraging and roosting shorebirds. Most salt marsh habitat and much of the upland beach berm on the refuge are closed to public access from April through at least July, and sometimes through September, to protect nesting shorebirds and waterbirds. Roosting shorebirds likely benefit from these closures, but many shorebirds are still migrating through Monomoy NWR in September, October, and even November, and although the number of beach enthusiasts declines in the fall, September is still a popular month to enjoy the refuge (Koch and Paton 2009). Additionally, the majority of flats where shorebirds forage are mostly open to public access. Although some of the habitats used by shorebirds are not easily reached without a boat, and human disturbance is relatively low compared to other sites in Massachusetts, we recognize the potential for impacts from human disturbance. Therefore, in chapter 3, we discuss strategies for providing additional protection to foraging and roosting shorebirds on Monomoy NWR.

Data collected by volunteer birders conducting International Shorebird Surveys (managed by Manomet Center for Conservation Sciences) provide documentation of tens of thousands of shorebirds using Monomoy NWR (these data can be explored at <http://ebird.org/content/iss/>; accessed March 2015). Most of these surveys are conducted at higher tides when birds are more concentrated in smaller areas, often at roosting sites, and thus easier to count. Additionally, refuge staff quantified shorebird use of Monomoy NWR during lower tides, with more of a focus on foraging shorebirds. Standardized shorebird surveys were conducted on 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 3.7 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 8 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 3.7. 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)

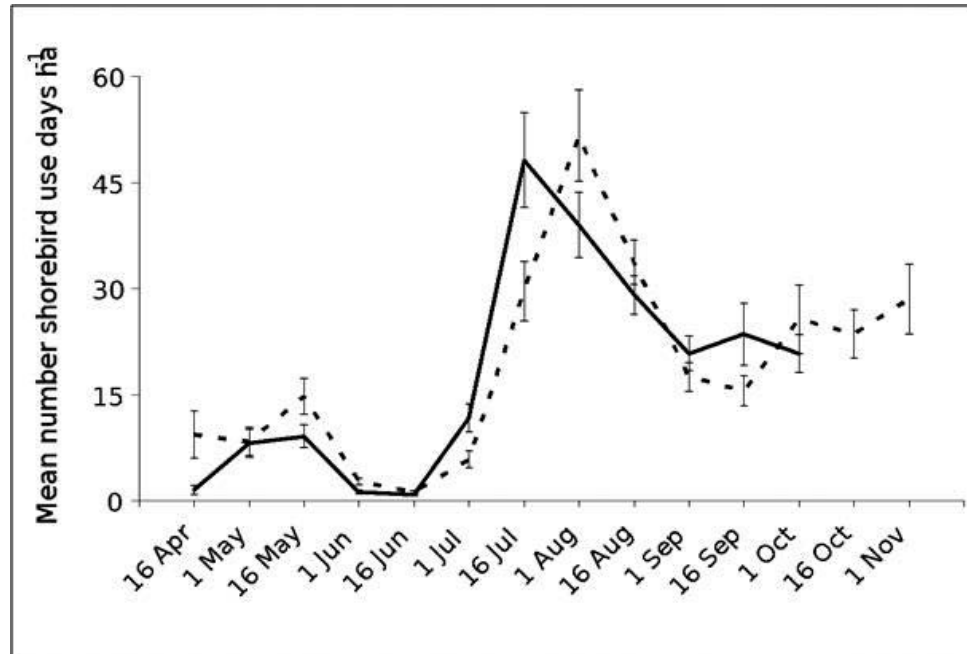
^a Additional shorebird species detected outside of plots include: killdeer, solitary sandpiper, spotted sandpiper, upland sandpiper, curlew sandpiper, stilt sandpiper, buff-breasted sandpiper, and red-necked phalarope.

^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 3.5 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 3.5. Seasonal Variation in Mean ($\pm 1SE$) Shorebird-use-days for all Shorebirds Based on Semi-monthly Time Intervals at Monomoy NWR. Solid Line Represents 2006 and Dashed Line Represents 2007.

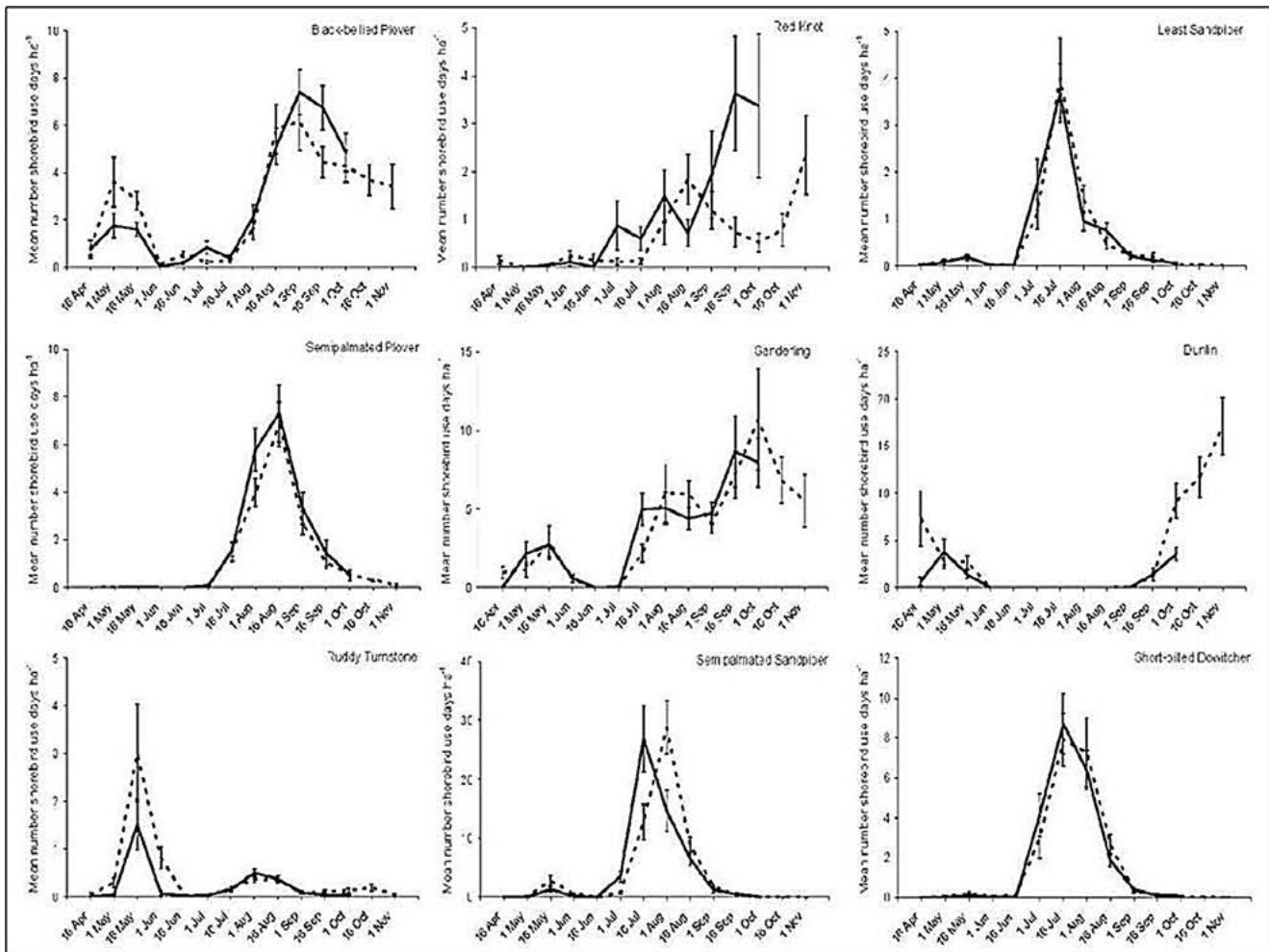


All species, except ruddy turnstone, were more common during southward migration compared to northward migration (figure 3.6). Of the eight species that were more common during southward migration, we observed two different patterns of migration. During southward migration, semipalmated plover, semipalmated 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 NWR during southward migration. Refuge staff were interested in capturing shorebirds to test for highly pathogenic avian influenza (HPAI).

Figure 3.6. Seasonal Variation in Mean (± 1 SE) 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). Due to 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, USGS bird band laboratory-issued bands on all shorebirds, and unique 3-digit alpha-numeric lime green flags which can be read from a distance 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 NWR within the last 30 years. Numbers of nesting American oystercatchers in the past 18 years are included in table 3.8, but pair numbers prior to 2002 are likely underestimates due to the low level of monitoring 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, and the refuge tallies 25 to 50 pairs annually, though actual numbers of nesting pairs are likely much higher. 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, personal communication 2011).

Table 3.8. American Oystercatcher Nesting and Productivity at Monomoy NWR (1996 to 2014).

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

Year	Number of Nesting Pairs; Productivity (p)			
	North Monomoy Island	South Monomoy	Minimoy Island	Refugewide
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
2013	8; p = 1.25	9; p = 0.56	5; p = 1.00	22; p = 0.91
2014	7; p = 0.43	4; p = 1.75	6; p = 0.67	17; p = 0.82

**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 1979, Nisbet 1973).

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 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 3.7). Since 2009, tern numbers have returned to levels of over 6000 pairs and have continued to increase slightly. Tern numbers have remained stable in large part due to habitat management being conducted on South Monomoy.

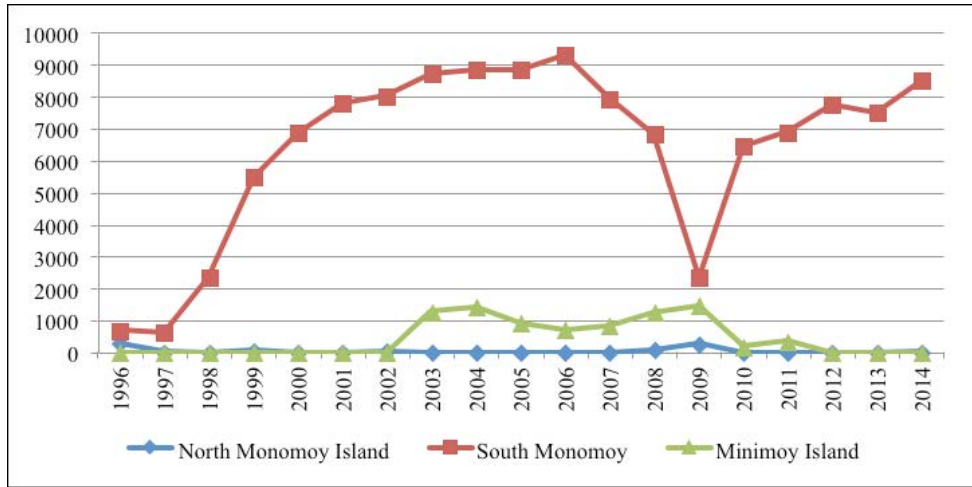


Figure 3.7. Nesting Common Terns on Monomoy NWR (1996 to 2014).

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 one of the largest tern colonies 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 3.9). Additionally, the number of nesting common

Common tern



Phyllis Cooper/USFWS

terns on Monomoy NWR is inversely related to the number of nesting common terns at Plymouth Beach in Plymouth, Massachusetts, 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 NWR. Similarly, in recent years when nesting numbers at Monomoy NWR 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 3.9. Common Tern Productivity (1996 to 2014).*

Year	Common Tern Productivity
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
2013	1.65
2014	1.58

**Productivity is calculated for nests initiated during the A-nesting period which is defined by Massachusetts as occurring on or before June 20th.*

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 by 30 meter control plot and two 15 by 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 by 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, four controlled burns have been conducted on the refuge to improve nesting habitat for terns. On April 8, 2004, two 60 by 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. However, despite the success of the burn in 2004, 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, and again in November 2015.

Prescribed fire has been used as a tool to thin vegetated areas 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. Spindelov, USGS/BRD, Patuxent Wildlife Research Center, Laurel, Maryland) 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 for 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.

Tern colony

Katrina Scheiner 2007

The colony is also monitored for large mortality events and unusual behavior that could be associated with HPAI (H5N1). The HPAI H5N1 virus has not yet been detected in the United States in either wild migratory waterfowl or domestic birds (USFWS 2006b). 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, Wisconsin, tested negative for HPAI.

Least Terns

Least terns generally show high colony site tenacity (Burger 1984) and site fidelity (Atwood and Massey 1988), though research concerning predation on least tern colonies and its relationship to the efficacy of that colony has been inconsistent. Atwood and Massey (1988) assert that nocturnal mammals and owls may have a stronger link to abandonment than other factors. Abandonment of colony sites on South Monomoy Island, specifically on the southern portion of the refuge, has been documented immediately following instances of nocturnal predation by coyote (Iaquinto, personal communication 2016). It is possible that predation events may be the reason that nesting numbers remain low and vary widely from year to year despite available habitat.

In 1970, there were three least tern colonies totaling 200 pairs on Monomoy NWR. 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 most years within the last 18 years, all suitable least tern nesting sites have been carefully surveyed during peak nesting times and nesting birds have been censused during the State census window. Survey numbers are included in table 3.10. 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 3.10. Least Terns Nesting on Monomoy NWR (1996 to 2014).*

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)
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)
2013	261	0	261
2014	376	0	376

*The first number listed represents the A-period total (nests initiated on or before June 20th) and the number in parentheses represents the B-period total nest count (nests initiated after June 20th).

**Minimoy Island 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 square kilometers identified as important during the post-breeding period, 6.18 km² occur on Federal land (Cape Cod National Seashore and Monomoy NWR) (Jedrey, personal communication 2010).

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 Island. 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 3.8). 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.

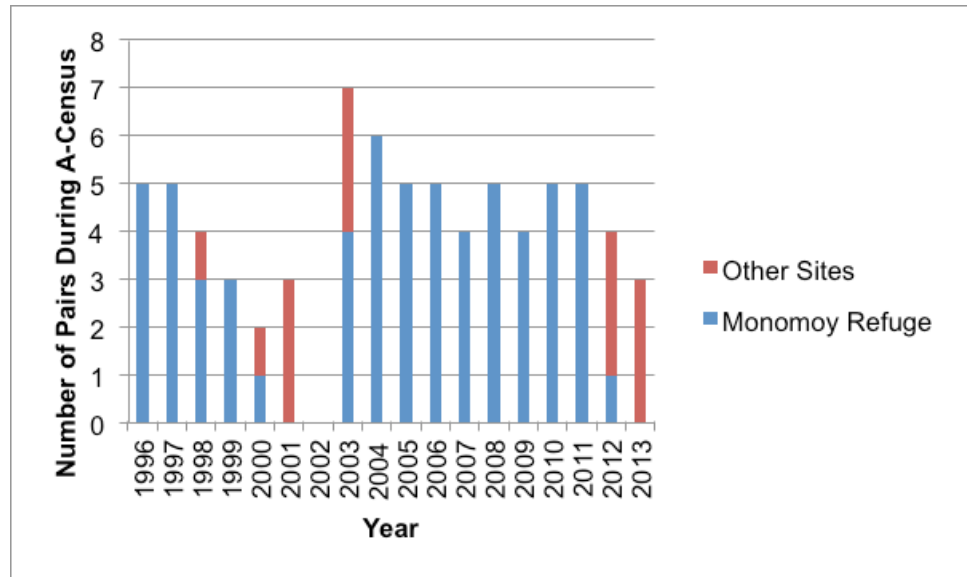


Figure 3.8. Black Skimmers Nesting at Monomoy NWR Compared to Other Sites in Massachusetts (1996 to 2013).

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 3.9; 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 3.9 for trends of nesting laughing gulls on Monomoy NWR.

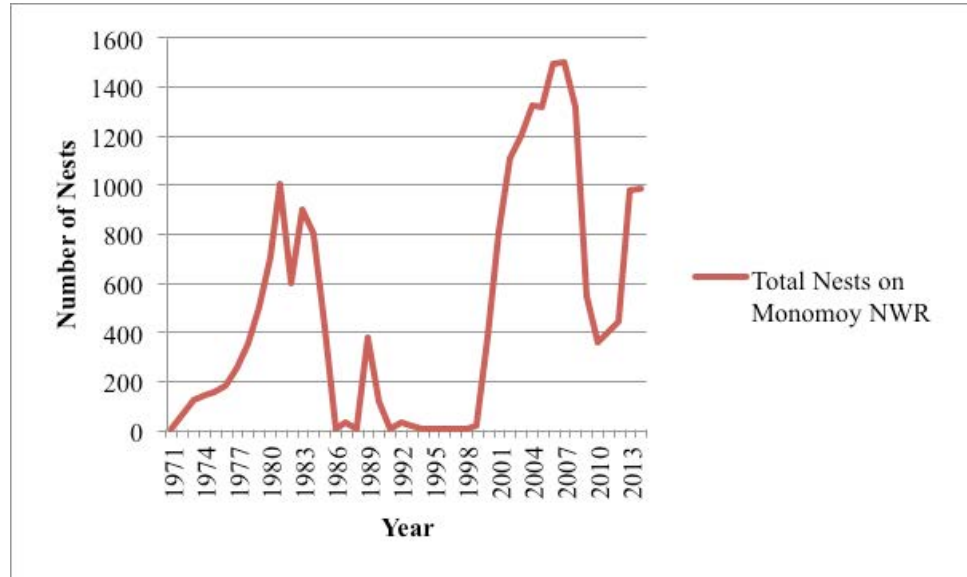


Figure 3.9. Number of Nesting Laughing Gulls Counted on South Monomoy (A-Census) 1971-2014. (The counts for 1972 to 1984 are estimates).

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 5 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).

However, these counts (through the mid-1990s) are estimates; uncertainty and inconsistency in methodology 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 3.11). 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 Island 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 3.11. 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	1,710	1,152	2,862
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. Census numbers for 2013 are not final so are not provide in this table.

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).

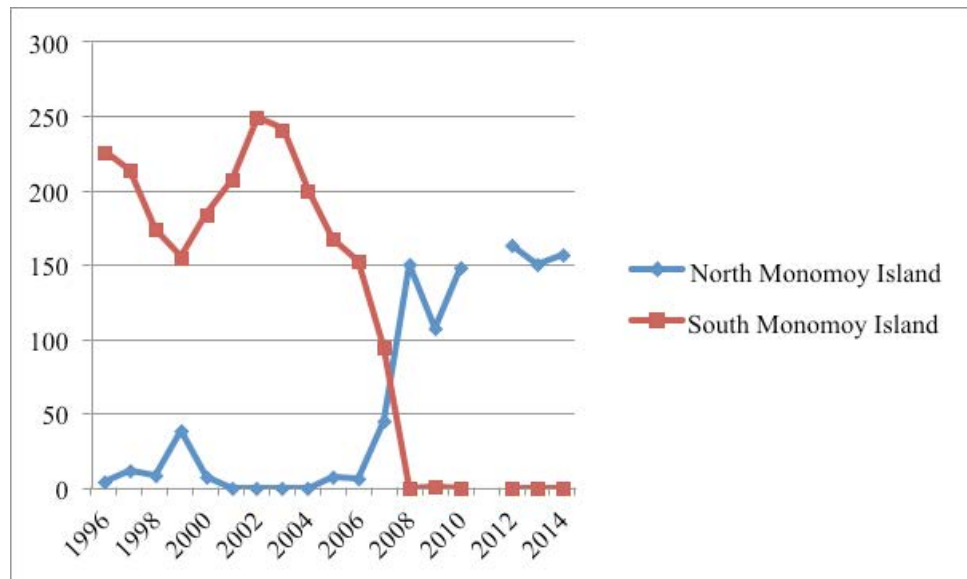
Various efforts between 1979 and 1995 were unsuccessful at controlling the gull population on the refuge. In accordance with tasks outlined in the Piping Plover Recovery Plan, Roseate Tern Recovery Plan, ESA of 1973, and the goals of the Refuge System in 1996, which direct national wildlife refuge units 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 Island (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 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 been 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 3.10). 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 publications or reports 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 3.10. Nesting Black-crowned Night-herons on Monomoy NWR (1996 to 2014).



Black-crowned night-herons have been significant predators of tern eggs in past years. Refuge staff deem black-crowned night-herons 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.

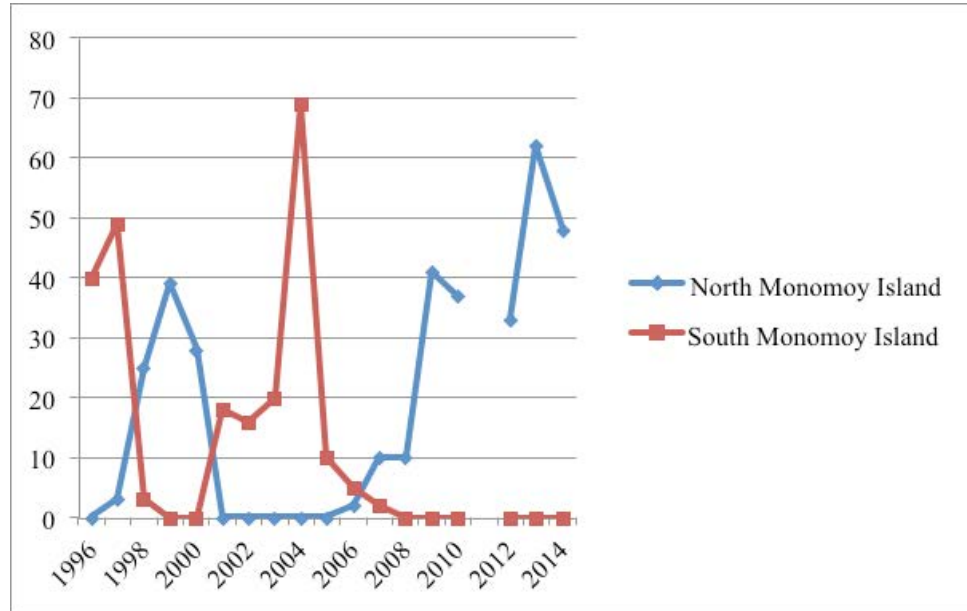
Monomoy’s snowy egrets first became established on the refuge in 1981 and nest in association with black-crowned night-herons. Feeding habitat within a 5-mile radius of the snowy egret rookery provides ample food, primarily sand lance, mummichogs, and striped killifish (USFWS unpublished data). The nesting 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 37 nesting pairs in 2010 (USFWS unpublished data), although numbers may be higher than recorded (figure 3.11).

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 through 2014.

Figure 3.11. Snowy Egrets on Monomoy NWR (1996 to 2014).



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 3.12.

Red tail hawk



George Gentry/USFWS

Table 3.12. 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	1,062	754	406	692	549	1,442	802	939	575	291
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, personal communication 2011). 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 2014, 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 Ph.D. 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 SUPs 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 $0.7 \mu\text{g/g}$) (unpublished data, 2011 SUP#53514-11016 Annual Report) but were below the estimated reproductive success effect level of $1.2 \mu\text{g/g}$ in songbird blood (Jackson et al. 2011).

In 2013, as part of the SHARP project, Ph.D. 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 operated from 2011 to 2014 with 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 station staff were present.

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 3 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 2 days of netting.

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 3.13. 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 3.13. 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). The banding station was continued in 2013 and 2014.

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 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 3 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 1990s, 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. Harbor seal numbers increase slowly through the fall and winter 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, personal communication 2010).

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 NWR (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 predation by small mammals on the refuge, refer to appendix J.

Evidence of coyote on Monomoy NWR was first recorded in 1996 (USFWS 1996b), 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 Island 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. ESP (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 website 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, personal communication 2013) 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 so common in Cape Cod Bay are sighted infrequently 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 temperatures are favorable, and return south before the onset of winter (NOAA 2013).

Threats to sea turtles in the marine environment 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 weirs) on or near the refuge (map 3.5) (Landry, personal communication 2013). 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 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 Island cover more than 140 acres (USFWS 1988). There are no freshwater ponds or marshes on North Monomoy, Minimoy Island, or Morris Islands. The main freshwater ponds on South Monomoy Island are Big and Little Station Ponds; other small freshwater ponds and wetlands dot the island. The two main salt ponds on South Monomoy Island 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 Island. 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

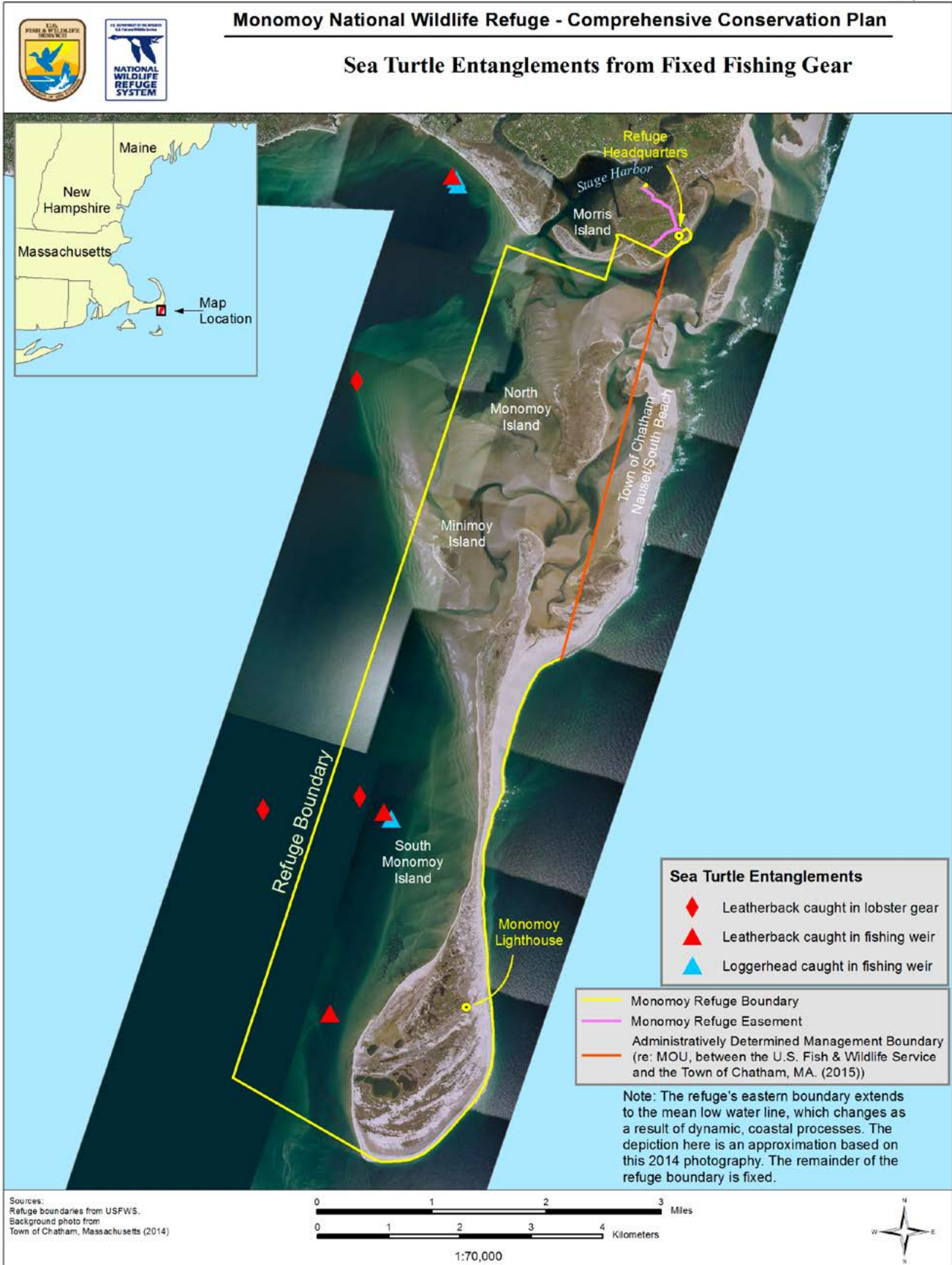
Big Station Pond, approximately 32 acres, and Little Station Pond, approximately 11 acres, naturally formed on South Monomoy Island as deep saltwater lagoons, which subsequently became cut off from the ocean and are now freshwater ponds. Big Station Pond may occasionally get an influx of salt water from high storms (Iaquinto, personal communication 2011). 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, personal communication 2011). 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 Island. These fish species are listed in appendix A, as compiled from the State of Massachusetts Division of Marine Fisheries (MA DMF) 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 Island.

Map 3.5



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 NMFS 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.

EFH 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 wolffish, smooth dogfish, and Atlantic bluefin tuna (table 3.14; 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 3.14. Essential Fish Habitat at Monomoy NWR.

Common Name	Scientific Name	Life History Stages			
		Egg	Larval	Juvenile	Adult
Major Gadids					
Atlantic cod	<i>Gadus morhua</i>	X	X	X	
Pollock	<i>Pollachius virens</i>			X	
Flat Fish					
Windowpane flounder	<i>Scophthalmus aquosus</i>			X	X
Winter flounder	<i>Pseudopleuronectes americanus</i>		X		X
Yellowtail flounder	<i>Limanda ferruginea</i>			X	X
Hakes					
White hake	<i>Urophycis tenuis</i>		X	X	
Silver hake	<i>Merluccius bilinearis</i>	X	X	X	
Skates					
Little skate	<i>Raja erinacea</i>			X	X
Winter skate	<i>Leucoraja ocellata</i>			X	
Other Species					
Ocean pout	<i>Zoarces americanus</i>	X			X
Atlantic wolffish	<i>Anarhichas lupus</i>	X	X	X	X
Highly Migratory Species					
Atlantic bluefin tuna	<i>Thunnus thynnus</i>			X	X
Smooth dogfish	<i>Mustelus canis</i>	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 cm³), 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 3.15 below. The mean abundance for each category was statistically different between time periods (Koch 2010).

Table 3.15. 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 support softshell clams, northern quahogs, blue mussels, bay scallops, sea scallops, razor clams, 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) 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, personal communication 2011) including killifish species (Finley, personal communication 2011), such as striped killifish, eel species such as American eel, (Warwell 1897, deSylva et al. 1962), weakfish,

northern kingfish, Atlantic silverside, summer flounder, winter flounder (deSylva et al 1962, Penn and Brockman 1994), striped bass (Martin 1974), and white perch (Shuster Jr. 1982). 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



Robert Pos/USFW

Horseshoe crab

as in Shuster Jr. 1982), blue crab, green crab, spider crab in Barnstable Harbor, Massachusetts (Shuster Jr. 1958 as in Shuster Jr. 1982), devil ray, (Teale 1945 as cited in Shuster Jr. 1982), puffers (Shuster Jr. 1958 as cited in Shuster Jr. 1982), sharks (Shuster Jr. 1982), and loggerhead sea turtles (Atlantic States Marine Fisheries Commission [ASMFC] 1998 and Musick et al 1983).

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 early 2000 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 SUP by the refuge to collect horseshoe crabs from refuge waters by SUP. Commercial harvesting for bait was never officially permitted, and beginning in 2000, refuge staff enforced a prohibition on all harvesting activity and denied further SUPs for biomedical harvesting. A local horseshoe crab harvester filed a lawsuit against the USFWS and the neighboring NPS as a result. The Service completed a comprehensive CD 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 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 1:1.9 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 3.16 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 3.16. Total Number of Horseshoe Crabs Tagged on Monomoy NWR (2001 to 2014).

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
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
2013	304	80	384	91
2014	451	60	511	64

*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 (Laquinto 2013, personal communication). 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 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 7 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, Delaware, and must have been transported by artificial means.

Insects

Portions of South Monomoy Island 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 Island 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, personal communication 2013).

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, personal communication 2011).

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 3.6) on South Monomoy Island and submitted them to Cornell University to determine if they are the native or introduced genotypes. All samples (including 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. Mute swans are very aggressive during nesting season and have 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.

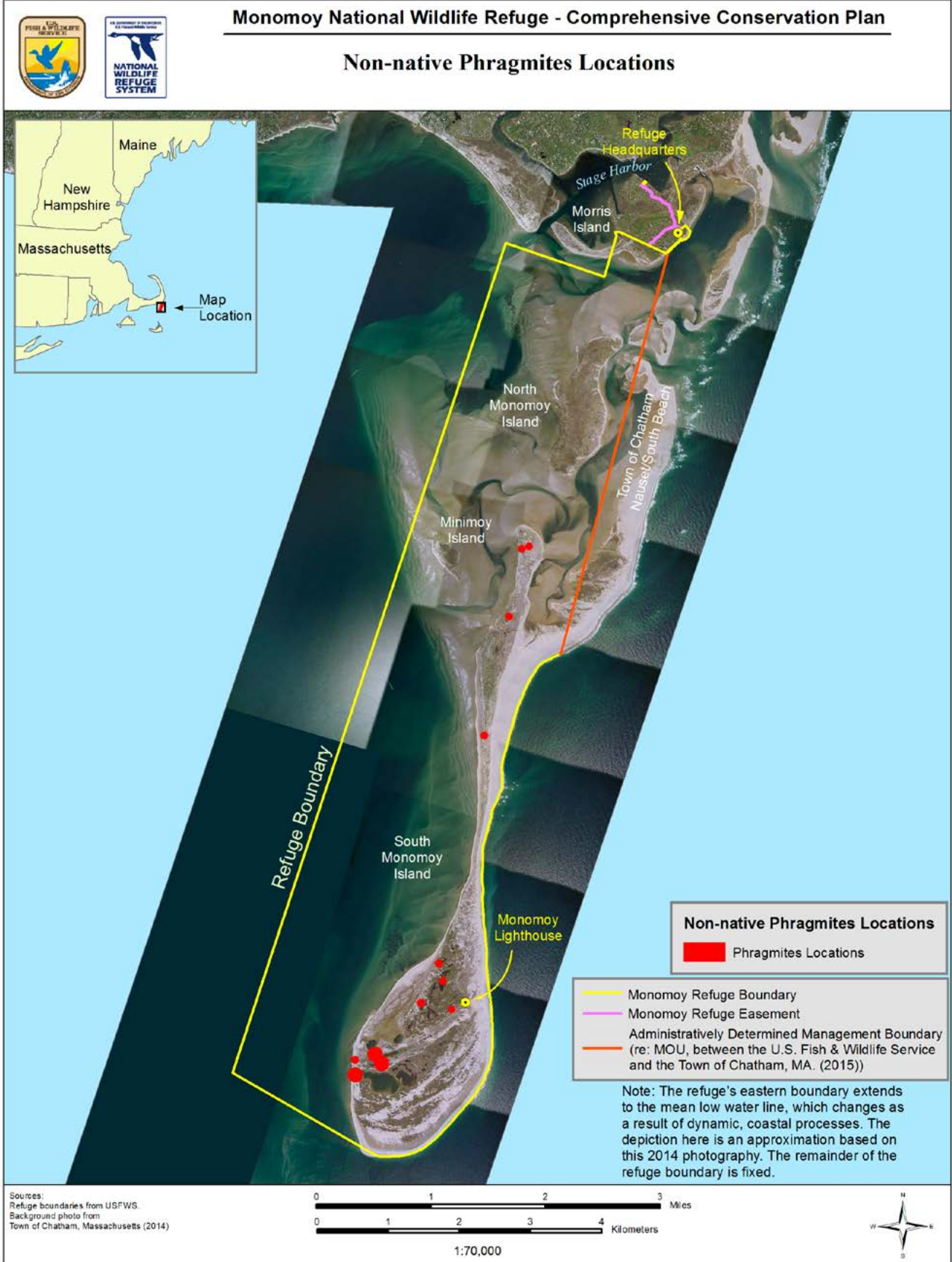
Refuge Visitor Services Program

The Refuge 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 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

Map 3.6



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 NPS, the Town, 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 CD 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 USGS, 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 CCP. 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 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 plays an important role in conservation. Of those who responded, approximately 75 percent traveled beyond 50 miles to visit the refuge, 50 percent of whom 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 unable to 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 4.

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 3.17 describes refuge visitation in 2014.

Table 3.17. Number of Visitors by Activity in 2014.

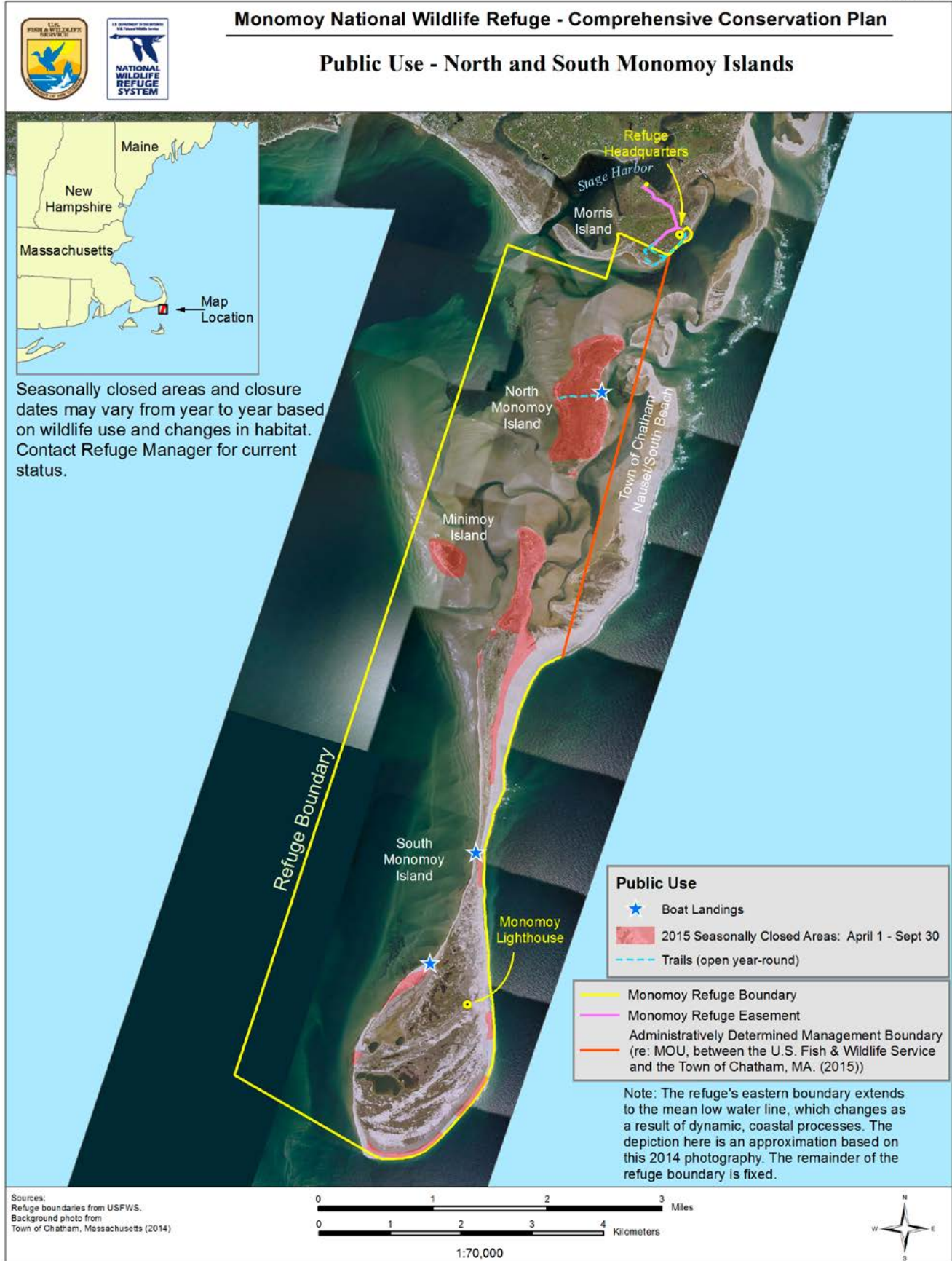
Activity	Visitors
Visitor center	13,800
Other non-priority public uses	9,135
Wildlife observation	6,020
Special events	0
Fishing	2,100
Nature photography	515
Interpretive programs onsite	580
Environmental education programs onsite	0
Total	32,150

Priority Wildlife-Dependent Public Uses

Described below are the current opportunities the refuge provides for engaging in priority public uses as defined by the Refuge Improvement Act of 1997. Portions of the refuge are closed seasonally to protect wildlife, as shown in maps 3.7 and 3.8. 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 Island. There is a small trail on North Monomoy Island; there are no formal trails on South Monomoy Island. Historically, a boat was needed to access both North Monomoy Island and South Monomoy Island, but with the connection of South Monomoy Island 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 SUP. These remote locations provide superior landscape and seasonal wildlife viewing opportunities in a nationally designated wilderness area.



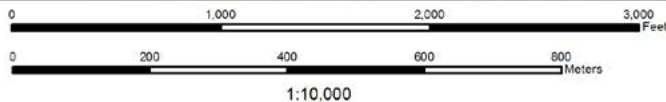


Monomoy National Wildlife Refuge - Comprehensive Conservation Plan

Public Use - North Monomoy Island



Sources:
 Refuge boundaries and public use data from USFWS.
 Background image from the Town of Chatham, 2014



Fishing

The Monomoy NWR offers superb recreational fin fishing opportunities from late spring through fall, as well as softshell clam and quahog harvesting. Anglers are allowed to surf fish in any of the areas open to public access, as well as 24-hour fishing on 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 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. 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 MA DMF to obtain a for-hire fishing permit to operate in State waters. We know that commercial guides work on the refuge, but SUPs 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 3.12; USFWS 1953 unpublished) as their destruction by the encroaching sea became imminent.

Figure 3.12. 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 3.13). 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.

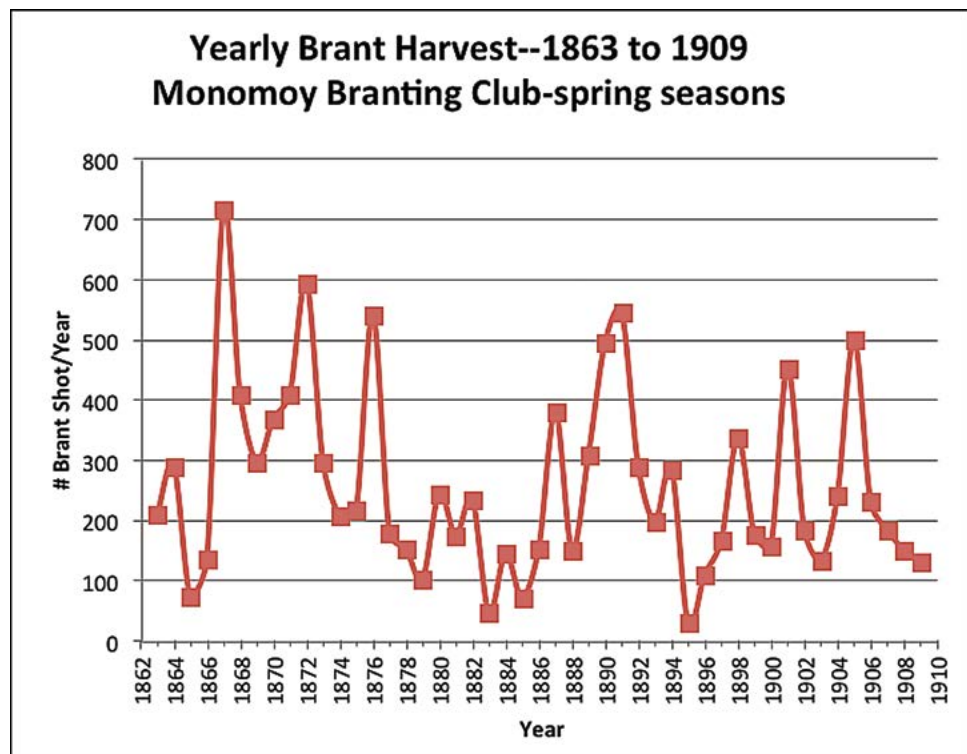


Figure 3.13. Monomoy Branting Club’s Annual Brant Harvest.

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 $\frac{3}{4}$ -mile long. The Morris Island Trail has interpretive panels that inform visitors about the refuge's purpose and natural 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 Island. Two ferry services have been issued SUPs 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 open waters within the Declaration of Taking are also described below.

Kiteboarding: This is a relatively 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, both the kite and the shadow it casts have the potential to disturb birds on shore. This sport is popular around Hardings Beach and the area known as the Morris Island Cut (<http://www.mychatham.com/kitesurfing.html>, accessed January 2015). Kite boarding appears to have replaced “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 and the connection to South Monomoy Island. At this time, the carry-in/out of kayaks or canoes from refuge parking on Morris Island is prohibited.

Shellfish Harvesting: The MA DMF established 17 designated shellfish growing areas in the Town, encompassing 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 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.

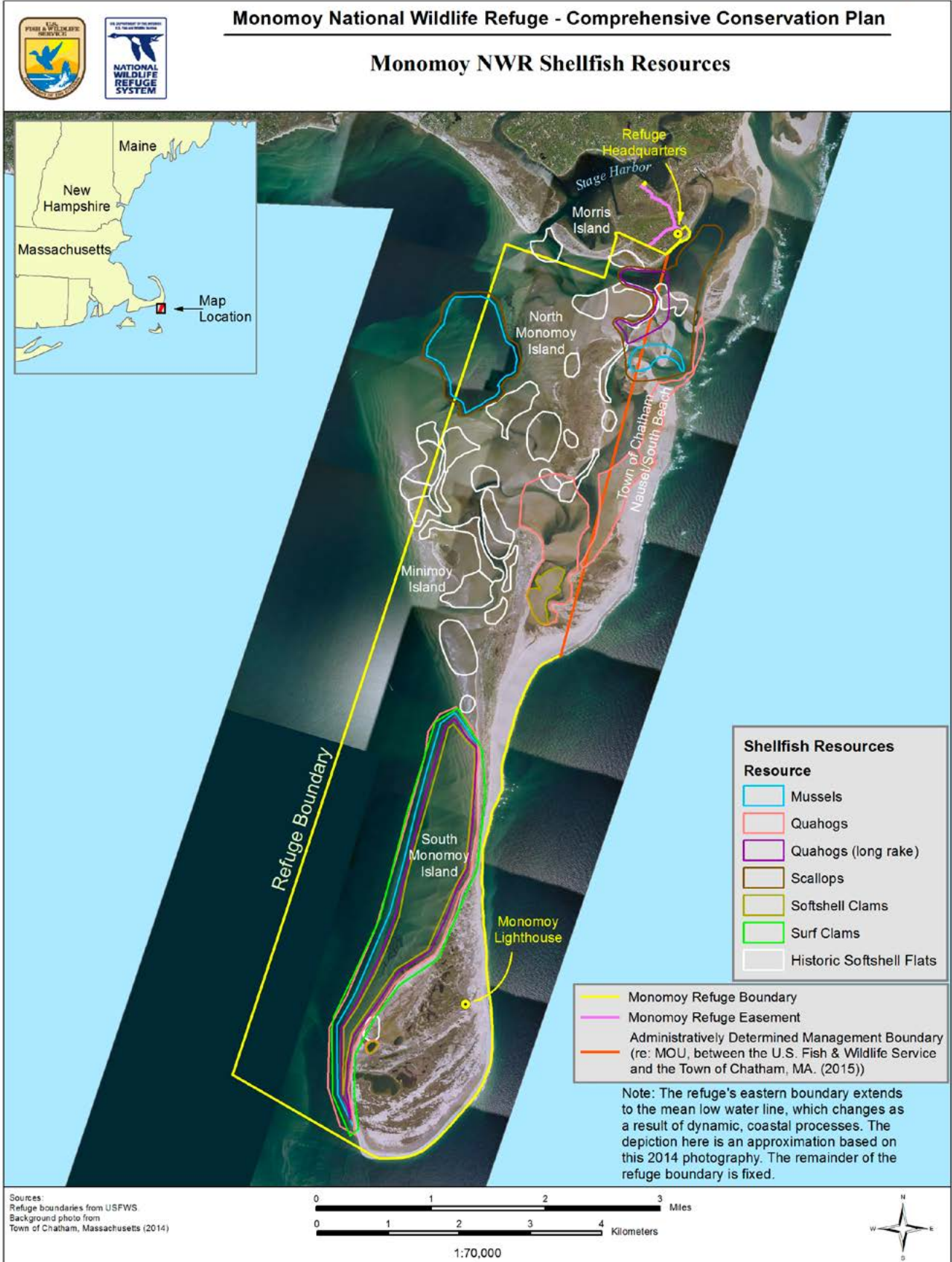
Clamming: For over 150 years, the Monomoy area has been known as one of the most productive clamming areas in Massachusetts. In fact, the first shellfish regulations enacted by the Town about clamming took place in 1781 (Town of Chatham 2014). Traditionally harvested species are softshell clams, quahogs (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 Island (especially the northern end), the eastern side of Minimoy Island, the area between Morris Island and North Monomoy Island,

the area between North Monomoy Island and South Monomoy Island, 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 3.9 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 (February 21, 2012), by the Board of Selectmen, 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 m² of sediment in a low tide event (Leavitt and Fraser 2004). In 2005, it was estimated that an average of about 170 to 180 softshell harvesters specifically targeted the Monomoy flats (Leavitt and Peters 2005).

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. Hydraulic quahog harvest is allowed in waters deeper than 20 feet and in precisely defined areas (Town of Chatham 2014). Quahogs are also harvested using bull rakes, often from shallow drafting boats in water, and only in sub-tidal waters (Town of Chatham 2014). 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.

Sea (surf) clam harvesting: Sea (surf) clam harvesting is not currently occurring within the submerged lands and open waters on the refuge (Town of Chatham 2014). Sea (surf) clams are present in the shallow water within the Declaration of Taking boundary along South Monomoy Island (map 3.9). The hydraulic sea clam fishery is regulated by the Commonwealth and is open to all harvesters. The Town has jurisdiction over hand harvesting and salting of sea clams (Town of Chatham 2015b). Sea clams "can occasionally be found on tidal flats, and can be harvested with hand-tools" (Town of Chatham 2015a). There is currently no commercial harvest for sea clams in Town waters, but "if there were a commercially viable set best accessed by hand tools, there is a high probability one or more commercial harvester(s) would take advantage of the opportunity. There is a small "sushi grade" market for sea clams not harvested hydraulically as non-hydraulically harvested clams tend to be less sandy" (Town of Chatham 2015b).



Mussel harvesting: The Town 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) in sub-tidal areas. The use of teeth or rakes on dredges is prohibited (Town of Chatham 2014) as is hydraulic dredging (Town of Chatham 2015a). 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. According to the Town (Town of Chatham 2015a), “the last economically viable set of mussels occurred outside the Declaration of Taking in 1999 on the traditional mussel beds between South Beach and North Monomoy Island (locally referred to as “Big and Little Mussels Flat”).” Mussel dragging occurred in shallow waters along the northwestern and the eastern flats of North Monomoy Island from 2008 to 2011 (map 3.9). 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, personal communication 2013). 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.

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 requires that all scallop dredge frames measure 36 inches or less in width. The use of teeth or rakes on scallop dredges is prohibited (Town of Chatham 2014). Scallops are currently harvested from subtidal eelgrass beds located along the western side of North Monomoy Island, the Morris Island Channel, and the northern end of the old Southway Channel (between North Monomoy Island and Nauset/South Beach; see map 3.9). 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 (MA DMF 2014). 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; MA DMF; 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: The Town indicated that this is a sub-tidal fishery which “may be the least predictable of all the shellfisheries” (Town of Chatham 2015a). To the best of our knowledge, razor clam harvesting is not currently occurring on the refuge, but is occurring nearby. Razor clams have previously been harvested on the refuge and may be again in the future, as regional conditions change. There was 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. According to the Town, “dry salting” (salt not in a water solution) or broadcast salting (spreading dry salt over a tidal flat) is prohibited (Town of Chatham 2015a).

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 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). The Town 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 NMFS—a branch of the NOAA, the NEFMC and the MAFMC (established by the MSFCMA), and the MA DMF. 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 MA DMF Statistical Reporting Area 10 (SRA 10). MA DMF 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, notwithstanding the existence of a pocket of Federal waters within the center of the sound. NOAA Fisheries and MA DMF 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). MA DMF 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, MA DMF 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 (MA DMF 2013a).

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 MA DMF and the NMFS. The waters of the refuge constitute less than 1 percent of MA DMF 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.

MA DMF 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 MA DMF 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 3.18). These species represent approximately 93 percent of commercial fin fish landings reported by MA DMF from SRA 10 in 2010 and 99 percent of the landings in 2011.

Table 3.18. 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)	*	
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

Species	2010	2011
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: MA 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 MA DMF regulates (Dean 2010). Monomoy NWR is located within the Outer Cape Lobster Conservation Management Area (MA DMF 2014).

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 through 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 3.19). 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 3.19). It is not known how many lobsters are harvested commercially from within the refuge’s Declaration of Taking boundary.

Table 3.19. 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

Year	SRA	Lobster Pounds
2009	10	9,244
2010	10	22,668
2011	10	28,979

Source: MA DMF Annual and Trip-Level Catch Reports

Commercial fisheries utilize a variety of gear types in Nantucket Sound. These are described below in table 3.20. 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.com/the-fishermen>; accessed January 2015).

Table 3.20. 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%

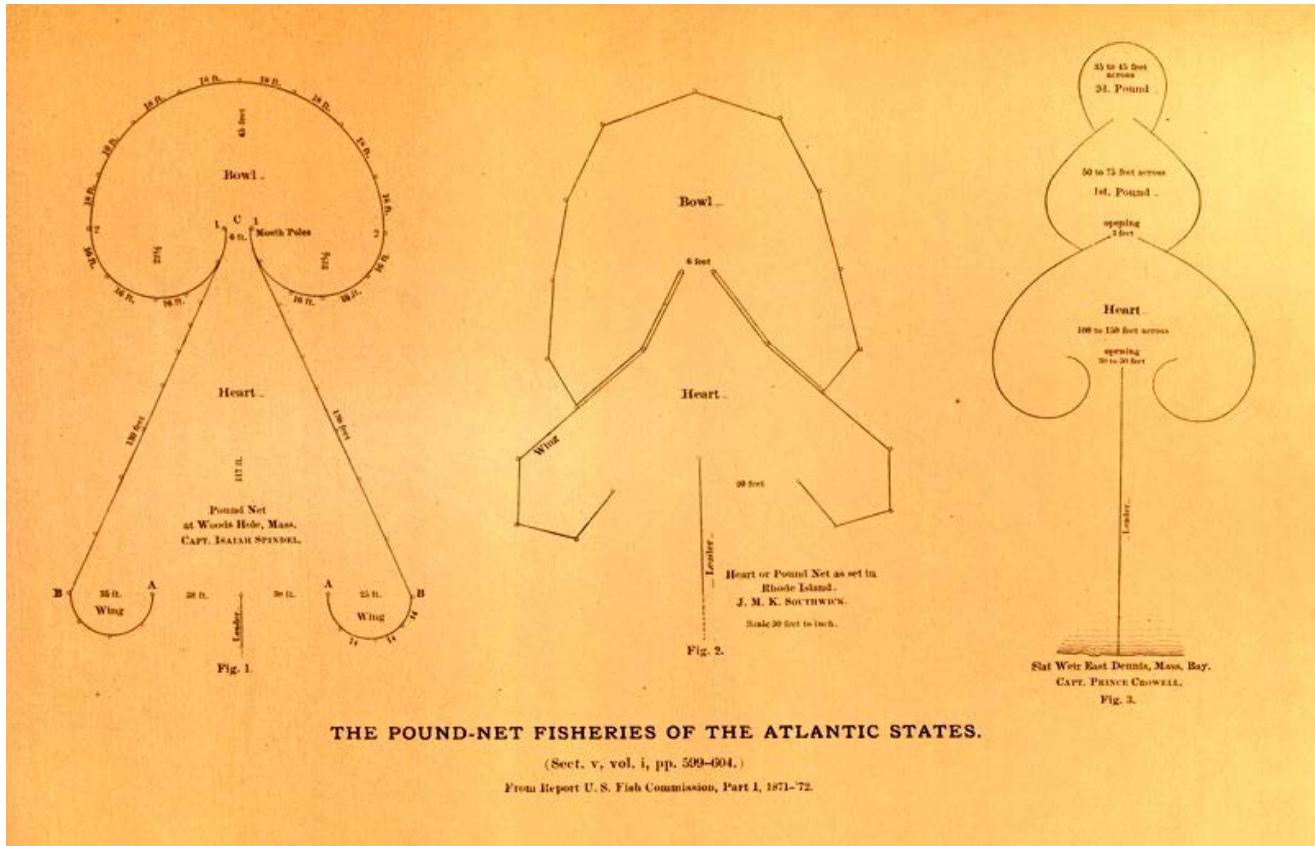
Fixed gear—Fish Weirs: Although historically used throughout Cape Cod, Chatham is one of the few Massachusetts towns to permit fish weirs, also known as trap nets or pound nets. Monomoy Trap Company currently has trap grants (permits) to operate up to nine seasonal fish weirs within Nantucket Sound. Four of these trap grants are located within the refuge’s Declaration of Taking boundary.

A fish weir consists of a series of hickory posts and nets of varying mesh sizes assembled in the water to create three distinct parts: the leader, the heart, and the bowl (Jones 2005). Posts are placed in areas of soft sand using a saltwater pump that only temporarily disturbs the sediments (Nichols, personal communication 2015). Figure 3.14 displays a variety of structure arrangements that have historically been used along the Atlantic coast and are similar to the design currently employed in Chatham. “The weir is positioned perpendicular to the shoreline and acts as a guide in which schools of migratory fish travel along its leader to the deeper end of the structure” (E. Eldredge, personal communication 2014) or the bowl. Some fish remain in the bowl, swimming freely, until they are harvested with small handheld dip nets or a larger kill-devil if necessary (Nichols, personal communication 2015). Others escape the trap prior to harvesting.

Fish weirs are typically used for harvesting “squid, scup, black sea bass, mackerel, bluefish, butterfish, bonita, false albacore, herring, and Spanish mackerel” (S. Eldredge, personal communication 2014). Non-target fish as well as seals and sea turtles occasionally swim into these nets and become trapped, though entanglements are relatively rare and the animals are most often released alive by fishermen. In fact, grey seals have been documented entering the weir nets to eat fish and squid from the catch as they are drawn to the nets by the groups of schooling fish contained in the bowl (Nichols et al 2014). However, 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.

Figure 3.14. Several examples of a trap net set-up (Goode 1887)



THE POUND-NET FISHERIES OF THE ATLANTIC STATES.

(Sect. v, vol. i, pp. 599-604.)

From Report U. S. Fish Commission, Part 1, 1871-72.

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 (MA DMF 2013b).

Fixed gear—Whelk (Conch) Pots: The commercial conch fishery is open from mid-April to mid-December (MA DMF 2014). 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 (MA DMF 2013a). 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 (MA DMF 2013a). Commercial hook and line fishing for striped bass and bluefish occurs primarily in rips along the southern tip of South Monomoy Island; 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://cchfa.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 June 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 to November 15 (Chapt. 130, 322 CMR 4.09).

Placement of moorings (commercial and recreational): There are no existing 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 weighed 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 is a potential problem and we anticipate possible future interest in placing moorings within the refuge.

Dredging: The USACE 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 interest by some citizens and businesses to maintain (dredge) 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 will 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, and we now realize that beach renourishment on Morris Island is not only beneficial but necessary. The Service has met with the USACE and the Town 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 Prior to Refuge CCP

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, all horseshoe crab harvesting was found incompatible with the refuge's purpose and mission, based on new scientific data, and has not been allowed since. That CD 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 (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 NPS also does not allow harvesting of horseshoe crabs within their 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 additional 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 USCG lifesaving stations on South Monomoy Island. 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 NRHP. In general, archaeological resources on the refuge may be at risk due to erosion and natural forces.

Because very little of the refuge has received systematic archaeological sampling, it is possible that many archaeological sites, both Native American and European-American, remain 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 Island 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 shoreline 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-20th 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 complies with the NHPA (Section. 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 Service's Northeast Regional Office in Hadley, Massachusetts.

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).

*Monomoy Point
Light Station*



Kate Jaquinto/USFWS

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 NRHP. 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, personal communication 2010). 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 USLSS 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 station was built on Morris Island near the current refuge administrative complex and designated as LSS #13 Chatham. The second 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 USCG 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 USCG 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-20th 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 3.15), as follows:

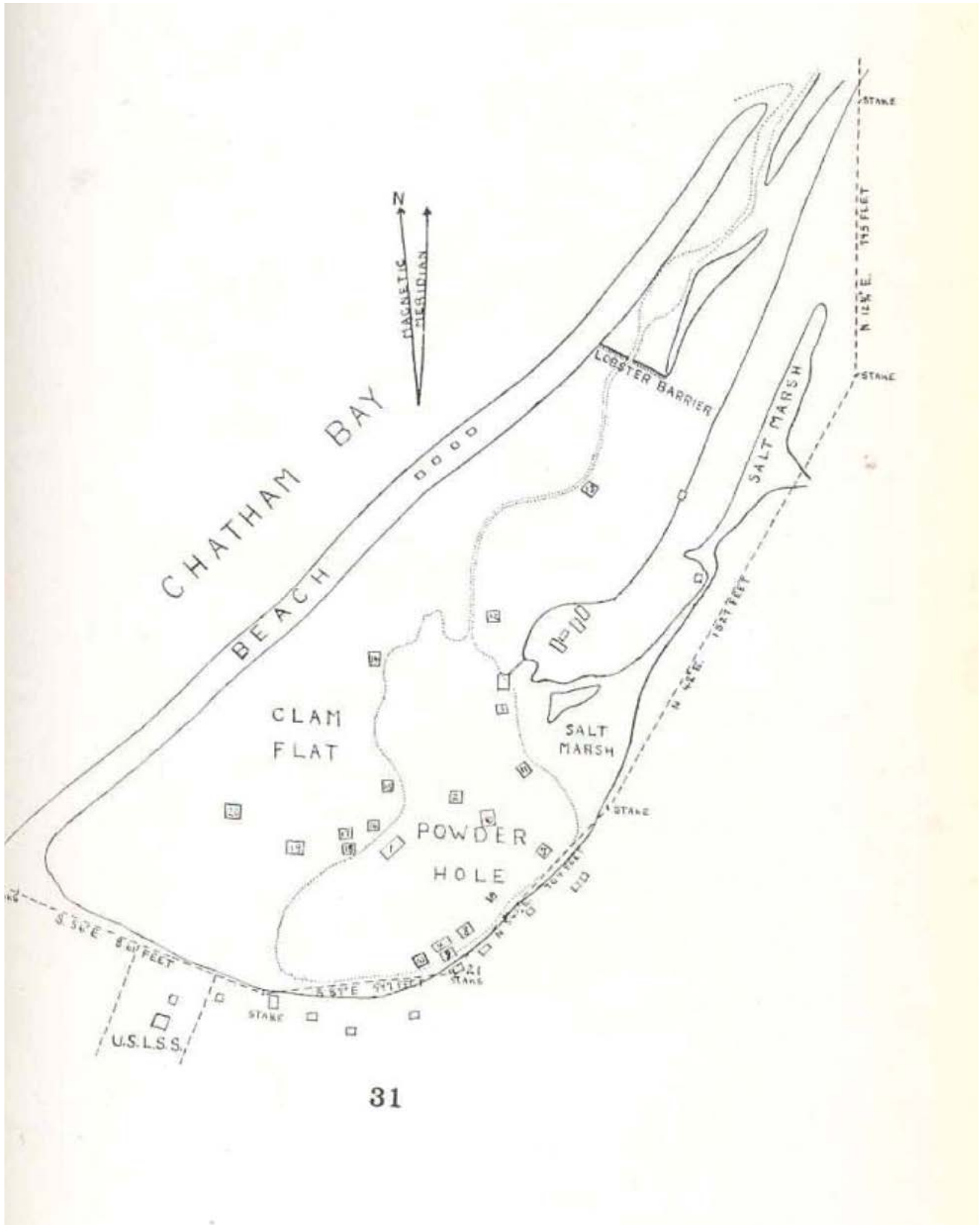
During the period from 1905 to 1910 [quahog] growth experiments were conducted in the Powder Hole...The natural aquarium of several acres, teeming with shellfish life, was leased for experimental purposes by the Commonwealth, and proved by its protection and variety of natural conditions in a limited 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 by 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 3.15. 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 has a very long fishing history, and maintaining a vibrant fishing industry is very important to the Town. Chatham is a tourist destination because of its scenic beauty, beaches, seals, and its vibrant and artistic downtown. Many homeowners are retirees or maintain their primary residence elsewhere. 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 300 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#a.xzzz2PSYG7wUH; accessed April 2013).

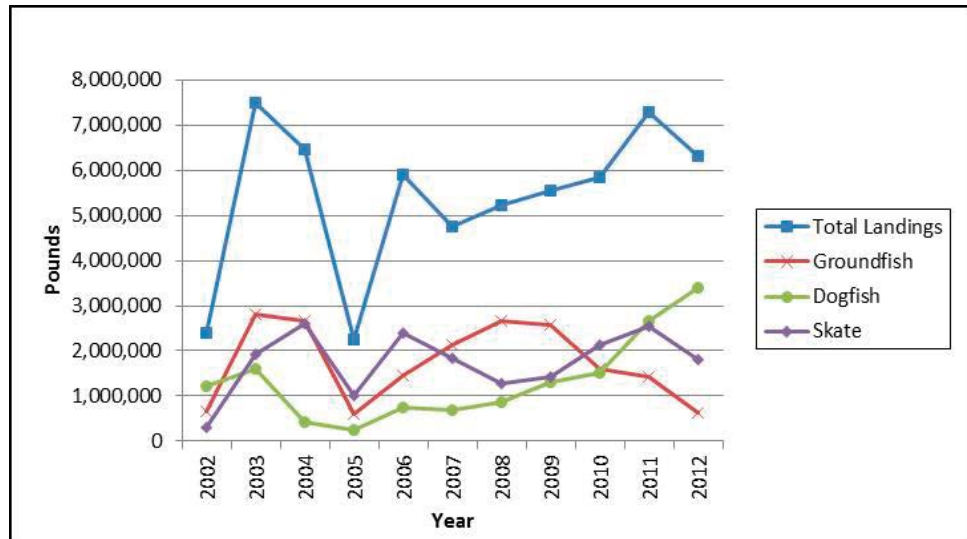
By the late 19th and 20th centuries, large fleets of schooners sailing from Gloucester and Boston targeted cod and other groundfish along offshore banks from Cape Cod to Newfoundland. The majority of cod were preserved with salt prior to the vessels returning to port. Overfishing by the early hook-and-line 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 MSFCMA 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 3.16). Since 2009, 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 3.16). Together, skate and dogfish represented 82 percent of the total 2012 landings at the Chatham Fish Pier (<http://www.cchfa.org/media/documents/CCC.FutureofChathamFishing.2.28.13.pdf>; accessed April 2013).

Figure 3.16. 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, Barnstable County decreased 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 census-designated place (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—60 percent higher than 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 Island, 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 Island, 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 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 Island, and the northern tip of South Monomoy Island (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 Island. 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, personal communication 2011).

Additionally, many summer visitors come to the refuge primarily to sunbathe and swim. 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 2013). Monomoy NWR and adjacent Nauset/South Beach are unmatched on Cape Cod 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 refuge 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/or 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 tidal shellfish areas. In fact, the Monomoy area, which has no seasonal shellfish 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, common during warmer months.

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 softshell 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 about specific mussel harvests on the refuge or how often this has occurred. The Town provided the following information: “The harvesting effort is determined by the extent of the mussel bed and typically ranges from one to ten vessels involved in the fishery. Vessels targeting mussels usually employ at least two permit holders, though if three or more work on a vessel, only two Individual limits can be filled per vessel per day. Therefore, a good mussel set could employ upwards of 20 plus individual permit holders. The last successful mussel set in Chatham was in 2008 in Pleasant Bay” (Town of Chatham 2015a). Over the past 20 years, on average, the typical mussel harvest has been about 28,000 bushels (Maillett 2013). Mussel harvest was the primary reason for the record total harvest levels in 1990, 1991, 1992, and 2008. Mussels have also been harvested out of Chatham Harbor.

Softshell Clams

In 2002, the peak year for softshell clam harvest in Chatham, the total amount of harvest was 78,000 bushels (Maillett 2013, Town of Chatham 2005b). 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, only about 5 percent of the 2002 peak harvest. 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 Island.

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 2013). 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 shellfish closures.

Razor Clams

We have little information about razor clam harvest on the refuge. The Town indicated this was not occurring on the refuge because it is a sub-tidal fishery (Town of Chatham 2015a), but there are sub-tidal areas on the refuge so there is potential for this fishery to occur on the refuge. According to the Town, “The razor clam fishery may be the least predictable of all the shellfisheries. The commercial success of this fishery is the quick adaptation and response of harvesters. Razor clams are very particular to their surrounding environment and will “move” when conditions become unfavorable. Though razor clams can be found in most all marine environments throughout Chatham, economically viable razor clam sets occur predominately in “new sand, such as what occurred in Pleasant Bay in 2012-2013...Many factors limit accessibility for harvesters making the fishery self-limiting “ (Town of Chatham 2015a). The Town was not able to predict the future growth of this fishery, stating “There is no predicting ANY shellfishery within such a dynamic area. As with any fishery, the “set” will determine the effort” (Town of Chatham 2015a).

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 2013), 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 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 through 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 NWR in 2012 contributed close to \$100,000 in visitor spending to the local economy (Maillett 2013). 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).

Monomoy Island Ferry

The Monomoy Island Ferry Company has 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, at the 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 Island, 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 one-half 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 2013).

Refuge Contributions to the Local Economy

The operation of the 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 (FY) 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 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 formulae. 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 by the refuge for the FY 2008 to 2014 are shown in table 3.21. The most recent refuge revenue sharing payment was based on 7,604 acres. When the next appraisal occurs, it will be based on the official acreage figure for the refuge at that time.

Table 3.21. Refuge Revenue Sharing Payments for Monomoy NWR.

Fiscal Year	2007	2008	2009	2010	2011	2012	2013	2014	Total 2007 - 2014
Payment	\$32,805	\$25,452	\$23,917	\$22,533	\$24,146	\$22,690	\$26,629	\$24,924	\$203,096

Monomoy NWR also spent approximately \$63,000 (FY 2011) annually on materials and services to operate the refuge (Maillett 2013). 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 MLW 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 MLW including a portion of Morris Island, all of Monomoy Beach, North Monomoy and South Monomoy Islands, 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 land 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 MLW along the eastern shore. The boundary established by of the Declaration of Taking recognized 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 refuge 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 MLW lines was conducted. The acreage determined to be above the high water line was 1,838 acres, the acreage above the MLW 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).

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 initial 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 MLW 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 (by condemnation), 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.

The ambulatory east boundary of the refuge moves as the MLW 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 constantly change over time as land and water characteristics change. The dynamic nature of this ambulatory boundary, along with the southward movement of sand from the Atlantic facing sandy beaches to the north and the slow filling in of the Southway and the creation of salt marsh in what had formerly been open waters, creates complications related to locating legal property boundaries and jurisdictional issues.

The Declaration of Taking defined the Monomoy NWR eastern boundary (Atlantic Ocean side), as MLW. As long as South Monomoy Island remained an island, the eastern boundary was not in dispute, but once Nauset/South Beach attached to it in 2006 after years of gradually infilling, 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 defining the southern boundary in the designation of Cape Cod National Seashore in 1960 under NPS jurisdiction. The national seashore designation extends 1/4-mile out (seaward) from the MLW line, and there are now areas where the NPS jurisdiction overlaps with Service's jurisdiction.

The Town, NPS, and 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, the NPS, 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 MOU formalized the handshake agreement among the NPS, the Service, and the Town. The MOU contained an agreement among the parties to establish a management 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 2008, 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 (the thread). Because all parties to the MOU maintained effective communication and working relationships, 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 did not have an agreement on how to define a new boundary.

*Monomoy National
Wildlife Refuge shoreline*



Claire Revekant 2014

This lack of agreement on a new boundary coincided with the final development of the Monomoy draft CCP/EIS. Then, in February 2013, South Monomoy became an island once again with a break in Nauset/South Beach. The legal and management questions remained complex, but our initial legal analysis indicated that 717 acres of Nauset/South Beach that had attached to South Monomoy were now under the jurisdiction of the Service. This calculation brought the total refuge ownership to 8,321 acres, which was the number we presented to the public in the Monomoy draft CCP/EIS.

While some agreed with the legal reasoning behind our assertion to ownership of part of Nauset/South Beach, the Commonwealth of Massachusetts, the Town, and many individuals did not. Uncertainty remains about the precise boundary location. Therefore, after the public comment period for the draft CCP/EIS closed, in June 2015 the Service worked with the Town of Chatham Select Board to develop a new MOU and administratively determine a management boundary on Nauset/South Beach (see appendix L). The management boundary line was drawn from the northeasterly most point of open water within the Declaration of Taking to the point where this line crosses Nauset/South Beach on the Atlantic Ocean. The Monomoy Lighthouse, which is a fixed location, became the reference point from which this line was drawn; but the management boundary ends at the Atlantic Ocean.

While the Service and Town remain in disagreement over the precise location of the legal boundary between our respective ownerships, this mutually agreed upon management boundary provides for Town management over much of the area that the Service had preliminarily determined to be lands of the United States. The agreement will be in effect for the next 15 years and is extendable by mutual agreement of both parties. The MOU facilitates cooperation between the Service and the Town on resource protection, public access and use, while both parties continue working toward settling the more complex question of the precise location of our common legal boundary.

The NPS is not a party to the new MOU, even though they had been one of the signatories of the 2008 MOU. The fundamental protections that apply to all of Nauset/South Beach as part of the Cape Cod National Seashore remain in effect. The NPS interprets Nauset Beach as extending to the point on South Monomoy Island where the connection first occurred in 2006. In the area where the Seashore's 1/4-mile offshore jurisdiction might overlap with refuge lands above MLW, we agree that the most restrictive rule of either agency involved would prevail. This addresses the issue of a jurisdictional overlap, and also preserves the intent of Congress that the Atlantic coast from Provincetown to the tip of Monomoy Island would be officially protected by the Federal Government.

In the course of the new MOU development, it was acknowledged that the Nauset/South Beach landform is shifting to the west. A review of recent aerial photography affirms that the northern tip of the part of Nauset/South Beach located below the 2013 (and subsequent 2014) breach is moving toward South Monomoy Island. Also, sand is being pushed west into the Southway in the vicinity of the inlets created by the breaches. Because this landform is different than it was when the refuge acreage was established for the Monomoy NWR draft CCP/EIS, the new refuge acreage is larger than some might expect based on the new MOU. Using the 2014 aerial photography that was used as the base for depicting the management boundary, the upland/saltmarsh area east of the Southway that is now under Town management totals 574 acres. The upland area is decreasing as sand is deposited in the Southway particularly adjacent to South Monomoy Island. The new refuge acreage, for purposes of this CCP, is 7,921 acres.

If, today, you were to calculate the acreage figures for both the refuge and the part of Nauset/South Beach that will remain in Town management, completely different acreage figures would be identified. As previously stated, the Monomoy NWR is a dynamic system, and therefore the actual refuge acreage is also variable and dynamic, with the potential to change on a daily basis. Since it is necessary to fix an acreage figure for the purposes of planning and revenue sharing, we are using an acreage value that derives from the 2015 MOU's location of the management boundary based on 2014 aerial photography.

Wilderness Designation

On October 23, 1970, Monomoy NWR was afforded additional protection when PL 91-504 designated as wilderness most of the land and intertidal areas within the refuge. It is currently the only nationally designated wilderness on the densely populated New England coastline. The Monomoy wilderness area designation extends to MLW. 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 PL 91-504 provides that wilderness areas shall be administered in accordance with the provisions of the Wilderness Act (PL 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).

In 1970, when the wilderness area was designated, it 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 MLW 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 MLW 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. With the addition of the lands and waters below the new inlet on Nauset/South Beach, the Monomoy Wilderness is now about 3,500 acres. Those lands lying west of the management boundary designated in the June 2015 MOU, addressing the eastern refuge boundary with the Town on Nauset/South Beach, are considered a natural expansion of the Monomoy Wilderness and will be managed as wilderness. Just as it has over the past 40 years, this acreage will continue to change over time as the landform continues to shift.

There were two tracts of land that were excluded from the wilderness areas: Inward Point and Powder Hole. 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 NRHP designated site.

These two 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 States for all parcels. 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 MLW. 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).

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 wilderness inventory (appendix E) determined that none of the current non-wilderness

portions of South Monomoy Island 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/refuge/Monomoy/what_we_do/conservation.html (accessed October 2015).

Untrammeled

At present, it seems that nearby developments have not trammled 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. Boat traffic is heavy at times during the summer; seal tours and

fishing boats circulate South Monomoy Island. 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 Island.

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 15 permanent positions, 11 located at the complex headquarters at Great Meadows NWR in Sudbury and another at the Assabet River NWR, also in Sudbury. Monomoy NWR currently has three permanent full-time staff positions: the refuge manager, a wildlife refuge specialist and a wildlife biologist. 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 NWR are addressed in the same fashion as for the other refuges in the complex. Table 3.22 shows the specific allocation for Monomoy NWR and for the entire refuge complex for fiscal years 2007 to 2013.

Table 3.22. 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 FY 2014 was about the same as previous years due despite 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 square feet) 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 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 MOU 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 Island, refuge structures currently listed on the NRHP 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 CD, 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 CDs and associated findings of appropriateness.

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. Since 2009, 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, 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 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 (MA DMF)
- National Marine Fisheries Service (NMFS)
- NPS, 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

The Friends of Monomoy NWR support 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 are 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 including 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**

SUPs 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 SUPs 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 3.23. Additional information on these studies can be obtained from refuge headquarters.

Table 3.23. 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	NPS, 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 (WNV) 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 SUP 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.

WNV 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). WNV 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 WNV cases were documented in the Town of Barnstable, one case in 2003 and another in 2007. There have been no human WNV cases documented for Chatham or surrounding communities (Harwich, Dennis, Brewster, or Orleans). WNV has not yet been detected in humans, dead birds, or mosquito pools in Chatham.

Periodic outbreaks of the eastern equine encephalitis virus (EEE), with an epicenter in southeastern Massachusetts just west of Cape Cod, are also documented. The majority of human EEE 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 EEE 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, EEE 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 EEE virus occurrence records yet from Chatham or Harwich.

Larvicide treatments to reduce the threat of human transmission of WNV were applied annually to select Morris Island wetland areas along the refuge boundary from May to October, after monitoring 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 EEE 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 EEE 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 EEE virus transmission. For additional details on the refuge's mosquito management program, refer to the mosquito control compatibility determination in appendix D.

Chapter 4

Kaiti Tīherington/USFWS



Roseate tern

Management Direction

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

Introduction

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

Developing Management Direction

Relationship Between Goals, Objectives, and Strategies

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

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

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

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

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

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

Developing Alternatives, including those not selected

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

We grouped the objectives that seemed to fit together in what we loosely called “alternative themes.” For example, we considered such themes as “current management,” “enhanced management of habitat and public uses,” and “natural processes management.” We formed those into three management alternatives after further evaluating how the objectives would interact, their compatibility with refuge purposes, and the reality of accomplishing them within a reasonable period.

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

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



Bill Thompson/USFWS

American black duck duckling

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

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

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

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

Overview of Management Direction by Program

Habitat and Population Management

We will take a more active role in habitat and species management both on and off the refuge through partnerships, including those facilitated by the NALCC (see chapter 3). Our highest priority will be the protection of dynamic coastal beach and dune systems and the focal species that rely on them for critical nesting, resting, foraging, and staging habitat. Our actions will continue to include annually identifying and symbolically fencing important wildlife habitat to avoid and minimize adverse impacts from public use to sensitive beach and dune ecosystems for beach-nesting or migrating birds and other wildlife. In recent years, public access closures have generally occurred between April 1 and September 30 (see maps 3.7 and 3.8).

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

We will also evaluate the need for maintaining suitable nesting areas for shorebirds by setting back grassland succession, and monitoring and treating invasive species as staffing and funding permit. The refuge will consider increasing the acreage of grassland by removing some shrublands. Refuge staff will work with partners to protect alternative, offsite areas in order to maintain habitat otherwise lost to sea level rise.

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

Inventory and Monitoring

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

Visitor Services

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

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

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

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

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

Wilderness Management

We will manage the existing Monomoy Wilderness to simultaneously secure an enduring resource of wilderness and accomplish refuge purposes in a way that preserves wilderness character. We will continue managing the existing wilderness to maintain its size, naturalness, and outstanding opportunities for solitude or primitive and unconfined recreation, to the extent that it will not prevent us from fulfilling and carrying out refuge establishing purposes and the Refuge System mission, in accordance with Service wilderness stewardship policy (610 FW). Chapter 3 provides a description of the history of Monomoy wilderness designation, the dynamic nature of the area, and the results of our wilderness review during this planning cycle. We will also manage the two exclusion areas, Inward Point and Powder Hole (currently non-wilderness), so as not to diminish their eligibility as a wilderness area. In 15 years, these exclusions may once again be reviewed by the Service for suitability as additions to the NWPS.

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

Cultural Resources

We will continue to protect cultural resources on the refuge.

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

Refuge Administration

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

Management Goals, Objectives and Strategies

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

REFUGE GOAL 1:

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

Objective 1.1 (Dune Grasslands—Roseate and Common Terns)

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

Rationale

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

The need for active management for common and roseate terns (including habitat and predator management) is detailed in chapter 3.

We will manage 75 acres of habitat for common terns and 10 acres of habitat for roseate terns in a manner consistent with preserving wilderness character. More resources will be put toward improving a larger area of habitat for both species, as well as attracting prospecting birds to newly created habitats. Because the Northeast population of roseate terns only nests in association with large, productive common tern colonies, habitat and predator management still needs to focus on both species (USFWS 1998a, USFWS 2005b, and USFWS 2010a). Management actions will be the minimum necessary and will be evaluated annually through a minimum requirements analysis.

The Northeastern population of roseate terns is a Federal and State-listed endangered species, and common terns are listed as a species of special concern in Massachusetts. Both roseate and common terns in the Gulf of Maine were decimated in the late 1800s by a combination of shooting and eggging for food and bait, and feather collection for the millinery trade (Drury 1973). Conservation legislation passed in the early 1900s provided protection from human persecution, but expanding gull populations (which also benefited from protection and from

artificial food sources provided by dumps and fish offal) soon caused tern numbers to again decrease significantly (Drury 1973, Kress 1983). By 1977, the New England populations of nesting herring and great black-backed gulls had reached more than 40,000 and 80,000 pairs respectively (Erwin 1979). During this same timeframe, tern populations throughout the entire Gulf of Maine had declined significantly, and by 1977 the number of islands supporting nesting terns had declined by half. In 1987, the Northeast population of roseate terns was listed federally as endangered because of significant breeding range contraction and declining numbers, including the total loss of breeding birds in Virginia, Maryland, and New Jersey (Nisbet 1980, USFWS 1989, USFWS 1998a).

Roseate terns currently nest on offshore islands from New York to the Magdalen Islands in Quebec (Nisbet et al. 2014, Environment Canada 2006). The population increased from about 3,350 peak period nesting pairs in 1988, to 4,450 nesting pairs in 2000, but has since declined dramatically to fewer than 3,100 nesting pairs in 2009, erasing 13 years of progress toward recovery. Breeding roseate terns are close to extirpation on the south shore of Long Island, New York, in Connecticut, and in the northern limits of their range in Canada.

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

The avian diversity project was initiated in 1996, when thousands of nesting great black-backed and herring gulls were removed from potential tern nesting areas, and gull-free areas were identified and maintained for terns (refer to appendix J for more details). This marked the beginning of nesting tern population increases that have been largely sustained for the last 20 years on Monomoy NWR. Nesting common terns increased from just a few hundred pairs in 1995 to more than 2,000 pairs in 1998 and more than 10,000 pairs by 2003. Maintaining gull-free areas for terns has also proven to be effective in restoring large numbers of nesting terns at other Massachusetts sites (Blodget and Henze 1992) and in Maine (Kress 1983, USFWS 2005a).

The increase of nesting common terns in the first few years following the start of the avian diversity project was concomitant with a decline in the number of nesting common terns at Plymouth Beach (USFWS 2000, Blodget 1999, see chapter 3) which led to a dramatic increase in the number of common terns nesting at the refuge and for several years Monomoy NWR also saw an increase in the number of roseate terns (USFWS 2000). However, the increasing terns were generally nesting in a similar sized area in successive years, although the shape of the nesting colony changed somewhat. Impacts of increased nesting density were not specifically studied, but anecdotal observations suggested increased neighbor aggression and disturbance among common terns. In addition, increased aggression was seen between common and roseate terns, and this may have contributed to the decline in roseate tern numbers and their eventual relocation to Minimoy Island (although predation by great horned owl likely also contributed to this shift) (USFWS 2007a). Storm overwash and erosion over the last several years has severely reduced available nesting space on Minimoy Island, and roseate terns have mostly abandoned this site now as well (USFWS 2012).

Since the recent peak nesting years following implementation of the avian diversity project (2003 to 2006), numbers have fluctuated in response to habitat changes, predator pressures, and nesting habitat quality at other nearby sites. Despite this fluctuation, Monomoy NWR has remained one of the most important sites in the State, and in some years has provided nesting habitat for more than 50 percent of the State's total population.

Monomoy NWR remains one of the most important common tern nesting sites in the State, and one of just a few sites that support roseate terns. However, the long-term continued success of this project depends on a flexible adaptive management approach that incorporates annual management actions (focused on habitat manipulations and management of predator and competitor species) and careful monitoring of habitat and birds' responses to the management actions. This then informs adaptations of strategies for subsequent years.

In recent years, several species of specialist predators became problematic for nesting terns at Monomoy NWR. The most prevalent mammalian predator on the refuge during the last 15 years has been the eastern coyote. With the State's increasing coyote population, and the establishment of the land bridge to South Monomoy Island in 2006, coyote presence in the tern colony increased substantially. In most years since 1998, coyotes also attempted to den on the refuge (USFWS annual field season activities reports from 1998 to present).

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

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

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

Successful predator management is critical to success, but maximum benefits are realized when it is combined with a site-specific habitat management program. Roseate terns generally prefer dense vegetation or some level of overhead cover for nesting (USFWS 2000). This is somewhat contradictory to the more open habitat used by nesting common terns. Fortunately, these differences in habitat preference can usually be accommodated on the same island. Management that results in a mosaic of high-quality roseate and common tern nesting habitat typically includes a combination of multiple actions, including constructing nest boxes and chick shelters, promoting dense vegetation in some areas, suppressing vegetation in other areas (through herbicide, hand-pulling, or prescribed fire), and restricting public access to minimize disturbance (USFWS annual field

season activities reports). Habitat management needs to be adaptive, and managers have found that techniques that work at one site may not work at others (USFWS 2005a, USFWS 2005b, Kress and Hall 2004).

During the last 10 years, we have experimented with various types of habitat management on a small scale (see chapter 2 for details), but have only recently applied management at a scale that exceeds the current nesting area (a prescribed burn of 30+ acres). Careful monitoring of different techniques has provided the foundation for moving forward with habitat management on a much larger scale. Providing more habitat may allow for even more nesting common terns, but more importantly, would allow common terns to increase nearest neighbor distances, while still maintaining the benefit of being a colony member. We also expect prospecting roseate terns to find nesting space more readily within a common tern colony that is not at a saturated density. Roseate terns generally nest 7 to 10 days later than common terns at Monomoy NWR, so prospecting roseate terns are often trying to establish a territory amid hundreds or thousands of already established common tern territories. Roseate terns are also generally a bit more skittish and less aggressive than common terns, which presents an additional challenge to prospecting roseate terns that are repeatedly being chased by common terns (Koch, personal communication 2013; Spendelow, personal communication 2013; Burger and Gochfeld 1991a, Burger et al. 1995a, Cooper et al. 1970, Nisbet 1981). A larger habitat base will also allow terns to move around between microhabitats within the larger area, as we apply a rotational-based habitat management scheme. We will continue working mostly on the north end of South Monomoy Island where terns have nested during the last 15 years; however, we will also consider establishing suitable nesting habitat on other areas of the refuge if there is evidence of more suitable sites (consideration will be given to habitat free from human disturbance, with ease of access for monitoring, and low presence of predators).

In addition to trying to improve nesting habitat, we use social attraction to actively attract prospecting roseate terns to these areas. Terns are reluctant to colonize new nesting sites, even when suitable the available habitat is available. Social attraction consists of placing wooden or plastic decoys of terns in the available habitat, combined with a sound system that plays vocalizations (Kress and Hall 2004). Sound systems that play recordings of terns, combined with tern decoys, have been successful at luring terns to nesting sites on other islands (Kress 1983, USFWS 2005b). Placement of sound systems is modified annually depending on habitat and where roseate terns nested in previous years. Artificial nesting structures are also placed in quality habitat to encourage nesting roseate terns. Each structure consists of six tern boxes (series 500, modeled after J. Spendelow, USGS Patuxent Wildlife Research Center, Laurel, MD) covered with a 2.4 m by 0.6 m by 2 cm thick sheet of outdoor plywood, which is secured to the ground (USFWS 2012).

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

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

Strategies

Continue to:

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

Within 1 year of CCP implementation:

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

- Evaluate potential for establishing new tern habitat and attracting birds to areas of the refuge not currently used, including further installation of sound systems and decoys.
- Strengthen partnerships to manage lands adjacent to the refuge to create a larger area of continuous protection for terns.
- Meet annually with the Town and NPS to discuss any proposed changes in refuge, Cape Cod National Seashore or Town coastal management and regulations.

Within 5 years of CCP implementation:

- Control non-native invasive plant species throughout dune grasslands using manual tools, herbicides, or prescribed fires to ensure less than 10 percent coverage refugewide, with a control emphasis in tern nesting areas.
- Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to provide wildlife habitat.

Monitoring Elements

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

collecting, and submitting dead birds for analysis at the National Wildlife Health Center.

- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of nesting habitat. (This may help us prioritize areas where dredge material deposition could be beneficial.)
- Update a cover-type map refuge-wide every 5 to 10 years.

Objective 1.2 (Beach Shoreline and Dune Edges—Piping Plover)

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

Rationale

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

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

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

Reports of local or Statewide declines between 1950 and 1985 are numerous and many are summarized by Cairns and McLaren (1980) and Haig and Oring (1985). Blodget (personal communication 1991) reports that there was little focus on gathering quantitative data on piping plovers in Massachusetts through the late 1960s because the species was commonly observed and presumed to be secure. However, numbers of pairs of breeding piping plovers declined 50 to 100 percent at seven Massachusetts sites between the early 1970s and 1984

(Griffin and Melvin 1984). Further, recent experience of biologists surveying piping plovers has shown that counts of these cryptic birds sometimes go up with increased survey effort. This suggests that some historic counts of piping plover numbers by one or a few observers, who often recorded occurrences of many avian species, may have underestimated the piping plover population. Thus, the magnitude of the species' decline may have been even more severe than available numbers imply.

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

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

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

We currently protect approximately 5 percent (35 to 40 pairs) of the State's nesting population of piping plovers. On Monomoy NWR, nesting habitat is currently not considered a limiting factor. A thorough assessment of refuge beaches conducted by Service and MA DFW biologists in 1995 and 1997 found all prime piping plover habitat to be located on South Monomoy Island. Sections of the beach were ranked from "A+," such as areas that contained abundant suitable nesting habitat with feeding habitat available along an ocean-side beach and a pond, bay, estuary, or salt marsh, to "D," which included habitat believed unlikely to be used by nesting plovers (USFWS 1996b). These habitat assessments indicated the refuge could have supported approximately 94 pairs at that time (approximately 50 percent of the State's population). Even today, much seemingly high-quality plover nesting habitat remains unused every year. Common limiting factors for piping plovers rangewide are loss of habitat due to human development and intensive recreation (Hecht and Melvin 2009) which are not limiting factors for the refuge population. Monomoy Island is a rare example of

an actively accreting coastal landform (appendix I). Habitat has been increasing in recent years due to an annual influx of sand from Nauset/South Beach and the outer Cape Cod. Research could shed more light on why more available habitat on the refuge is not utilized by piping plovers. We also recognize that the importance of Monomoy NWR, relative to the percentage of the State population we support, could increase if sea level rise adversely affects habitat on artificially stabilized sites.

Piping plovers are subject to impacts of sea level rise and loss of high-quality nesting habitat. According to the IPCC Fourth Assessment Report: Climate Change 2007: “Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea level rise. The effect will be exacerbated by increasing human-induced pressures on coastal areas.” Although we cannot predict with certainty how storm frequency and intensity would directly impact the refuge, we know that these factors will continue to increase relative to 20th century trends (CCSP 2008b, appendix I). Sea level rise alone could increase coastal flooding during storm surges and amplify rates of habitat change on coastal beaches. Increased numbers and intensity of storms during the breeding season could directly affect piping plover breeding success by increasing long-term rates of nest inundation, nest abandonment, or chick mortality due to harsh weather (USFWS 2009a). This would also likely impact other beach nesting species, such as American oystercatcher and least tern.

On many mainland sites, predation on eggs and chicks by coyote, fox, skunk, raccoon, and other predators is increasing (USFWS 2009a, USFWS 1996a). Mainland sites also experience OSV users, and higher volumes of beach visitors that potentially impede foraging or accidentally crush the cryptic plover eggs or chicks. Management of beach recreation is imperfect, poses more conflicts with human beach activity at mainland sites, and requires costly and labor-intensive management (USFWS 2009a, Hecht and Melvin 2009). Protecting crucial habitat from development and restricting recreational use in plover nesting areas is essential to maintaining healthy piping plover populations in the long term (USFWS 2009a).

Much of the refuge upland is federally designated wilderness that is mainly accessible by boat and where OSVs are not allowed. Dog walking is also prohibited on these offshore portions of the refuge year-round. The refuge provides a safe place for plovers to nest, and is relatively unaffected by human disturbance issues more common at other mainland nesting sites. Thus, the refuge uses seasonal closures to protect areas containing prospecting pairs, but has not needed to close all areas that contain suitable but unused habitat. All high-quality habitat is monitored regularly to ensure proper protection from human disturbance. Areas that are known to have more public use are closed in April before the birds start nesting, and other closures are based on the breeding behavior observed on the refuge.

Due to the fact that public use is well-managed, predation is the main issue of management concern for nesting piping plovers on the refuge. Predation has been identified as a major factor limiting piping plover reproductive success at numerous sites in the region (MacIvor 1990, Patterson et al. 1991, Cross 1991), and is included as an important strategy in the Piping Plover Recovery Plan (USFWS 1996a). As recognized in the recovery plan, natural threats from predation have been exacerbated by many human activities in the coastal zone. In addition, the cumulative impacts on piping plovers from predation, habitat loss, human disturbance, and small population size decrease the plover's ability to withstand predation. Due to the magnitude of predation threats to plovers and limitations associated with all currently available solutions, the recovery

plan strongly recommends that onsite managers employ an integrated approach to predator management that considers a full range of management techniques (USFWS 1996a). At Monomoy NWR, both avian and mammalian predators have been documented preying on piping plover eggs, chicks, and adults. On the refuge, the most common predators are gulls and coyotes, which opportunistically take eggs and chicks.

Studies have shown that predator exclosures can help minimize predation or reduce nest abandonment (Rimmer and Deblinger 1990, Vaske et al. 1994, Mabee and Estelle 2000). Exclosures are actively utilized on the refuge. Though exclosures are a useful tool, they may be inappropriate under certain conditions, including habitat that is too steep, densely vegetated, or susceptible to predators that may use the exclosures to target nesting birds (refer to Blodget and Melvin 1996 for more information about appropriateness of use). All exclosures placed on the refuge are monitored frequently to ensure that they are safely protecting the nests and birds within them and not putting the adults at risk. The benefits of exclosures have been questioned as reproductive output has declined at many sites using exclosures, concurrent with increased observations of nest abandonments at exclosed nests. Recent evidence that most nest abandonments are caused by mortalities of incubating adults (Roche et al. 2010) makes evaluation of hatching benefits versus potential risk of elevated nest abandonment rates a critical decision. Research is currently being done to study the impacts of exclosures, and management on the refuge will be adjusted based on the outcome of this research. In addition to exclosures, active predator management has been employed on the refuge to selectively remove unwanted predators (see appendix J).

We will increase management to protect nesting piping plovers in a manner consistent with preserving wilderness character by closing all available high-quality habitat to the public by mid-April. All high-quality habitat (as described above) will be closed, with access corridors provided for the public to cross the island or access the interior of the island at various locations determined each season. These access points will be mapped on the annual closed area map and will be posted in public locations (map 3.7). Closures used will be appropriate for preserving wilderness character. Closed areas will be created using fiber rod posts (1/2-inch diameter) and string. Signs currently used on the refuge for closing areas will be interspersed with the new posts, approximately one sign every 100 meters, to explain the reason for the posted areas. Using this method, closed areas will be visually less obtrusive and more in line with wilderness management, but will still adequately identify closures to visitors. Closed areas will be maintained until all plover chicks within them have fledged or no nesting activity has been initiated by July 1. In addition to predator management already in use, we will experiment with the use of temporary electric and non-electric predator fencing to protect piping plovers. Refer to the rationale for objective 1.3, for a full explanation of when the use of electric fencing is deemed appropriate on the refuge.

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

Strategies

Continue to:

- Patrol and enforce closed areas during the nesting season.

*Service employees at
the refuge*



USFWS

- Use temporary predator exclosures on piping plover nests that are located in sparsely vegetated areas with nothing obstructing the view of the bird or inhibiting the bird's ability to detect predators.
- Minimize impacts of avian and mammalian predators to nesting plovers through non-lethal and lethal management as described in appendix J.
- Strengthen partnerships to manage lands adjacent to the refuge to ensure the success and survival of piping plovers in the surrounding area and create a larger area of continuous protection.
- Participate in partner-based, high priority, landscape-level piping plover research, which may include resighting banded adults, collecting unhatched eggs for DNA analysis, or evaluating habitat availability as a limiting factor.
- Review 5-year reviews and recovery plan updates for piping plovers within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.
- Facilitate and participate in surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Within 1 year of CCP implementation:

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

- Minimize impacts to plovers by expanding the prohibition of dogs and pets on the refuge to include Morris Island from May 1 to September 15.
- Use temporary solar-powered electric fence in suitable nesting habitat to protect piping plover nests from mammalian predators.
- Experiment with using temporary non-electrified fencing to reduce mammalian depredation.
- Meet annually with the Town and NPS to discuss any proposed changes in refuge, Cape Cod National Seashore or Town coastal management and regulations.

Within 5 years of CCP implementation:

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

Monitoring Elements

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

Objective 1.3 (Beach Shoreline, Dune Edges, and High Salt Marsh—American Oystercatcher)

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

Rationale

American oystercatchers are a species of high conservation concern that breed on the refuge in high numbers. Though they are not currently protected under State or Federal endangered species legislation, they are protected under the Migratory Bird Treaty Act and are listed as a species of conservation concern in several management plans that guide refuge decision-making (see appendix A for full listing of conservation status). We will increase efforts to improve reproductive success of American oystercatchers. An annual productivity level

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

Historically, American oystercatchers were widespread on the Atlantic coast though in the early 1900s they were not found nesting north of Virginia (American Oystercatcher Working Group (AMOY WG) 2012). In the 1800s, market hunting and eggging reduced the population and extirpated the species from the Northeast. Concurrent with passage of the Migratory Bird Treaty Act of 1918 (16 U.S.C. § 703-712), populations rebounded and oystercatchers began to move back into northern breeding areas (AMOY WG 2012).

In 2001, the American oystercatcher was one of several species identified in the U.S. Shorebird Conservation Plan (Brown et al. 2001) as having small enough populations to warrant special attention. As a result, the High Priority Shorebird Group (HPSG), which met in November 2001, decided that a regional research strategy for the American oystercatcher was necessary to adequately address the following research priorities: breeding and wintering population estimates; identification of limiting factors among all life stages; and demography. The group decided to focus efforts on American oystercatchers as a focal species for coastal shorebird conservation. The AMOY WG was formed and, since the initial meeting in 2001, the group has met every year at various locations within the birds' Atlantic coast range (AMOY WG 2011).

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

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

predator activity, and overwash potential (Thibault 2008, McGowan et al. 2005, Nol 1989, Novick 1996, Davis et al. 2001).

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

On Monomoy NWR, predation is one management concern impacting American oystercatcher productivity and population growth. Hatch success in American oystercatchers is very low at many sites, including the refuge, due to overwash and predator pressures (see appendix J). On the refuge, the most common predators are herring and great black-backed gulls and eastern coyotes, which opportunistically take eggs and chicks. This is consistent with most studies of nest success, which have shown that predation is a significant factor (Schulte et al. 2010).

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

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

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

and appropriateness of artificially incubating eggs from nests on Monomoy NWR to increase hatch success. Eggs would be removed from nests and replaced with artificial eggs so adults will continue incubating and attending the nest. The real eggs would then be incubated in an incubator and replaced in the nest bowl just before hatching. Management actions will be the minimum necessary and will be evaluated annually through a minimum requirements analysis.

Since oystercatchers are a coastal species that uses low-lying habitats for nesting and roosting, they are particularly vulnerable to pressure from storm overwash and, ultimately, the effects of sea level rise. Overwash is known to destroy nests when storms occur during the nesting season and can also destroy beach habitat at other sites (Schulte et al. 2010). Storm and tidal overwash is a major factor influencing the success of American oystercatchers on the refuge. In 2008, 8 of 34 total nests and in 2009, 3 of 25 total nests lost, were lost to overwash or storm-related weather (USFWS 2008a, 2012). We will continue preliminary experiments with nest platforms to elevate nests that are vulnerable to overwash during storm and high lunar tides. In 2011, experimental efforts were implemented on North Monomoy Island to raise one American oystercatcher nest that was close to the high tide line. The eggs were removed from the nest; a tire was placed where the nest had been and was filled and covered with sand. The eggs were then replaced on top of the sand-covered tire. The incubating adult returned to the nest and continued to incubate for several weeks until the nest was depredated by a coyote. This method was again attempted in 2012; further investigation into elevating nests and creating stable nest platforms to prevent overwash will continue.

Strategies

Continue to:

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

Within 1 year of CCP implementation:

- Minimize impacts to American oystercatchers by expanding the prohibition of dogs and pets on the refuge to include Morris Island from May 1 to September 15.
- Use temporary symbolic fencing to seasonally close all suitable American oystercatcher habitat regardless of the presence of pairs (March or April); maintain these areas as closed until August 1 (if the areas remain unused), or until all chicks have fledged.
- Increase refuge participation in landscape-level color-banding efforts through the AMOY WG to improve productivity estimates on the refuge, and contribute to a range-wide understanding of survival, movement, and dispersal, which are critical to understanding and predicting population trends at multiple spatial scales.
- Meet annually with the Town and NPS to discuss any proposed changes in refuge, Cape Cod National Seashore or Town coastal management and regulations.

Within 5 years of CCP implementation:

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

Monitoring Elements

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

Objective 1.4 (Beach Shoreline and Dune Edges—Least Tern)

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

Rationale

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

*Shoreline at
Monomoy*



Gary M. Stolz/USFWS

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

Least terns were extirpated from much of the Northeast during the 1880s and 1890s (Nisbet 1973). Like many other seabirds, least tern populations rebounded after the passage of the Migratory Bird Treaty Act of 1918. After initial recovery, populations declined in many areas between 1950 and the early 1970s due to displacement by humans, predation, and disruption by organochlorine pesticides (Kress and Hall 2004). Regionally, the number of least tern adults and colonies increased from 1972 to 1987; this was followed by 7 years of gradual decline. However, in 1995, dramatic increases in the number of least tern adults in New York and Connecticut resulted in the greatest number of least terns recorded in more than 25 years (Kress and Hall 2004). In Massachusetts, least tern numbers have been generally increasing since 1985 with the exception of a few outlier years (Mostello 2014). In 2013, 38 percent of the State's least tern population could be found in three large colony sites during the a-period (Mostello 2014), which increases the vulnerability of the State population.

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

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

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

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

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

Strategies

Continue to:

- Minimize impacts to least terns by continuing the closure of the Monomoy Islands to dogs and pets.
- Patrol and enforce closed areas during the nesting season.
- Facilitate and participate in surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Within 1 year of CCP implementation:

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

Within 5 years of CCP implementation:

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

Monitoring Elements

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

Objective 1.5 (Beach—Northeastern Beach Tiger Beetle)

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

Rationale

The Service has responsibility for protecting and assisting in the recovery of federally listed threatened and endangered species under the ESA. In 1990, the northeastern beach tiger beetle was listed as a threatened species. This tiger beetle is also listed as a State-endangered species in Massachusetts. The loss of protected and undisturbed beaches has been cited as one of the primary reasons for the decline of this species. The Northeastern Beach Tiger Beetle Recovery Plan establishes four geographic recovery areas (GRA) and status and goals for each area. Monomoy NWR is currently one of only two occupied sites in GRA 1 (coastal Massachusetts and islands) sustaining a population of northeastern beach tiger beetles; the other site is located at Squibnocket Beach on Martha's Vineyard. Both of these sites contain large populations (peak count greater than 500); however, Monomoy NWR is the only site that is considered permanently protected (USFWS 2009b). The northeastern beach tiger beetle has been extirpated from most of its former range to the south between Massachusetts and Maryland (Kapitulik 2010).

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

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

In 2000, the refuge, due to the presence of large, relatively undisturbed beaches, was selected as a suitable recipient site to establish a new population of northeastern beach tiger beetles. Reintroduction efforts began that year, with larvae translocated from Squibnocket Beach on Martha's Vineyard to South Monomoy Island east of Hospital Pond (see map 3.4). Translocations of larvae occurred annually through 2003. Although no new transplants have occurred since 2003, adult beetles have been documented every year since, with counts indicating that the refuge's population is currently self-sustaining (see chapter 2 for more details).

During a nor'easter in November 2006, the Nauset/South Beach property connected to South Monomoy Island near the refuge's introduction site (map 3.4). Subsequent monitoring revealed that the tiger beetle population took advantage of the newly created habitat and has been expanding steadily northward on Nauset/South Beach and southward on South Monomoy from the introduction site. Map 3.4 details the most current information regarding the general location of adults seen on Nauset/South Beach and South Monomoy during the 2012 spawning season. Since there are two distinct cohorts occupying this site, the exact location of adult beetles varies from year to year. Wilderness designation on the refuge currently protects tiger beetle habitat from damage or "take" due to OSV use while providing for emergency access on the refuge property.

The most recent 5-year review of the Northeastern Beach Tiger Beetle Recovery Plan (USFWS 2009b) recommends that the status of this species be upgraded from threatened to endangered, and identifies a list of current research gaps. One gap identified is the lack of knowledge concerning genetic differentiation between the Massachusetts and Chesapeake Bay populations. Vogler et al. (1993) examined genetic variation in the two populations of the northeastern beach tiger beetle and found that the Massachusetts and Chesapeake Bay sites had low genetic variability, but little work has been done since regarding the genetic makeup of these two populations. By enabling work on this subject, the refuge will assist researchers in understanding the metapopulation structure of this species over time. Necessary additional research includes an analysis of the habitat currently being utilized on Monomoy NWR. Recent analysis done in Chesapeake Bay may provide a model for future research at the refuge. This project included looking at parameters such as sand grain size, sand bulk density, and slope, which have to be collected from the field, as well as parameters such as beach aspect, fetch, and bathymetry fronting the sites, which can be obtained from the Geographic Information System (GIS) (Drummond, personal communication 2011).

We will provide protection to northeastern beach tiger beetles, address research needs identified in the most recent 5-year review and work with partners to locate new introduction sites. One of the best ways to ensure the future survival of isolated, rare species is to protect and maintain as many populations across as broad an area as possible. In the event of a catastrophic loss of an entire population at one location, other non-contiguous sites with viable populations are likely to persist. Surviving populations can subsequently be used as donor sites.

New sites will not be viable unless they are able to provide permanent protection for the beetle population. We will work with the New England Ecological Services Field Office to serve as a donor population for newly identified sites by providing beetle larvae. Though the Monomoy population is considered stable, precautions will be taken to continue protection for the population while acting as a donor site for new locations.

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

Strategies

Continue to:

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

Within 1 year of CCP implementation:

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

Within 5 years of CCP implementation:

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

- Work with the New England Ecological Services Field Office to utilize Monomoy NWR as a donor population for newly identified sites, while ensuring that the Monomoy population is not adversely impacted.

Monitoring Elements

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

Objective 1.6 (Maritime Shrubland—Neotropical Migrant Songbirds, Black-Crowned Night-Herons, and Snowy Egrets)

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

Rationale

Neotropical Migrant Songbirds

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

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

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

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

Wading Birds

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

In contrast, snowy egrets first bred in Massachusetts in 1955 and the population steadily increased beginning in the late 1960s (Petersen and Meservey 2003). During the 1977 coastwide survey, 459 pairs of snowy egrets were counted (Erwin 1979) and during the 1984 survey, 538 pairs were counted (Andrews 1990). However, the 2006 to 2008 survey revealed a 36 percent decline from the 1994 to 1995 survey to only 401 pairs at 10 sites (Melvin 2010a). Thus, current numbers are less than those observed in the 1970s. According to Melvin (2010a) the wading bird populations in Massachusetts are small, "given the State's extensive coastline and abundant and diverse nesting and feeding habitats." Melvin (2010a) also recommends numerous actions in light of these declines,

including more frequent monitoring (at least every 3 years), research to improve surveys, a thorough assessment of regional trends, and research to identify influential factors in nesting trends.

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

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

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

Strategies

Continue to:

- Allow non-native rugosa rose to remain on the refuge in areas where wading birds nest.

- Use temporary symbolic fencing to seasonally close nesting areas in portions of the refuge with high seasonal public visitation to provide disturbance-free nesting opportunities for wading birds.
- Minimize impacts to wading birds by continuing closure of the Monomoy Islands to dogs and pets.
- Facilitate and participate in surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Within 5 years of CCP implementation:

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

Monitoring Elements

- Annually count active wading bird nests in primary nesting areas once between mid-April and mid-May, approximately 1 week prior to peak hatch to minimize disturbance impacts and depredation by gulls.
- Conduct a complete census of all wading birds refugewide every 5 to 10 years using aerial survey method or ground counts, and in conjunction with Statewide efforts.
- Oversee mist netting efforts conducted by Monomoy Banding Station staff/volunteers at the south end of South Monomoy Island from August through November to quantify abundance of neotropical migrants and evaluate importance of Monomoy NWR to shrubland-dependent birds.
- Map locations and record abundance of invasive/non-native species; monitor changes in species composition, and evaluate effectiveness of control techniques implemented.
- Update a cover-type map refugewide every 5 to 10 years.

**Objective 1.7
(Intertidal—Migrating
and Staging Birds and
Horseshoe Crabs)**

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

Rationale

Migrating and Staging Birds

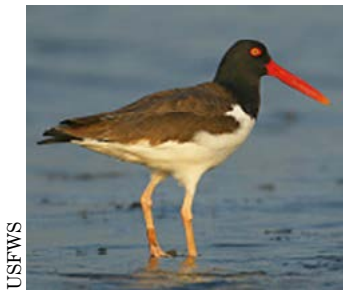
Shorebirds rely on strategically located high-quality stopover sites when migrating long distances between breeding and nonbreeding grounds (Senner and Howe 1984, Myers et al. 1987, Helmers 1992). Shorebirds face strict time constraints when migrating north to breeding grounds because their passage rate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

From maritime Canada to Virginia, the Western Hemisphere Shorebird Reserve Network has recognized six stopover sites that are especially important to migrating shorebirds: Monomoy NWR, Bay of Fundy in New Brunswick and Nova Scotia, the Great Marsh on the north shore of Massachusetts, Edwin B. Forsythe NWR in coastal New Jersey, Delaware Bay in New Jersey and Delaware, and Maryland-Virginia Barrier Islands in Maryland and Virginia (WHSRN 2006). The Bay of Fundy annually supports more than 30 species of southward migrating shorebirds, with peak counts of the nine most common species totaling 800,000 to 1,400,000 annually (Hemispheric Importance; Hicklin 1987). The Great Marsh supports about 30 shorebird species, with an estimated 67,000 shorebirds using the site annually, particularly during southward migration (Regional Importance; WHSRN 2006). Edwin B. Forsythe NWR supports 85,000 shorebirds annually during both migration periods combined (Harrington and Perry 1995). Maximum 1-day counts at Maryland-Virginia Barrier Islands have exceeded 54,000 birds during northward migration, and at Delaware Bay have exceeded 216,000 shorebirds (Clark et al. 1993), making this site the most important for northward migrating shorebirds in the eastern United States (Hemispheric Importance; Harrington et al. 1989, Clark et al. 1993).

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

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

longest migrations known, traveling from their furthest wintering ground at the tip of South America to their Arctic breeding grounds and back again each year, an estimated 16,000 miles round trip. Their migration also includes some of the longest nonstop flights in the bird world, an estimated 5,000 miles over a 6-day period (Niles et al. 2010). Protection of breeding, migration, and wintering habitat is critical to this species' recovery (Niles et al. 2008). Southeastern Massachusetts, and Monomoy NWR in particular, are likely some of the most important sites for red knots during southward migration (adults and juveniles; Koch and Paton 2009, Harrington et al. 2010a, Harrington et al. 2010b). Research has shown that this region supports red knots bound for different winter destinations. North American wintering birds exhibit different migration chronology, flight feather molt, and even foraging habits than South American-wintering birds (Harrington et al. 2010b). Red knots in this area have been documented primarily feeding on blue mussel spat and gem clams (Harrington et al. 2010b). During the last few years, geolocators have been placed on adult red knots at Monomoy NWR and Delaware Bay in an effort to learn more about important stopover sites and wintering destinations for adult birds. Preliminary results from geolocators retrieved from North American wintering red knots have confirmed the importance of Florida, but also raised the awareness of occupied sites in North and South Carolina, Haiti, Columbia, and Cuba (Burger et al. 2012). Juvenile wintering grounds remain unknown, but geocator work was initiated on the refuge in 2011.



USFWS

American oystercatcher

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

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

Conservation of stopover sites that provide abundant food and a relatively disturbance-free environment is critical to the long-term future of many shorebird populations, especially those that concentrate at just a few stopover

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

Understanding shorebirds' reactions to pedestrians on Monomoy NWR is necessary to develop management strategies that minimize human disturbance of shorebirds during migration. In 2006 and 2007, we quantified flight-initiation distances for 11 different species of shorebirds through controlled field trials. Researchers approached shorebirds foraging on the intertidal mudflat and recorded distances at which shorebirds flew away from the approaching researchers; distances differed by species. Smaller *Calidris* sandpipers generally allowed pedestrians to approach within 20 m before flushing, while larger shorebirds (black-bellied plover and American oystercatcher) had flight initiation distances over 50 m. Based on flight-initiation distances, we developed species-specific conservative buffer distances for 11 species that ranged from 61 m for least sandpiper to 186 m for black-bellied plover (Koch and Paton 2014). It is important to note that the point in time when a foraging shorebird flies or runs away is not generally the beginning of the disturbance. Typically, a foraging bird stops foraging and trades off foraging behavior for alert behavior, before ultimately making the decision to fly or run away from the foraging habitat. We chose to use flight-initiation distances as our metric of disturbance because it is a more easily recognizable change in behavior that is easily standardized across different observers. However, disturbance impacts to shorebirds are realized well before they actually take flight (especially in lost foraging time). Therefore, these buffer distances are necessarily larger than the flush distances observed in the field to provide disturbance-free foraging habitat, rather than just preventing abandonment of habitat.

Shellfish harvesters, like all refuge users, may cause disturbance to birds using intertidal and nearshore open water habitats on the refuge. However, shellfish harvesters spend most of their time bent over at the waist or on hands and knees harvesting patches of shellfish, and traverse the exposed mudflats only to move among patches (Burger 1981, Leavitt and Fraser 2004). They generally spend less time traversing mudflats than other users, such as bird watchers, anglers, and beachcombers, who also occupy these mudflats. We investigated the potential impacts of shellfish harvesters, raking for softshell clams on mudflats where shorebirds actively foraged, separate from other users. Microhabitats with recent shellfishing activity had a positive influence on the density of two species (ruddy turnstone and American oystercatcher), while the presence of shellfishers did not appear to affect the density of other species of shorebird we monitored. We regularly detected black-bellied plovers and ruddy turnstones actively foraging in microhabitats where shellfishers had recently exposed sediment. However, observed densities of shorebirds in microhabitats of shellfishing activity do not necessarily translate to increases in density of these birds across a large landscape.

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

on wildlife use and changes in habitat. Given the levels of pedestrian traffic at Monomoy NWR in recent years, we think a small expansion of the current seasonal is sufficient to reduce most disturbance to migratory shorebirds using this stopover site. However, if the amount of pedestrian traffic were to increase substantially, we may need to adjust closures further during peak migration periods.

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

It is not feasible or practical to close the entire 2,500 acres of intertidal habitat to public users, therefore, we will adaptively manage this acreage to ensure relatively disturbance-free habitat for the majority of migrating shorebirds of conservation concern. Based on our flushing trials, implementing a buffer of 61 to 97 m at important foraging sites with frequent disturbance should benefit least and semipalmated sandpipers, semipalmated plovers, sanderlings, dunlins, and short-billed dowitchers. Larger buffer distances (113 to 186 m) should be implemented to protect willets, red knots, ruddy turnstones, American oystercatchers, and black-bellied plovers. At the current time, public use and perceived disturbances from use is generally very low on the intertidal flats of Monomoy NWR. Much of the foraging habitat likely already provides these recommended buffer distances. However, refuge staff will implement closures in the future if areas of high public use and high shorebird foraging activity overlap, and we observe more than 10 percent of shorebirds being disturbed regularly and frequently.

Staging Terns

Intertidal areas on Cape Cod are extremely important for post-breeding staging common and roseate terns. Researchers have documented a dramatic decline in roseate tern populations since 2000, but not common terns, and this decline has occurred despite intensive management efforts at major colony sites and no apparent major change in either roseate tern adult survival or productivity (Spendelow et al. 2008). These facts suggest that there has been a decrease in post-fledging to first-breeding survival, as well as recruitment of young adults. This post-breeding dispersal period just prior to fall migration is an especially sensitive time for many species of terns, as parental care may continue well into fall migration and even after arrival at the wintering areas (Ashmole and Tovar 1968, Feare 2002, Nisbet 1976). At fledging, young terns usually have not achieved adult mass, and several studies have demonstrated that post-fledging parental care given prior to departure from breeding colony sites provides an increase in mass and post-fledging survival probability (Feare 2002, Stienen and Brenninkmeijer 2002, Schaubroth and Becker 2008). During the post-breeding dispersal period, young terns start to transition to independence, learning skills needed to fish independently, and increasing body condition and strength of flight muscles needed for the 7,000 km migration to South America. Much of the presumed recent reduction in post-fledging to first-breeding survival likely results from events that take place during this period (Spendelow et al. 2002). After an initial period of more widespread dispersal, most, if not all, roseate terns in the northwest Atlantic congregate at locations around Cape Cod, including Monomoy NWR, and the offshore islands of Martha's Vineyard and Nantucket (Shealer and Kress 1994, Gochfeld et al. 1998). Refer to chapter 2 for numbers of staging terns using Monomoy NWR in recent years.

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

Horseshoe Crabs

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

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

In 2001 and 2002, Monomoy NWR biologists collected gut samples of southward (2001) and northward (2001 and 2002) migrating shorebirds to determine if horseshoe crab eggs were a prey item of shorebirds. Of the 21 shorebirds examined during northward migration, 16 had been feeding on horseshoe crab eggs, and of the 49 shorebirds examined during southward migration, 17 had been feeding on horseshoe crab eggs (Koch, personal communication 2011) (table 4.1). Although studies did not quantify the proportion of shorebirds' diets composed of horseshoe crab eggs, various species are clearly utilizing the eggs as a food source during both migration periods.

Table 4.1. Gut Samples From Shorebirds at Monomoy NWR Examined During Migration.

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

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

In addition, horseshoe crab eggs and larvae are often eaten by minnows and juveniles of larger fish, (Harrington and Shuster Jr. 1999, Mugford 1975, USFWS 1988, Finley, personal communication 2011) including killifish species (Finley, personal communication 2011) such as striped killifish, eel species such as American eel (Warwell 1897, deSylva et al. 1962), weakfish, northern kingfish, Atlantic silverside, summer flounder, winter flounder (deSylva et al. 1962, Penn and Brockman 1994), striped bass (Martin 1974), and white perch (Shuster Jr. 1982). Observations of other fauna feeding on horseshoe crab eggs, hatchlings, and adults include sand shrimp (Price 1962), eight mollusk species (Perry 1940, as in Shuster Jr. 1982), fiddler crabs (Shuster Jr. 1958 as in Shuster Jr. 1982), blue crab, green crab, spider crab in Barnstable Harbor, Massachusetts (Shuster Jr. 1958 as in Shuster Jr. 1982), devil ray, (Teale 1945 as cited in Shuster Jr. 1982), puffers (Shuster Jr. 1958 as cited in Shuster Jr. 1982), sharks (Shuster Jr. 1982), and loggerhead sea turtles (ASMFC 1998 and Musick et al 1983). All of these species occur on or near Monomoy NWR.

In addition to their importance to wildlife, horseshoe crabs are harvested as bait for various fisheries, including American eel and whelk, or by biomedical facilities producing LAL. LAL is a clotting agent (Novitsky 1984) used for the detection

of endotoxins pathogenic to humans in all injectable drugs and implantable medical devices (Berkson and Shuster Jr. 1999). Horseshoe crabs are susceptible to overharvest because of their reproductive strategy and ecology. They are slow to reach sexual maturity (Shuster Jr. 1982) and do not spawn until 9 to 10 years of age. Beach geochemistry, local tidal rhythms, predation, and intraspecific competition for nesting space probably all affect nest site selection (Penn and Brockman 1994), but at Monomoy NWR many horseshoe crabs lay eggs in the gently sloping, wide intertidal areas. After a female lays 80,000 to 100,000 eggs during several high tides, she returns to deeper waters (Shuster Jr. and Botton 1985, as cited in Shuster Jr. 2000). Larvae hatch within 4 weeks after fertilization (Botton 1995), remain in the sand for several weeks, and then begin moving toward the beach surface (Rudloe 1979). During the first summer, juvenile horseshoe crabs generally live in shallow waters near the shore, but undergo multiple molts and disperse over the tidal flats, moving in an offshore direction (Shuster Jr. 1979). Intertidal flats remain extremely important to successful population recruitment. Adults return annually to spawn on beaches and may do so for at least 8 years (Shuster Jr. 2000). Horseshoe crabs may live as long as 15 to 20 years (USFWS 1998b).

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

The full impacts of the biomedical industry's use of horseshoe crabs are unknown. Because the number of horseshoe crabs harvested for this purpose is much less than those collected for the commercial bait fishery, and surviving horseshoe crabs are returned to the waters after bleeding, the impacts of this activity are likely less than those of bait harvesting. A comprehensive overview of bleeding studies is included in the CD, but a summary of some of these studies is included here. A study conducted in Maryland from 1999 to 2001 compared mortality of bled and unbled horseshoe crabs; a 7.5 percent differential mortality was found between the two groups (overall mortality rate of bled and unbled crabs was 8 percent and 0.5 percent, respectively) over the 3 years (Walls and Berkson 2003). Very recently, a study (Leschen and Correia 2010) found that mortality of bled female horseshoe crabs in Massachusetts (which included estimates of handling specific to a Massachusetts facility's protocol) ranged from 22.5 to 29.8 percent (higher for crabs held overnight), compared to 3 percent mortality for unbled crabs. No studies have been done on impacts to reproductive behavior following bleeding, and limited studies have been conducted on long-term survival following bleeding. Rudloe (1983) collected, tagged, bled, and released 10,000 mature horseshoe crabs; tag returns indicated a 10 percent mortality for bled horseshoe crabs during the first year after bleeding. Animals recovered during the second year following bleeding showed a cumulative 11 percent mortality (an additional 1 percent over the first year returns).

Determining the effects of harvesting is confounded by the fact that no studies to date have considered the long-term impacts and effects of bleeding on spawning behavior, fecundity, and long-term survival of horseshoe crabs. There are no

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

In addition to the protections described above, we will monitor juvenile horseshoe crab activities to assess whether additional protection measures are warranted. After a female lays eggs, larvae hatch within 4 weeks after fertilization (Botton 1995), remain in the sand for several weeks, and then begin moving toward the beach surface (Rudloe 1979). During the first summer, juvenile horseshoe crabs generally live in shallow waters near the shore (Shuster Jr. 1979), and we often see these juveniles in the intertidal-salt marsh interface (Koch, personal communication 2012). Thus, intertidal flats remain extremely important to successful population recruitment.

Strategies

Continue to:

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



USFWS

Red knot

- Maintain closure of the refuge to mussel harvesting to preserve the food source for red knots and American oystercatchers.
- Review 5-year reviews and recovery plan updates for roseate terns, red knots or other listed species present in this habitat type within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.
- Maintain and enforce closure of the refuge to horseshoe crab harvesting.
- Work with partners to study movement and embayment site fidelity of horseshoe crabs by tagging 500 crabs annually.
- Participate in State and regional efforts to document changes in populations of horseshoe crabs by conducting spawning surveys on Morris Island, North Monomoy Island, and South Monomoy Island.
- Review 5-year reviews and recovery plan updates for roseate terns and red knots within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.

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

Within 1 year of CCP implementation:

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

Within 5 years of CCP implementation:

- Collect data on shorebird use, high tide roosting areas using International Shorebird Survey protocols, and low tide foraging areas using refuge protocols.
- Initiate an outreach campaign to provide information to all visitors about the importance of minimizing disturbance to migrating and staging birds; the outreach message will focus on a recommended viewing distance of at least 50 m to allow birds to remain undisturbed in their resting and foraging areas, which are critical to successful migration.
- Annually identify areas refugewide that consistently support foraging or staging shorebirds or terns and close areas to all human use that are subject to high levels of disturbance; a rapid-assessment method of identifying areas will be developed and implemented.

Monitoring Elements

- Resight and report banded shorebirds to *bandedbirds.org* (accessed October 2015), with a focus on red knots, during migration periods to contribute to studies on migration pathways, strategies, habitat use, and survival, and to better understand Monomoy NWR's importance during migration.
- Rely on volunteers and refuge partners to conduct International Shorebird Surveys opportunistically during north and south migration on North Monomoy Island and South Monomoy Island and report new primary roost sites as they occur on the refuge.

- Conduct tern staging counts and resight and report color-banded roseate terns on the refuge and Nauset/South Beach to contribute to study of staging areas and disturbance.
- Conduct post-breeding counts of American oystercatchers on the northern half of the refuge in conjunction with partner efforts, and report color-banded birds through the AMOY WG to better understand Monomoy NWR's importance during migration and staging.
- Every 5 to 10 years, quantify migrating shorebird chronology and spatial distribution for 2 consecutive years according to Koch and Paton (2009) to monitor longer-term changes in shorebird use.
- Periodically monitor human disturbance levels in an effort to ensure that at least 90 percent of habitat being used by species of conservation concern is not subjected to frequent disturbance.
- Quantify flushing of feeding and resting shorebirds from human disturbance.
- Obtain aerial photography through collaboration with the Town to monitor changes in intertidal habitat every year.

Objective 1.8 (Beach Berm, Intertidal, and Nearshore Marine Waters—Marine Mammals)

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

Rationale

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

Concerns about an increasing seal population, their impact on fishing, and the increase in the great white shark population are resulting in some deliberate acts of harassment. We protect these animals when they are on refuge lands and in refuge waters. Seals are protected by the Marine Mammal Protection Act and the Service has an affirmative responsibility to protect seals when they are on refuge lands and in refuge waters.

Continue to:

- Work with the Cape Cod Stranding Network to assist with rescues of stranded and entangled marine mammals, and help monitor injured or sick marine mammals.
- Conduct partner-led pupping counts and aerial surveys of haulout sites to track use by seals refugewide.

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

Within 1 year of CCP implementation:

- Encourage, support, and actively participate in partner efforts to study marine mammals, including gray and harbor seals.
- Evaluate use of symbolic fencing for seal haulout sites and pupping sites that are subject to frequent human disturbance.
- Minimize impacts to marine mammals by expanding the prohibition of dogs and pets on the refuge to include Morris Island from May 1 to September 15.

Monitoring Elements

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

Objective 1.9 (Salt Marsh)

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

Rationale

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

Up to 80 percent of the marshes that once occurred in New England have already been lost to human development, and the remaining salt marshes in southern New England are rapidly being degraded by fragmentation and development (Bertness et al. 2002). Ninety percent of salt marshes in New England were parallel ditched for mosquito control and to facilitate salt marsh haying. In addition to years of pressures from dredging, filling, and diking, salt marshes are now threatened by submergence when development prevents upslope migration to keep pace with sea level rise (Smith 2009).

On Cape Cod, evidence shows salt marsh has been declining over the last 60 years. “Analysis of aerial photographs dating back to 1947 reveals that extensive marsh area loss and alterations of tidal creek structure have occurred where vegetation along the edges of tidal creeks and mosquito ditches in the low marsh

has declined or disappeared. The extent of high marsh vegetation in virtually all systems has diminished greatly, particularly since the 1980s, with the seaward edge of this zone rapidly retreating in a landward direction. In several systems, this has resulted in high marsh being replaced by barren mudflat.” (Smith 2009).

Salt marshes throughout Cape Cod have additionally been impacted by the loss of marsh vegetation—termed sudden wetland dieback. The loss of *Spartina alterniflora* in the low marsh has been substantial on Cape Cod, and has been attributed to herbivory by the non-native purple marsh crab. “Surveys revealed that *Sesarma* herbivory has denuded nearly half the creek banks in Cape Cod marshes, and differences in crab-grazing intensity among marshes explained greater than 80 percent of variation in the extents of the die-offs. Moreover, the rate of die-off expansion and area of marsh affected have more than doubled since 2000.” (Holdredge et al. 2008). In the high marsh, loss of *Spartina patens* has also been documented, but although purple marsh crabs have been observed feeding on this plant, loss of *Spartina patens* may be more closely linked with hydrologic changes (Smith 2009). Purple marsh crabs may be increasing in number due to overharvesting of blue crabs, a predator of purple crabs (http://www.nsf.gov/news/special_reports/science_nation/purplemarshcrabs.jsp; accessed November 2013). We do not know if purple marsh crabs are present in salt marshes on Monomoy NWR.

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

Salt marsh on North Monomoy Island provides important nesting habitat for American oystercatchers (see objective 1.3 for refuge importance to American oystercatcher) and saltmarsh sparrows. Saltmarsh sparrows are a species of highest conservation priority in BCR 30. PIF lists the saltmarsh sparrow as a “species of continental importance for the U.S. and Canada,” and includes it in the top category of watch list species in need of immediate conservation action due to multiple causes for concern across its entire range. The U.S. and Canada population estimate is 250,000 individuals, with a continental objective to increase the population by 100 percent (Rich et al. 2004). More than 90 percent of the saltmarsh sparrow global breeding population is in the northeastern United States (Dettmers and Rosenberg 2000). Monomoy and Parker River NWR’s have the highest sparrow richness detected during counts performed by SHARP students within Massachusetts, and have some of the highest raw abundance counts of saltmarsh sparrows recorded in the State within the limits of the count locations (Maureen Correll, personal communication 2013). North Monomoy Island is also one of the only places to reliably detect seaside sparrows, another salt-marsh obligate, within Massachusetts (Maureen Correll, Ph.D. student, University of Maine, personal communication 2013). Generally, occurrence of saltmarsh sparrows within the Gulf of Maine is related to salt marsh patch size and connectivity. Large patches of good quality salt marsh habitat must be available across the landscape for sparrow populations to persist and grow.

One threat to saltmarsh sparrow productivity, especially in places like Monomoy NWR where the patch size does not restrict habitat, is flooding. Flooding, particularly during new moon tides, is the primary cause of nest failure for the saltmarsh sparrows, which are synchronized to nest immediately after a new moon tide. Vegetation structure and composition are less important in predicting

nest success. Females wedge or suspend a nest in medium-high cordgrass just above the substrate or water near the mean high-tide line (Greenlaw and Rising 1994).

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

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

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

Strategies

Continue to:

- Use temporary symbolic fencing to seasonally close most salt marsh habitat on North Monomoy Island from April to September to minimize trampling of vegetation and invertebrates and minimize disturbance to nesting saltmarsh sparrows, American oystercatchers, and roosting shorebirds.
- Support partner efforts to investigate impacts of mercury on saltmarsh sparrows and natural processes that affect mercury speciation and bioavailability.
- Support partner efforts to investigate the hybridization of saltmarsh sparrows and how it impacts the population fitness of saltmarsh sparrows and Nelson's sparrows.
- Support partner efforts to investigate changes in tidal marsh bird populations on the refuge and in eastern Massachusetts by comparing current survey data to historical data.

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

Within 1 year of CCP implementation:

- Minimize impacts to salt marsh wildlife by expanding the prohibition of dogs and pets on the refuge to include Morris Island from May 1 to September 15.
- Evaluate expansion of areas of temporary symbolic fencing to include protection for salt marshes refugewide which will benefit roosting shorebirds. Consider maintaining closures through October at important roost sites.
- Participate in regional efforts to monitor the health and integrity of salt marsh habitat on the refuge. Focus management on reducing non-climate stressors to salt marshes.
- Complete rapid assessments of vegetative composition on the North Monomoy Island salt marsh to evaluate suitability for sparrow nesting and allow for proactive development of habitat adaption efforts if needed.
- Determine presence and abundance of purple marsh crabs in all salt marshes on the refuge; if present, initiate studies to determine if herbivory is having an impact on salt marsh vegetation and health.

Monitoring Elements

- Conduct annual census and monitor productivity of American oystercatchers as identified in objective 1.3.
- Analyze saltmarsh sparrow survey data from previous years to determine population trends and inform future management and inventory needs.
- Collect salt marsh elevation information from saltmarsh elevation tables and evaluate the need for remediation and to evaluate the effects of various factors on the salt marshes' ability to keep pace with sea level rise.
- In future years, monitor growth and expansion of the marsh through coastal shoreline monitoring protocols currently being developed; in the meantime, monitor growth and expansion through onscreen digitizing of aerial photos combined with ground-truthing.
- Map locations and record abundance of invasive/non-native species; monitor changes in species composition, and evaluate effectiveness of control techniques implemented.
- Record the number of mosquito samples monitored on Morris Island for WNV or other arboviruses that pose a potential human health risk.
- Update a cover-type map refugewide every 5 to 10 years.

Objective 1.10 (Freshwater Ponds and Marshes)

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

Rationale

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

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

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

Strategies

Within 1 year of CCP implementation:

- Analyze 2 years of acoustic bat monitoring data to quantify the importance of Monomoy NWR to migrating bats and determine if future monitoring is warranted.

- Control non-native invasive plant species, especially common reed, throughout freshwater habitats using manual tools, herbicides, or prescribed fires to ensure less than 10 percent coverage refugewide.
- Submit samples of common reed from stands that have not been previously tested to determine if they are native.
- Facilitate and participate in surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Monitoring Elements

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

Objective 1.11 (Nearshore Marine Open Water)

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

Rationale

Ongoing and future projects and activities that occur in nearshore marine waters within the Declaration of Taking boundary have the potential to affect priority resources of the Service. Open waters and the underlying subtidal areas are considered refuge land for purposes of refuge/Service jurisdiction. To date, we have regulated only horseshoe crab harvest and clamming within the refuge boundary. Public uses such as fishing, tour boats, jet skis, and kite boards occurring within the Declaration of Taking are of primary concern. Protecting and, as appropriate, restoring SAV beds, especially eelgrass beds, is vital for their value in sustaining waterfowl, providing habitat for fisheries, substrate for shellfish, and sediment and shoreline stabilization. Conservation, restoration, and monitoring measures for SAV will continue to be required through the CCP plan period if the long-term trend of SAV decline is to become one of sustained recovery.

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

Nearshore marine waters offer important habitat for a variety of species that together make up a complex ecosystem, including invertebrates, fish, sea turtles,

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

In addition to the rationale above, chapter 2 includes a summary of the importance of Monomoy NWR's nearshore marine, subtidal bottom, and SAV habitats to migrating, staging, and wintering waterfowl and other migratory birds, marine mammals, sea turtles, and interjurisdictional fish.

Strategies

Continue to:

- Maintain and enforce closure of the refuge to horseshoe crab harvesting.
- Maintain closure of the refuge to mussel harvesting to preserve food sources for red knots, common eiders, white-winged and black scoters, and American oystercatchers.
- Support partner efforts to study wintering sea ducks using the waters surrounding the refuge and monitor impacts of diseases affecting these populations.
- Support partner efforts to study shellfish, fin fish stocks, marine mammals including seals, and great white sharks.
- Support partner efforts to assess the distribution and genetic diversity of eelgrass across the region and test it against an experimental factorial design of potential stress parameters.
- Support partner efforts (New England Aquarium and Mass Audubon) to rescue stranded sea turtles and to collect dead sea turtles recovered from refuge waters for scientific research.
- Facilitate and participate in surveys and protection efforts for additional identified priority species, including State-listed species, which may benefit from management of this habitat type.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and can inform future management.

Within 1 year of CCP implementation:

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

Within 5 years of CCP implementation:

- Reinstall permanent markers visually delineating the Declaration of Taking boundary in open waters based on the Regional Surveyor's coordinates; commercial Global Positioning System (GPS) software vendors would be provided with digital map layers for incorporation into their software products.
- Work with partners to evaluate and map the current and historic extent of SAV, specifically eelgrass, within the Declaration of Taking to determine whether these species are stable, decreasing, or increasing, and to determine if active management of the resource is necessary.
- Collect baseline data of flora and fauna in the subtidal areas of the refuge to help determine priority species and develop a management plan to ensure conservation of these species.
- Evaluate need for "no anchoring zones" to minimize disturbance to eelgrass beds and implement as warranted.

Monitoring Elements

- Monitor the impact and record the number of aquaculture activities initiated within refuge waters.
- Monitor avian health specific to common eider and other sea ducks by conducting surveillance during fall and winter to detect field mortality events, documenting observations of sick or dying birds, and identifying, collecting, and submitting dead birds for analysis at the National Wildlife Health Center in collaboration with the Region 5 Migratory Birds Office.
- Conduct opportunistic surveillance year-round to detect field mortality events of marine wildlife, including sea turtles; document observations of sick or dying turtles, and identify, collect, and submit these for analysis at the National Wildlife Health Center in collaboration with the Mass Audubon Sea Turtle Stranding Office.
- Update bathymetry data refugewide every 5 to 10 years.

REFUGE GOAL 2:

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

Objective 2.1 (Access and Use)

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

Rationale

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

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

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

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

adequate signs deters and discourages visitors and confuses visitors who may accidentally drive through private neighborhoods while trying to find the refuge facilities.

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

Leashed dogs will be allowed only on Morris Island from September 16 through April 30. Dogs may also be used to retrieve game shot by waterfowl hunters. Dogs and pets will not be allowed elsewhere on the refuge year-round. We have not previously found dog walking to be a compatible use on the refuge, but a decision was made in the refuge's 1988 Master Plan to allow dogs on the refuge from October 1 through March 31. This decision was apparently not successfully implemented, as dogs have been present on the Morris Island portion of the refuge on-leash year-round, even though the use itself has not been found to be compatible. We close most of the refuge to pets because many visitors unleash their dogs on the beach, dogs may disturb other visitors, dog feces on the beach create unsanitary conditions, and dogs disturb wildlife. Dogs can disrupt breeding displays (Baydack 1986), disrupt foraging activity in shorebirds (Hoopes 1993), and disturb roosting activity in ducks (Keller 1991). Other studies have shown that even when dogs are restrained on leash, they have the ability to displace native migratory bird species from natural habitats (Banks and Bryant 2007). A study of shorebird disturbance from humans and dogs found that gulls recovered faster from disturbance than did smaller shorebird species (Burger et al. 2007). This rapid recovery time could give a competitive advantage to gulls over other shorebirds that are the focus of refuge management goals. Dog walking is not a priority public use.

Strategies

Continue to:

- Open all of North Monomoy Island to the public from October to March. During the April to September nesting season, an east-west trail corridor bisecting North Monomoy Island is open to the public, as is the Broad Creek area to the south; in addition, the entire perimeter of North Monomoy Island below the mean high tide line is open for public circumnavigation around North Monomoy Island.
- Restrict travel on the refuge to foot traffic to maintain the wilderness character of North and South Monomoy Islands, as well as to protect sensitive nesting areas and wildlife habitat; this may include limiting access to dune areas to prevent erosion.
- Allow motorized and non-motorized boating (includes kayaks, canoes, and paddleboards) in refuge waters with landings prohibited in areas that are seasonally closed. Provide a map that shows recommended sites for safe landings.
- Maintain and enforce closure of the refuge to operation and landings of motorized personal watercraft (e.g., wave runners, jet skis).
- Maintain and enforce closure of the refuge to kiteboarding.

- Use the existing right-of-ways on Tisquantum Road, Wikis Way, and Stage Island Road to access refuge properties.
- Phase out non-Service parking and dinghy storage at Stage Island Lot 7b.
- Facilitate enforcement of the Marine Mammal Protection Act through regular communication and coordination with staff from partner agencies and organizations, including the NMFS, NOAA, and International Fund for Animal Welfare.

Within 1 year of CCP implementation:

- Utilizing adaptive management, strive to keep Morris Island and large portions of South Monomoy Island open year-round, and open seasonally closed areas after chicks fledge or after staging seasons for migratory birds such as roseate and common terns, piping plovers, red knots, and American oystercatchers to provide additional wildlife viewing and photography opportunities; temporarily close portions of the refuge only when necessary to protect wildlife and their habitat based on seasonal use by priority species.
- Meet annually with the Town and NPS to discuss any proposed changes in refuge, Cape Cod National Seashore or Town coastal management and regulations.
- Improve visibility of the right-of-way trail access to the western portion of Morris Island refuge property off Tisquantum Road; improve signs so visitors can easily view the access point and understand that they have the right to use the path to access the refuge.

Along Morris Island Trail



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

Within 3 years of CCP implementation:

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

Within 5 years of CCP implementation:

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

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

Within 7 years of CCP implementation:

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

Monitoring Elements

- Estimate the number of visitors at the refuge engaged in wildlife-dependent priority and other non-priority public use activities.
- Monitor available empty parking spaces and document traffic congestion at the Morris Island refuge administrative complex and nearby causeway throughout the year.
- Record the number of SUPs.
- Conduct a daily patrol of the Morris Island parking lot for vehicles displaying valid parking passes and enforce parking fee requirements when violations are detected.
- Monitor and report daily parking fee collections and number of parking passes issued.
- Record the number of visitors who utilize concession services.

**Objective 2.2
(Interpretation)**

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

Rationale

Interpretation is a communication activity designed to forge emotional and intellectual connections between an audience and the inherent values of natural resources. It also serves to make complex or arcane information more understandable and meaningful. Interpretation differs from environmental education in that it is more informal, geared toward the general public, and not necessarily curriculum-based. Interpretation is a priority public use identified in the Refuge Improvement Act and is one of the most effective ways we can raise our visibility, convey our mission, and identify the significant contribution the refuge makes to wildlife conservation. Public understanding of the Service and its activities in the Commonwealth of Massachusetts is currently low. Many are unaware of the Refuge System and its scope, and most do not understand the importance of the refuge in the conservation of migratory birds.

Based on the USGS Visitor Survey–National Wildlife Refuge Survey results from 2010 to 2011, visitors to Monomoy NWR reported that, before participating in the survey, they were aware of the role of the USFWS in managing national wildlife refuges (70 percent) and that the Refuge System has the mission of conserving, managing, and restoring fish, wildlife, plants, and their habitat (84 percent). Monomoy NWR is designated as a WHSRN site, an IBA, and a MPA; these designations can be highlighted in our interpretive programs. Monomoy NWR is also part of the NWPS. This designation is also considered a refuge purpose, and needs to be interpreted so people can learn about and appreciate the value of an enduring wilderness resource.

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

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

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

Strategies

Continue to:

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

Within 1 year of CCP implementation:

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

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

Within 5 years of CCP implementation:

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

Within 7 years of CCP implementation:

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

Within 10 years of CCP implementation:

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

Monitoring Elements

- Record the number of participants at onsite and offsite refuge programs and events.
- Record the number of visitors to the refuge Web site.
- Record the number of people who report use of geocaching trail or stamp the letterbox.
- Record the daily number of visitors to the visitor contact station.
- Record the annual number of refuge brochures/rack cards ordered.
- Record the number of visitors who participate in concessionaire-led tours.

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

**Objective 2.3
(Environmental Education)**

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

Rationale

As one of the six priority public uses, environmental education receives enhanced consideration in refuge planning. The Refuge System’s guiding principles for environmental education programs are detailed at <http://www.fws.gov/policy/605fw6.html> (accessed October 2015). Generally, conducting environmental education involves more than facilitating field trips. It requires the refuge to develop a course of study designed to meet national and state curriculum-based academic standards. We believe that educating people about the significance of the refuge for birds and other wildlife will foster an appreciation of conservation and encourage them to make environmentally responsible decisions.

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

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

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

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

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

Strategies

Continue to:

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

Within 5 years of CCP implementation:

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

Within 7 years of CCP implementation:

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

Within 10 years of CCP implementation:

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

Monitoring Elements

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

- Record the number of students who engage in non-refuge-led environmental education on the refuge.
- Record the number of requests for supporting documentation and materials developed to support curriculum-based educational modules about the refuge and wildlife found on the refuge.
- Record the number of teacher workshops and the number of attendees.
- Record the number of times tool kits are checked out.

Objective 2.4 (Wildlife Observation and Photography)

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

Rationale

Wildlife observation and photography are identified in the Refuge Improvement Act as priority public uses. Priority public uses are to receive enhanced consideration when developing goals and objectives for refuges. Guiding principles for these uses within the Refuge System for wildlife observation and photography can be viewed at <http://www.fws.gov/policy/605fw4.html> and <http://www.fws.gov/policy/605fw5.html> (accessed October 2015), respectively.

Developing specific areas that visitors can conveniently access to view wildlife enhances wildlife observation and limits disturbance to wildlife and habitat. Morris Island provides opportunities to view and photograph wildlife in natural settings along the Morris Island Trail, which offers two viewing platforms; these overlooks along the trail provide views of North Monomoy Island and South Monomoy Island. An unmaintained footpath leads visitors from a boat landing to the Monomoy Point Light Station. The refuge has historically been a popular birding site, is part of the WHSRN, and has been recognized as a globally significant IBA by the National Audubon Society.

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

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

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

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

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

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

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

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

Strategies

Continue to:

- Allow wildlife observation, which includes nature study, year-round on refuge lands open to public use from ½ hour before sunrise to ½ hour after sunset; prohibit touching, feeding, or harassing wildlife.
- Maintain the two viewing platforms on Morris Island.
- Allow commercial filming and photography on the refuge by SUP only when there is a direct benefit to the refuge or the Service; and in wilderness, only when necessary to provide educational information about wilderness uses and values in a manner which does not degrade wilderness.
- Allow recreational photography in any area of the refuge open to the public.
- Host a youth or adult photography contest.

Within 3 years of CCP implementation:

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

Within 5 years of CCP implementation:

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

Within 7 years of CCP implementation:

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

Monitoring Elements

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

Objective 2.5 (Fin Fishing)

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

Rationale

Fishing is a healthy, traditional outdoor pastime that promotes public understanding and appreciation of natural resources and their management on all lands and waters in the Refuge System. The Refuge Improvement Act identifies fishing as a priority wildlife-dependent use, and further states that...“Compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System.” Guiding principles and other general information related to fishing within the Refuge System can be found at <http://www.fws.gov/policy/605fw3.html> (accessed October 2015). Sport fishing is an important activity on Monomoy and both boat and surf-fishing are popular. Fishing on the refuge consists primarily of saltwater fishing such as surfcasting off beaches, and fly fishing on tidal flats. Anglers fish primarily for striped bass, bluefish, bonito, false albacore, flounder, and fluke. Additionally, some freshwater fishing is possible in the ponds on South Monomoy Island, although access is difficult due to their location and the prevalence of poison ivy throughout the area.

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

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

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

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

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

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

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

Strategies

Continue to:

- Allow fin fishing from all refuge lands otherwise open to public use, from ½ hour before sunrise to ½ hour after sunset, in accordance with Massachusetts and Federal regulations, which includes possessing a saltwater or freshwater fishing license recognized by the Commonwealth of Massachusetts.
- Allow anglers to fish on Morris Island 24 hours per day in accordance with all Federal and State fishing regulations.
- Allow freshwater fishing in the ponds on South Monomoy Island during daylight hours.

Within 1 year of CCP implementation:

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

Within 2 years of CCP implementation:

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

Within 3 years of CCP implementation:

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

Within 5 years of CCP implementation:

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

Within 10 years of CCP implementation:

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

Monitoring Elements

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

Objective 2.6 (Shellfishing)

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

Rationale

In recent years, visitors have primarily harvested softshell clams and quahogs with hand tools. Softshell clam harvesting has been considered a traditional use and occurred prior to refuge establishment. Special regulations were issued in the 1970s and early 1980s allowing shellfishing on refuge lands to individuals who held a town shellfishing license. In 1994, shellfishing was determined to be a compatible use on the refuge, and the actual type of shellfishing described in the compatibility determination was the traditional hand digging of shellfish.

Although softshell clams are never specifically identified in the compatibility determination, it is obvious that the intent of refuge managers at that time was to continue to allow the harvest of softshell clams only. Since then, other shellfish have been harvested in refuge waters, including quahogs, mussels, and occasionally bay scallops, razor clams, and sea (surf) clams using a variety of harvest methods. Although not shellfish, some sea worms are regulated by Town shellfish regulations and have been harvested on the refuge, despite the refuge never having been open to this use. Horseshoe crabs, which also are not shellfish, were harvested by SUP until 2002.

The Town administers permits and enforces regulations throughout the town, including refuge lands (refer to http://www.town.chatham.ma.us/public_documents/ChathamMa_shellfish/ShellReg2004Book.pdf [accessed October 2015] for more information). The refuge staff does not directly manage shellfish harvest activity on refuge lands, but instead relies on indirect management through the Town. Details regarding this use are found in the Shellfishing Compatibility Determination in appendix D.

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

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

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

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

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

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

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

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

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

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

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

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

Strategies

Continue to:

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

Within 1 year of CCP implementation:

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

Within 2 years of CCP implementation:

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

Monitoring Elements

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

Objective 2.7 (Waterfowl Hunting)

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

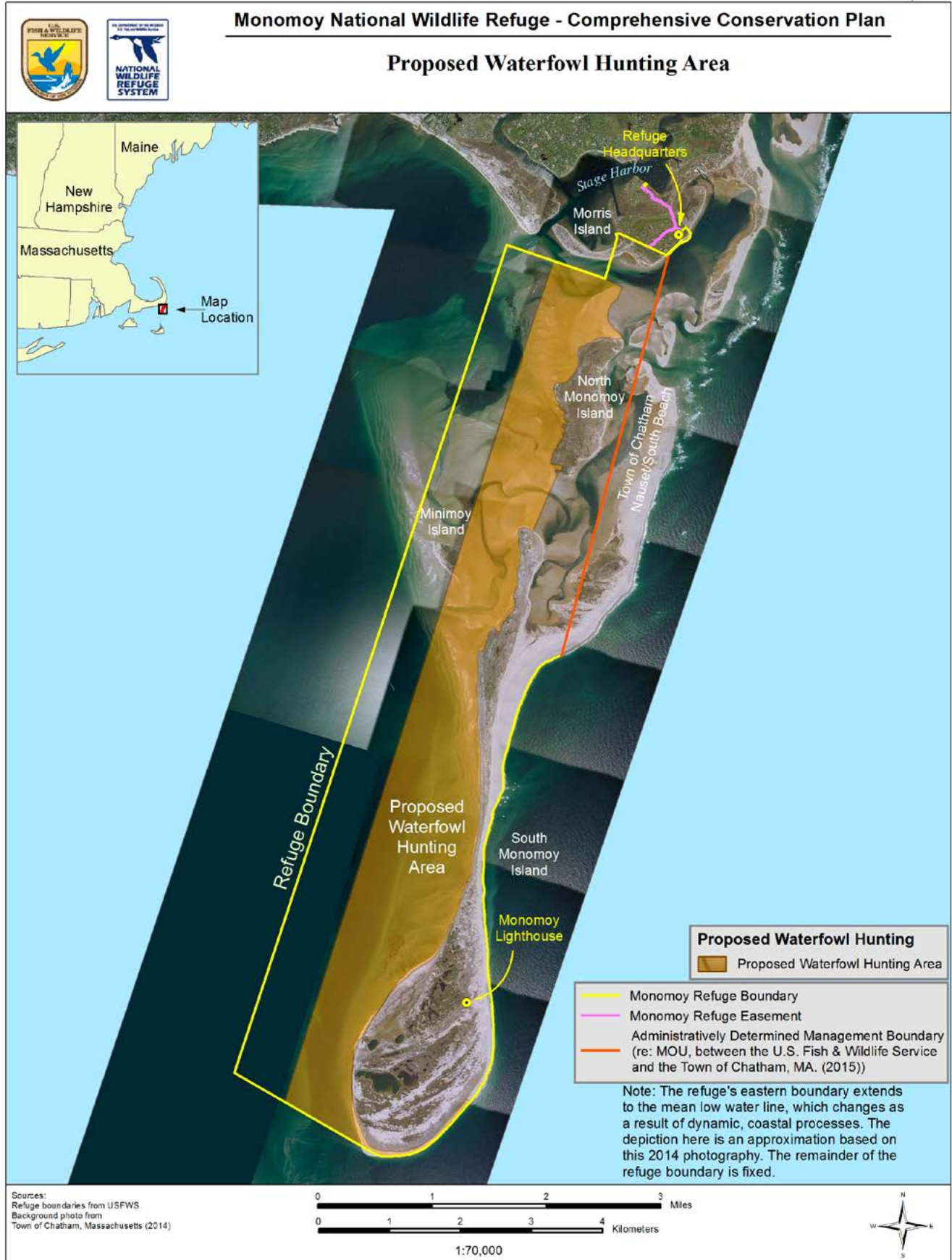
Rationale

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

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

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

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



Strategies

Within 3 years of CCP implementation:

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

Monitoring Elements

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

REFUGE GOAL 3:

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

Objective 3.1 (Public Outreach)

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

Rationale

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

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

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

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

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

Strategies

Continue to:

- Update and print brochures and rack cards and make them available to the Chamber of Commerce and tourist attractions.
- Use internet resources to inform the public about the refuge, its mission, and management actions.
- Issue press releases to inform the public about refuge activities, respond to media inquiries, and publish our accomplishments on-line.
- Give presentations about refuge management actions and wildlife at venues such as the Cape Cod Natural History Conference.
- Occasionally participate in local festivals and parades.
- Work with the Friends group and volunteers to increase refuge activities and funding opportunities.
- Speak about the refuge and its purposes to local service and civic organizations and regionwide conservation partners.

Within 1 year of CCP implementation:

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

Within 5 years of CCP implementation:

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

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

Within 7 years of CCP implementation:

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

Monitoring Elements

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

Objective 3.2 (Community Support)

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

Rationale

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

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

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

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

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

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

In 2011, people conducting wildlife management, habitat management, public use, or maintenance activities contributed nearly 5,300 volunteer hours to Monomoy NWR. New community partnerships such as with the American Lighthouse Foundation, which resulted from the restoration efforts on the historic Monomoy Point Light Station, can provide expanded community support for refuge programs and activities.

Strategies

Continue to:

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

Within 2 years of CCP implementation:

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

Within 10 years of CCP implementation:

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

Monitoring Elements

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

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

REFUGE GOAL 4:

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

Objective 4.1 (Wilderness Implementation and Designation)

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

Rationale

Wilderness is a congressionally designated land use. As defined by the Wilderness Act, wilderness is untrammeled (free from human control), undeveloped, and natural, and offers outstanding opportunities for solitude and primitive recreation. The Refuge System manages refuge wilderness to simultaneously secure an enduring resource of wilderness and accomplish refuge purposes in a way that preserves wilderness character. The Service is responsible for ensuring that the Monomoy Wilderness retains its primeval character and influence, without permanent improvements (except for the light house, which Congress acknowledged in 1970 needed to be preserved) or permanent human habitation, and its natural conditions are preserved. The Service is to manage the Monomoy Wilderness so visitors will experience an area affected primarily by the forces of nature where the imprint of humans in their immediate surroundings is substantially unnoticeable; find outstanding examples of ecological, geologic, scientific, educational, scenic, or historic features; and can seek and experience solitude or primitive and unconfined recreation.

Refuge management activities in the Inward Point and Powder Hole inventory areas will remain largely unchanged from those employed since the 1970 designation of the adjoining Monomoy Wilderness. Located outside designated wilderness on South Monomoy Island is the historic Monomoy Point Light Station consisting of a lighthouse, a keeper's house, and former oil shed. Stabilization and historic restoration of the light station buildings began in 2010 and was substantially completed in 2012. Maintaining the historic light station structures may require periodic mechanized transport or motorized equipment use, and access to the worksite along a temporary overland trail or road through the Monomoy Wilderness. We will analyze all activities associated with light station upkeep and determine, through use of the minimum requirements decision guide process, how to minimize impacts on the Monomoy wilderness.

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

Strategies

Continue to:

- Manage the Monomoy Wilderness for naturalness, wildness, and outstanding opportunities for solitude or primitive and unconfined recreation by managing refuge operations and visitor uses in a manner that protects wilderness character.
- Continue managing the Inward Point and Powder Hole inventory areas as wilderness, to the extent that it will not prevent fulfilling refuge establishment purposes or the Refuge System mission.
- Review all refuge management activities proposed within the Monomoy Wilderness and the Inward Point and Powder Hole inventory areas to ensure they are consistent with wilderness management; use the minimum requirements analysis process presented previously.
- Review and implement actions recommended in the Monomoy Wilderness Character Report.
- Use the appropriate response to unplanned wildfire ignitions that provides for public and firefighter safety while recognizing periodic fire as a natural process with long-term benefits to an enduring wilderness resource.
- Where fire exclusion or other human-caused alterations of natural coastal processes have led to unnatural wildland fuel and vegetation conditions, apply prescribed fire to restore a more natural fire regime or migratory bird or endangered/threatened species habitat conditions.
- Implement management activities that involve temporary rather than permanent uses or site occupancy, that create no new surface disturbance, and do not involve placement of permanent structures or installations or use of motorized equipment or mechanized transport unless it is the minimum tool necessary.
- Provide refuge staff with wilderness stewardship training appropriate for their positions.

Within 1 year of CCP implementation:

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

Within 2 years of CCP implementation:

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

Within 3 years of CCP implementation:

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

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

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

Within 5 years of CCP implementation:

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

Monitoring Elements

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

REFUGE GOAL 5:

Objective 5.1 (Archaeological Resources and Historical Structures)

Protect cultural resources that exist on the refuge.

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

Rationale

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

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

Strategies

Continue to:

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

Within 1 year of CCP implementation:

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

Within 5 years of CCP implementation:

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

Within 10 years of CCP implementation:

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

Monitoring Elements

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

REFUGE GOAL 6:

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

Objective 6.1 (Staffing)

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

Rationale

Although volunteers are an integral part of making many refuge programs possible, additional staffing is needed to consistently complete the additional workload required to reach the expanded objectives proposed above. Three permanent staff at Monomoy NWR include a refuge manager, a wildlife refuge specialist, and a wildlife biologist. A 2008 national staffing model for the Refuge System indicated that Monomoy NWR, due to its location, size, number of visitors, and complexity of its biological program, should have a permanent staff of nine full-time employees. Funding levels have never been sufficient to achieve that staffing level, and immediate budgets are not likely to provide the funding needed to fully meet our responsibilities under Federal law to protect wildlife, serve the American public, and maintain our facilities. Nevertheless, with any additional staff increase, we will provide more services and implement more resource actions, depending on the type of position filled.

In 2011, the Service released a Diversity and Inclusion Implementation Plan. It sets four strategic goals as follows:

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

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

Strategies

Continue to:

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

Within 15 years of CCP implementation, if funding allows:

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

Monitoring Elements

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

Objective 6.2 (Facilities and Maintenance)

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

Rationale

Refuge infrastructure includes a building serving concurrently as an office headquarters and visitor contact station. A second building is a dormitory for seasonal staff and a maintenance shop. There is another public restroom building, two small storage sheds, the Monomoy Point Light Station, wildlife observation trails, platforms, stairs, and boat moorings. The light keeper's house at the Monomoy Light Station serves as a summer camp for staff and volunteers and equipment storage from April to September.

The fleet equipment includes three motor vehicles and three boats. Boats are necessary to safely perform biological work on the islands. Moorings need to be maintained in places for refuge staff to be able to efficiently travel to North Monomoy Island and South Monomoy Island as channels continue to fill in. Two moorings are maintained at a small, waterfront lot with parking on the north side of Stage Island that is the only Service-owned waterfront suitable for loading/unloading boat transported cargo. The vehicle fleet consists of a truck, a small sport utility vehicle, and a hybrid car.

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

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

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

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



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Setting nets

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

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

Strategies

Continue to:

- Maintain the headquarters and visitor contact station, dormitory, and maintenance buildings, and Monomoy Point Light Station to provide a safe working and living environment for refuge staff and volunteers.
- Work with the NWS through an MOU for use of Service-owned land on Morris Island. Should the NWS at any point decide to relocate their existing operation, the refuge will look into re-utilizing their current buildings and space at the Morris Island site.

- Maintain a fleet of three highway vehicles and three outboard motor boats that provide safe and efficient transport to North and South Monomoy Islands, Minimoy Island, and offsite locations for resource management and administrative work; replace boats and motors as necessary to maintain a functional fleet.
- Develop potential partnership with the USCG to establish new docks, covered boat storage, and maintenance with secure marine equipment storage and additional parking.
- Work to acquire additional parking and waterfront boat access, either next to our current Stage Island lot, or elsewhere in a convenient location.

Within 5 years of CCP implementation:

- Conduct a cost-benefit analysis to evaluate the cost of maintaining or renovating existing structures on Morris Island to meet the refuge's future needs, the cost of relocating all facilities to a preferred site, and the option of shoreline armoring and its possible impacts to determine the most cost-efficient option the refuge could implement.
- Increase the number of motor vehicles or boats to accommodate staff increases as needed.
- Explore additional refuge staff housing opportunities within the local commuting area.

Within 10 years of CCP implementation:

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

Objective 6.3 (Energy Efficiency)

Move the refuge toward carbon neutrality consistent with the Service's 2010 *Strategic Plan for Responding to Accelerating Climate Change* by using practices to avoid or minimize greenhouse gas emissions, and offset remaining emissions, to meet the Service goal of carbon neutrality by 2020. Increase the proportion of electricity consumption derived from clean, renewable sources, while reducing the proportion derived from fossil fuel combustion and associated

greenhouse gas emissions, to achieve a smaller carbon footprint at refuge headquarters. Reduce metered, potable (treated) water consumption at refuge facilities. Refuge facilities will themselves demonstrate renewable “green” energy measures; similar to those a residential homeowner or small business owner might install, and move refuge operations and facilities toward carbon neutrality by 2020.

Rationale

The refuge proposes several methods to support the Service’s 2010 *Strategic Plan for Responding to Accelerating Climate Change* and achieve its objective. Guiding principles and other general information on implementing sustainable practices within the Refuge System can be found in Policy 565 FW 1. In an effort to create a smaller carbon footprint, we will continue to evaluate the possibility of developing alternative energy at the Morris Island visitor contact station and the Monomoy Point Light Station on South Monomoy Island.

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

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

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

A solar-thermal domestic hot water system was added to the shop/dorm building in 2011, and additional thermal insulation was added to the headquarters attic. As new or replacement vehicles and boat motors are purchased, converting to more fuel efficient technologies such as alternative fuel capable models will reduce fossil fuel consumption and associated atmospheric carbon emissions. Driving or using motorboats less, and walking, bicycling, or paddling more, while accomplishing the refuge purposes, will also reduce fossil fuel consumption.

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

Strategies

Continue to:

- Pursue feasibility and seek funding to install a solar photovoltaic system at the Monomoy Point Light Station site.
- Train staff and volunteers about water and energy conservation, purchase materials made with post-consumer content or with built-in solar panels for charging cell phones and other electrical devices in the field, and recycle and reuse materials.
- Maintain recycling and compost bins at refuge facilities.
- Work with local and regional partners seeking funding for alternative transportation measures for refuge visitors that reduce fossil fuel consumption and associated carbon emissions, such as local passenger shuttles with satellite parking, improved highway signs, and improved facilities for pedestrians, bicyclists, and kayakers.
- Use hybrid and alternative fuel vehicles when available.

Within 5 years of CCP implementation:

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

Within 10 years of CCP implementation:

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

Within 15 years of CCP implementation:

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

Monitoring Elements

- Calculate the amount of electricity generated onsite through alternative energy production and as a ratio of electricity usage purchased from the commercial grid.

- Calculate the annual fossil fuel consumption (heat, vehicles, boats, and small engine equipment) for refuge operations.
- Calculate the annual metered/potable water use.
- Estimate the total annual atmospheric carbon footprint for all refuge facilities and operations.
- Submit an annual Environmental Management System management review report that calculates green actions taken during the year, including the amount of waste that is recycled.

General Refuge Management Direction

We primarily developed our management direction hierarchically, from goals to objectives to strategies. However, we also found that some important actions either relate to multiple goals or represent general administrative or compliance activities. Thus, below we list actions that may be required by law or policy, or represent management decisions that have undergone NEPA analysis that includes public review, agency review, and approval. Others may be administrative actions that do not require public review, but that we want to highlight in this public document. We present them below.

Conducting Resource Management and Public Use Activities Consistent with Wilderness Principles

We will manage the existing Monomoy Wilderness to simultaneously secure an enduring resource of wilderness and accomplish refuge purposes in a way that preserves wilderness character. We will continue managing the existing Monomoy Wilderness and the Inward Point and Powder Hole (currently non-wilderness) exclusions to maintain their size, naturalness, and outstanding opportunities for solitude or primitive and unconfined recreation, to the extent that it will not prevent us from fulfilling and carrying out refuge establishing purposes and the Refuge System mission, in accordance with Service wilderness stewardship policy (610 FW). Wilderness designation also applies to the portion of Nauset/South Beach lying west of the agreed upon management boundary identified in the June 2015 MOU between the Service and the Town (appendix L).

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

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

FW 1.18 to 1.21). The MRA is prepared in conjunction with NEPA compliance documentation.

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

Adaptive Management

We will employ an adaptive management approach for improving resource management based on what is learned from management outcomes. In 2007, Secretary of the Interior Kempthorne issued Secretarial Order No. 3270 to provide guidance on policy and procedures for implementing adaptive management in departmental agencies. In response to that order, an intradepartmental working group developed a technical guidebook to assist managers and practitioners: “Adaptive Management: The U.S. Department of Interior, Technical Guide.” It defines adaptive management, the conditions under which we should consider it, the process for implementing it in a structured framework, and evaluating its effectiveness (Williams et al. 2009). You may view the guidebook at <http://www.doi.gov/initiatives/AdaptiveManagement/documents.html> (accessed August 2011).

The guidebook provides the following operational definition for adaptive management:

“Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a ‘trial and error’ process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increase scientific knowledge, and reduces tensions among stakeholders.”

This definition gives special emphasis to the uncertainty about management impacts, iterative learning to reduce uncertainty, and improved management as a result of learning. At the refuge level, monitoring management actions and outcomes, and key resources, will be very important to implementing an adaptive management process. Our threatened and endangered species, migratory birds, wildlife habitat management, and wilderness stewardship activities are examples of refuge programs or activities in which an adaptive management approach may already be implemented or will be in the near future.

This CCP covers a 15-year period. Periodic review of the CCP will be required to ensure established goals and objectives are being met and that the CCP is being implemented as scheduled, provided adequate resources are available to conduct the strategies outlined in the CCP. To assist this review process, a monitoring and evaluation program will be implemented, focusing on issues involving public use activities and wildlife habitat and population management, including the rates

of coastal (shoreline) change that determine the type, amount, and arrangement of wildlife habitats and populations.

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

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

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

Strategic Habitat Conservation

SHC, the conservation approach the Service is using to achieve its mission in the 21st century, is a framework that utilizes adaptive management to redefine broad-scale conservation. It departs from the general pursuit of conserving more habitat and species to a more planned approach based on scientific data, at a landscape level, and in cooperation with partners. Starting with explicit, measureable objectives that are based on testable assumptions that can be evaluated, it is enacted through an iterative process of biological planning, conservation design, conservation delivery, assumption-driven research, and outcome-based monitoring. The goal is to set specific population objectives for selected species of fish, wildlife, and plants, which become our conservation targets. We refer to this select group of species as representative or surrogate species because they represent other species or aspects of the environment. Such identified species are used for comprehensive conservation planning that supports multiple species and habitats within a defined landscape or geographic area. The surrogate species that have been identified for the NALCC in which Monomoy NWR is located, include the American oystercatcher, common tern, horseshoe crab, piping plover, red knot, saltmarsh sparrow, and semipalmated sandpiper.

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

**Monitoring and Abating
Wildlife and Plant Diseases**

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

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

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

Two diseases that have impacted common terns on the refuge are salmonellosis and PSP (Nisbet 1983). Salmonella bacteria are often present at low levels in seabirds, and outbreaks often affect large colonies of nesting terns and gulls. Because the colony on South Monomoy Island has grown larger and nesting birds are being recruited from several neighboring colonies, the potential for disease transmission has increased. Incidence of salmonellosis has been confirmed on the refuge most years since 2004. Paralytic shellfish poisoning, caused by red tide, impacted common terns on the refuge in 2005, resulting in adult deaths and low productivity due to soft eggshells. Several dead individuals tested positive for marine algal toxins associated with the poisoning that was likely caused by a red tide event that impacted much of the New England coast. Red tide has not directly impacted the refuge since 2005.

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

Continual surveillance for incidences of avian influenza, salmonellosis, PSP, and other avian diseases will continue. In addition to the diseases of wildlife, we will be attentive to the diseases and pests that affect the health of the ecosystems that the refuge supports, and respond in varying degrees. We will continue to opportunistically monitor for and report seabird mortality events on refuge

Common eider



Bill Thompson

beaches. We will also record and report instances of stranding as a wildlife disease because that might be the underlying reason for the stranding. It is likely that other monitoring efforts will be minimal, and the occurrence of any wildlife or habitat disease element will be responded to only if it posed an immediate or serious threat to indigenous wildlife and habitat. The Service will respond at a level commensurate with staffing and funding.

These are the general strategies for preventing or controlling disease:

- (1) Continue to conduct disease surveillance in conjunction with other fieldwork.
- (2) Cooperate with State agencies, particularly MassWildlife, and Tufts University by providing access for sampling and following protocols in the event of an outbreak.
- (3) Inform volunteers and others who work in the field about the dangers of Lyme disease and measures to avoid contracting it.
- (4) Monitor habitats for indicators of the increased occurrence of pests or disease. For example, note changes in flowering or fruiting phenology that do not appear to be linked to global climate change, physical damage, decay, weakening, or sudden death, particularly of major host species; also note changes in wildlife use of habitats, such as the absence of breeding birds that used to appear regularly.
- (5) Follow the protocols in national, State, and refuge disease prevention and control plans.

Biological and Ecological Research and Investigations

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

- (1) To promote new information and improve the basis for, and quality of, refuge and other Service management decisions.

- (2) To expand the body of scientific knowledge about fish and wildlife, their habitats, the use of these resources, appropriate resource management, and the environment in general.
- (3) To provide the opportunity for students and others to learn the principles of field research.

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

All research conducted on the refuge must be consistent with the approved finding of appropriateness and compatibility determination for research. Research projects also must contribute to a need identified by the refuge or the Service. As we note in chapter 3, we have allowed many research projects that meet these criteria. In determining the appropriateness and compatibility of future research proposals, we will follow the guidance in the manuals and employ the following general strategies:

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

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

Controlling Pest Plants and Animals

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

Integrated Pest Management

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

programs are carefully designed using a combination of compatible techniques to limit damage to that level.”

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

Managing Invasive Species

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

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

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

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

- (1) Manage invasive species on refuges under the guidance of the National Strategy for Management of Invasive Species and within the context of

applicable policy.

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

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

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

Addressing the Threats of Accelerating Sea Level Rise and Climate Change

Climate change is an issue of increasing public concern because of its potential effects on land, water, and biological resources. The issue was pushed to the forefront in 2007 when the IPCC, representing the world's leading climate scientists, concluded that it is "unequivocal" that the Earth's climate is warming, and that it is "very likely" (a greater than 90 percent certainty) that the heat-trapping emissions from the burning of fossil fuels and other human activities have caused "most of the observed increase in globally averaged temperatures since the mid-20th century" (IPCC 2007). The Northeast is already experiencing rising temperatures, with potentially dramatic warming expected later this century under some model predictions. According to the Northeast Climate Impacts Assessment Team, "continued warming, and more extensive climate-related changes to come could dramatically alter the region's economy, landscape, character, and quality of life" (Frumhoff et al. 2007).

We are becoming more aware and knowledgeable about the impacts of climate change on national wildlife refuges. In response to the growing threat of climate change, the Service developed a strategic plan titled "Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change," which establishes a basic framework within which the Service will work as part of the larger conservation community to help ensure the sustainability of fish, wildlife, plants, and habitats in the face of accelerating climate change. The plan

details specific steps the Service will take during the next 5 years to implement the strategic plan (USFWS 2010b). The plan employs three key strategies to address climate change:

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

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

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

According to the IPCC Fourth Assessment Report: Climate Change 2007: “coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea level rise. The effect will be exacerbated by increasing human-induced pressures on coastal areas.” Although we cannot predict with certainty how storm frequency and intensity will directly impact the refuge, we know that these factors will continue to increase relative to 20th century trends (CCSP 2008b, appendix I). Sea level rise alone will increase coastal flooding during storm surges and amplify rates of habitat change on coastal beaches. Increased numbers and intensity of storms during the breeding season could directly affect piping plover breeding success by increasing long-term rates of nest inundation, nest abandonment, or chick mortality due to harsh weather (USFWS 2009a). At Monomoy NWR, sea level rise will likely impact piping plovers, roseate terns and other beach nesting species, such as American oystercatcher and least tern.

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

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

Should we determine that the use of dredge material is feasible, we will conduct a separate NEPA analysis before making a decision. We will also monitor the impacts of dredging projects on subtidal areas within the refuge boundary; this may involve pre-and post-dredging monitoring of substrates, SAVs, or benthic communities as well as the benefit to focal species of habitat created on the refuge using dredge material.

Volunteer Opportunities and Partnerships

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

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

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

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

Refuge Staffing and Administration, Including Boundary Issues

The management direction outlined in this plan does not constitute a commitment for staffing increases, funding for operations and maintenance, or future land acquisition. Congress determines our annual budgets, which our Washington headquarters and regional offices distribute to the field stations. Chapter 3 presents our levels of staffing and operating and maintenance funds for the refuge over the last 6 years. The funding amounts identified for Monomoy NWR

were not sufficient to support refuge operations, so augmentation of the refuge budget came from the refuge complex budget. The activities we describe below pertain to staffing, administration, and operations. Implementing them supports all our refuge goals.

Permanent Staffing and Operational Budgets

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

In 2007, our Regional Directorate completed the “Strategic Workforce Plan for the National Wildlife Refuge System in Region 5” (Phase 2; January 16, 2007) to support a new base budget approach. Its goal is that a maximum of 75 percent of a refuge station’s budget cover salaries and fixed costs, while the remaining 25 percent or more will be operating and maintenance funds. Our strategy is to improve the capability of each refuge manager to do the highest priority work, and to avoid having most of a refuge budget tied up in inflexible fixed costs.

Within the constraints or opportunities of our budget and in conformance with future workforce plans, we will fill any currently approved but vacant positions that we believe are necessary to accomplish our highest priority projects. We propose additional staff to provide depth in our biological and visitor services programs. We identify our recommended priority order for new staffing in the RONS tables in appendix H. Appendix G identifies the proposed staffing to fully implement this plan.

Facilities Construction and Maintenance

We will conduct periodic maintenance and renovation of existing facilities to ensure the safety of and accessibility for staff and visitors. Our current facilities are described in chapter 3. They include refuge headquarters/visitor contact station, the dormitory and maintenance buildings, and the Monomoy Point Light Station, the headquarters parking lot, the Stage Island parking area, the 3/4-mile Morris Island Trail, signs, stairs, overlooks, and moorings. Any new facilities recommended in this CCP, once constructed, will be placed on the maintenance schedule. All maintenance and upgrades of facilities will incorporate ecologically beneficial and energy-efficient technologies, tools, materials, and practices.

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

Refuge Operating Hours

Monomoy NWR will remain open for visitation from ½ hour before sunrise to ½ hour after sunset, 7 days a week, to insure visitor safety and protect refuge resources. Surf fishing will continue to be allowed 24 hours per day on Morris Island. The refuge manager may issue SUPs to allow access outside those periods. For example, we may permit access for research personnel or anglers

at different times, or organized groups to conduct nocturnal activities, such as wildlife observation and educational and interpretive programs.

Protecting Resources and Ensuring Visitor Safety

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

Access or Right-of-Way

The refuge will use and maintain its existing right-of-ways on Tisquantum Road, Wikis Way, and Stage Island Road to access its properties for refuge resource management, public use, and visitor access. At high tide, the refuge shoreline on Morris Island can be inaccessible for most visitors, limiting them to accessing refuge lands and trails via the Tisquantum Road right-of-way. Refuge staff will work diligently to ensure that adequate signs are in place so visitors can find the trailhead while minimizing disturbance to neighbors. Refuge staff will work with the 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 by adjoining landowners under a 1998 permit. The northern end of this revetment, known as the return, was constructed on refuge lands with our permission. The 1998 permit from the Chatham Conservation Commission required annual renourishment of the beach for 5 years. In 2005, the Service thought that beach renourishment would adversely impact intertidal resources, so we recommended no further beach renourishment. However, we now understand that the revetment can actually accelerate erosion and beach narrowing. We intend to work with the upland landowners and all applicable local, State, and Federal agencies to determine possible actions that will protect and restore the beach habitat.

Boundary Issues/Overlapping Jurisdiction

As described in chapter 3, the gradual southward migration and ultimate connection of South Beach (the southerly portion of the NPS Cape Cod National Seashore's Nauset Beach) to South Monomoy Island in November 2006 resulted in the formation of a "land bridge" that has continued to grow over the past 6 years. It is highly unlikely that natural processes will break apart the connection at this point, although Nauset/South Beach breached a couple of miles north of the connection in February 2013 and then again in 2014, and could break at other locations as well. It is also possible there could be a reconnection of these landforms in the future. The NPS jurisdiction extends 1/4-mile offshore, and in the area where the Cape Cod National Seashore's jurisdiction might overlap with refuge land above MLW, we have reached agreement with the NPS that the more restrictive rule of either agency will prevail.

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

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

Distributing Refuge Revenue Sharing Payments

As we describe in chapter 3, we pay the Town annual refuge revenue sharing payments based on the acreage and the appraised value of refuge lands calculated by a formula determined by, and with funds appropriated by, Congress. We will continue those payments in accordance with the law, commensurate with changes in the appraised market value of refuge lands, the extent of our property, or new appropriation levels dictated by Congress.

Completing Step-down Management Plans

Service planning policy identifies 25 step-down plans that may be applicable on any given refuge. We have identified below the plans most relevant to this planning process and have prioritized their completion, if they are not already developed. Several are ongoing as part of the refuge complex planning, but others will be completed depending upon the associated level of funding and staffing to complete them. We will also develop a habitat management plan, an annual habitat work plan and an inventory and monitoring plan as the highest priority step-down plans. These are described in more detail below. They will be modified and updated as new information is obtained so we can continue to keep them relevant. Completion of these plans supports all CCP goals.

The following plans are either up-to-date or in progress and will be completed within 1 year of the issuance of the CCP. An updated fire management plan for the complex is scheduled for completion in 2016. Please see appendix F for general fire program direction.

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

Step-down plans scheduled for completion include:

- Habitat Management Plan, within 2 years of CCP approval (see discussion below)
- Annual Habitat Work Plan, annually after HMP approval (see discussion below)
- Inventory and Monitoring Plan, within 2 years of CCP approval (see discussion below)
- Fishing Plan, within 2 years of CCP approval
- Wilderness Stewardship Plan, within 3 years of CCP approval
- Integrated Pest Management Plan, within 4 years of CCP approval (see discussion below)

- Visitor Services Plan, within 5 years of CCP approval
- Avian Disease Contingency Plan, within 5 years of CCP approval
- Cultural Resources Management Plan, within 7 years of CCP approval

Habitat Management Plan

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

Annual Habitat Work Plan

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

Inventory and Monitoring Plan

The inventory and monitoring plan (IMP) for the refuge is a priority for completion upon CCP approval. An IMP is vital for measuring our success in meeting objectives. The IMP will outline the methodology to assess whether our original assumptions and proposed management actions support our habitat and species objectives and wilderness objectives. The IMP may also be used to monitor the potential effects of global climate change on refuge habitats and wildlife populations. We will prioritize our inventory and monitoring needs in the IMP. The results of inventories and monitoring will provide us with more information on the status of our natural resources.

Wilderness Stewardship Plan

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

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

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

Visitor Services Plan

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

The VSP will provide the reader with background information, including the refuge purpose, history of visitor services, goals, and a list of the present facilities and services. It will also discuss visitor services issues, concerns, and outreach topics and themes. The foundation of the plan will include the 10 standards and 4 optional standards that are used to judge and plan visitor services program growth. Typically, a site will receive a visitor services review, which develops strategies and recommends specific actions that the refuge will strive to carry out to provide and improve visitor services. There are 3 types of strategies in a plan: those that the refuge presently does; those that are planned for the near future and can be achieved without major additional financial or personnel resources; and others that are long-range and can only be accomplished with increased staffing or funding.

Protecting Cultural Resources

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

In addition, in compliance with Section 110 of the NHPA, we will continue our program to maintain the historic lighthouse and associated structures at the Monomoy Point Light Station to at least the minimum national historic preservation standards of the Secretary of the Interior. The Service will comply with Section 110 by protecting Native American and historical archaeological resources from ground-disturbing activities and artifact looting.

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

Alternative Energy Projects

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

As part of Federal mandates being implemented Servicewide, various energy efficiencies are already incorporated into our facilities and operations at Monomoy NWR. For example, our fleet is being converted to alternative fuel vehicles and a solar-thermal domestic hot water system was recently installed in the refuge dormitory building. On Monomoy Island, we are using alternative energy solutions in several ways, including solar panels that run a fan for the composting toilet in the keeper's house. The biological program has also used solar panels to charge batteries for the roseate tern attraction project (charging the battery for the sound system) and for charging the battery to run electric fencing that has been installed on occasion as a non-lethal predator management technique to protect nesting piping plovers, American oystercatchers, and least terns. Solar chargers for cell phone batteries have also been explored as a green option for field camp.

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

We will continue to explore options to increase the proportion of electricity consumption derived from clean, renewable sources while reducing the proportion derived from fossil fuel combustion and associated greenhouse gas emissions. This could include solar, wind or geothermal energy. We propose to investigate the possibility of developing alternative energy options to provide additional clean energy at the Monomoy headquarters. We will continue bird and bat surveys to help us determine the presence of species that could potentially be impacted by wind development.

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

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

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

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

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

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

Appropriateness and Compatibility Determinations

Chapter 1 describes the requirements for findings of appropriateness and compatibility determinations. Most Monomoy NWR compatibility determinations needed to be updated to be consistent with Service policy, resulting in some public use activities that were previously found compatible to be found incompatible due to changes in refuge wildlife, habitat, policy, or other aspects of the use. Appendix D contains the signed findings of appropriateness and compatibility determinations to identify and explain the decisions about which public uses the refuge is open for and those for which the refuge is closed.

Activities Allowed (Uses the Refuge is Officially Opened to)

The refuge manager has determined that five of the six priority public uses are compatible, subject to stipulations as detailed in appendix D. The refuge has not previously officially opened for the sixth priority public use—hunting—but will initiate additional NEPA analysis, planning and public outreach that could establish a waterfowl hunt program on the refuge.

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

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

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

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

Activities Not Allowed (Uses the Refuge is Officially Closed To)

All areas included in the Refuge System are closed to public access until and unless we open the area for a use or uses in accordance with the Administration Act of 1966 (16 U.S.C. § 668dd-668ee) and the Refuge Recreation Act of 1962 (16 U.S.C. § 460k-460k-4). The refuge will remain closed to all forms of hunting except possibly waterfowl hunting, as the existing deer and small mammal populations are not large enough to sustain a hunt program or the administrative burden of managing such a program.

*Monomoy lighthouse
at a distance*



Yianni Laskaris/USFWS

We have received requests for non-priority (non-wildlife-dependent) activities. According to Service policy, (603 FW 1), if the refuge manager determines a use is not appropriate, it can be denied without determining its compatibility. In 2002, we found horseshoe crab harvesting to be not compatible, and it has not been allowed since. In appendix D we identify the following uses as not appropriate on refuge lands: horseshoe crab harvesting, including within the submerged lands and waters within the Declaration of Taking boundary (refer to the 2002 horseshoe crab harvesting compatibility determination); mussel harvesting; camping; fires; fireworks; bicycling; beach use activities such as beach sports, kite flying, grilling, and use of shade tents; organized picnicking; kiteboarding, OSV, and motorized personal watercraft (e.g., wave runner and jet skis) in refuge waters within the Declaration of Taking boundary. We will end dinghy storage on both Morris and Stage Islands and parking in Stage Island Lot 7b. Appendix D documents the refuge manager's justification for why these are deemed not appropriate. Most of the activities are sufficiently provided for on other nearby ownerships, so the lack of access on the refuge does not necessarily eliminate the opportunity.

Waterfowl Hunting

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

Special Use Permits

The refuge manager will evaluate activities that require a SUP for their appropriateness and compatibility on a case-by-case basis. We will continue to only approve permit requests that are both appropriate and compatible, with the preference for activities that benefit the refuge or the Refuge System, are manageable by refuge staff, and are consistent with the Wilderness Act if the activity is proposed within designated wilderness. All economic activities or uses on the refuge will adhere to 50 CFR, Subpart A, 29.1 and follow Service policy (603 FWS 2), which allows these activities if they contribute to the achievement of refuge purposes or the Refuge System mission.

Mosquito Management

Mosquito control through larvicide has been allowed for many years on Morris Island, but not on North Monomoy Island or South Monomoy Island. The CCMCP has been treating the salt pannes on Morris Island since CCMCP establishment in 1930, and in recent years with Bti, a biological mosquito control method that kills mosquito larvae and also can kill non-target organisms such as midge (Chironomid) larvae. A SUP to control salt marsh mosquitoes has been issued annually since at least 1983 (2003 CD for mosquito control). Monitoring of mosquitoes is required so that larvicidal applications are only conducted when a threshold population size is reached. The two species that are controlled through larvicides are also bridge vectors for mosquito-borne diseases such as WNV and EEE. Recent monitoring (CO₂ light trap) by CCMCP of several mosquito species known as human disease vectors collected from the Morris Island area has not revealed any instances of mosquitoes infected with these human transmissible diseases, although EEE was detected in mosquitoes from nearby Brewster during 2012 mosquito monitoring.

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

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

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

We propose a small facility downtown to serve as a site for providing information to potential refuge visitors and the general public, as well as a place to display temporary exhibits about the refuge and the Monomoy Wilderness. There could also be a small expansion of the current infrastructure at Morris Island (such as a second story on the office) to meet refuge needs. Offsite shuttle parking could be acquired, and we will seek to provide additional offsite housing for seasonal staff.

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

Additional NEPA Analysis For all major Federal actions, NEPA requires site-specific analysis and disclosure of expected impacts, either in a categorical exclusion, EA, or EIS. NEPA provides for categorically excluding other routine activities from that requirement. The draft and final CCP/EIS's that preceded this CCP described alternatives in enough detail to comply with NEPA, and additional environmental analysis is not required for most of our actions. Although this list is not all-inclusive, the following projects fall into that category:

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

- Conducting a predator management program.

Additional NEPA analysis will be required if we were to implement a significant public action or construction project not considered in detail in this document. The following actions will require further NEPA analysis before a final decision is made to undertake them:

- Opening the refuge to waterfowl hunting.
- Construction of a new building at refuge headquarters, or construction of an offsite visitor contact facility.
- Installation of a wind turbine at the Morris Island headquarters site.
- Use of dredge material for habitat restoration to benefit migratory birds.

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 2, figure 2.1, 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 CCP 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 12 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.

We initially released the draft CCP/EIS for 60 days of public review and comment from April 10 to June 9, 2014. In response to several requests, we subsequently extended the public comment period through October 10, 2014. In total, the comment period was 6 months long. During the comment period, we held five public meetings in Town: one public hearing and four open houses. We also spoke to the Chatham Summer Residents Advisory Committee, at their request, at a televised meeting. We evaluated all the letters and e-mails sent to us during the comment period, along with comments recorded at our public hearing. We received 255 separate written responses (some letters had multiple signatures), and 39 oral comments from the public hearing on the draft CCP/EIS. Of the 255 written comments, 41 were a form letter. We also received two petitions: one signed by approximately 650 individuals and the other by approximately 1,276 individuals. Some individuals signed both petitions. Appendix K to this document summarizes all of the substantive comments we received and provides our responses to them.

We released the final CCP/EIS for public review on October 30, 2015, for a 37-day period which closed on December 7, 2015. We received comments from 34 individuals, agencies, and organizations on the final CCP/EIS.

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 NWR 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 the refuge, we asked the independent, nonpartisan, nonprofit facilitator, the 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. It was released for public comment in April 2014. After the close of the public comment period in October 2014, we revised our preferred alternative and drafted a final CCP/EIS, which was released in October 2015. This CCP represents the completion of the planning process for the Monomoy NWR.

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). About 500 individuals and organizations were informed by e-mail or U.S. Postal Service about the availability of the draft and final CCP/EIS documents. 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, March 2012, April 2014, and October 2015.

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Chapter 6



USFWS

Hudsonian godwits

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Short-eared owl

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Acronyms and Glossary



Winter on the refuge

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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

Acronyms and Abbreviations

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
MA DFW 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	<i>Federal Register</i> Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	<i>Federal Register</i> 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

Acronyms and Abbreviations

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
WHSRN	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	<p>focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable ecosystems</p> <p>Adaptive management:</p> <ul style="list-style-type: none"> • 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 <p>(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.)</p>
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	<p>a proposed or existing use on a refuge that meets at least one of the following three conditions:</p> <ul style="list-style-type: none"> • 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
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	<p>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</p> <p>[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).]</p>
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
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	<p>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.]</p> <p>[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).]</p>

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	<p>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</p> <p>(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.</p>
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	<p>(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</p> <p>[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).]</p>

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 <i>Federal Register</i> 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 <i>Federal Register</i> 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: <ul style="list-style-type: none"> • 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 non-natives 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	<p>an area of high biological value</p> <p>[N.B. We normally direct most of our resources to SFA's that were delineated because of</p> <ul style="list-style-type: none"> • 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/esa-library/pdf/glossary.pdf (accessed October 2015))
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/esa-library/pdf/glossary.pdf (accessed October 2015))
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	<p>the attempts to meet economic objectives in ways that do not degrade the underlying environmental support system</p> <p>[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.”]</p>
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	<p>a resource that the Government holds in trust for the people through law or administrative act</p> <p>[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.]</p>
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 untrammelled 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	<p>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”)</p> <p>[N.B. A wilderness study area must meet these criteria</p> <ul style="list-style-type: none">• 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	<p>a free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands [FWS Manual 621 FW 1.7]</p>
wildland fire	<p>every wildland fire is either a wildfire or a prescribed fire [FWS Manual 621 FW 1.3]</p>
wildlife-dependent recreational use	<p>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)</p>
wildlife management	<p>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</p>
wildlife-oriented recreation	<p>recreational activities in which wildlife is the focus of the experience</p> <p>[“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]</p>
wind turbine	<p>a machine for converting the kinetic energy of wind into mechanical energy, which is then converted to electricity.</p>

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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