U.S. Gulf of Maine Habitat Restoration and Conservation Plan: A Needs Assessment for Maine, New Hampshire, and Massachusetts

DRAFT

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Foreword

At the Gulf of Maine Summit in 2004, the Gulf of Maine Council on the Marine Environment issued its *Gulf of Maine Habitat Restoration Strategy*. This strategic document presents a vision for habitat restoration and broadly describes the environmental, social and economic benefits of this work. It identifies habitat types (riverine, intertidal, subtidal—including nearshore and offshore waters—and beaches, sand dunes, and islands), impacts, and restoration needs. Finally, it presents recommendations for enhancing habitat restoration.

In July 2010, the President's Ocean Policy Task Force released its final set of recommendations, among which are included: establishing and implementing an integrated ecosystem protection and restoration strategy; enhancing water quality in the ocean and along our coasts; strengthening and integrating ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system; and strengthening the resiliency of coastal communities and their ability to adapt to climate change impacts.

We are pleased to build on the seminal work of the Gulf of Maine Council's *Restoration Strategy*, the President's Ocean Policy Task Force recommendations, and other studies with the publication of the *U.S. Gulf of Maine Habitat Restoration and Conservation Plan: A Needs Assessment for Maine, New Hampshire, and Massachusetts*. This document is the result of a collaborative effort by state, federal, and non-government organizations to quantify the needed investment in five broad issue areas: fish and wildlife habitat, water quality, invasive species, climate change, and long-range planning, science, and communications. This document contains numerous recommendations to reap the economic and environmental benefits of healthy and productive coastal and marine ecosystems.

New Hampshire:
- New Hampshire Coastal Program
- Department of Environmental Services
- Geological Survey
- Fish and Game Department
- Department of Resources and Economic Development

Massachusetts:
- Department of Environmental Restoration
- Department of Fish and Game
- Department of Environmental Protection
- Office of Coastal Zone Management

Maine:
- State Planning Office
- Department of Transportation
- Department of Environmental Protection

- Department of Inland Fisheries and Wildlife
- Department of Marine Resources

The following federal agencies were consulted and concurred with the goals and priorities of this plan:

- National Oceanic and Atmospheric Administration, Restoration Center
- US Fish and Wildlife Service, Gulf of Maine Coastal Program
- US Environmental Protection Agency, Region I

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Executive Summary

The Gulf of Maine is renowned as one of the world's most economically and ecologically valuable ocean ecosystems. It is bordered to the west by Massachusetts, New Hampshire, and Maine, and the legendary fishing grounds of Georges Bank mark its southern and eastern boundary. New Brunswick and Nova Scotia form the northern boundary of the Gulf of Maine.

Coastal and ocean habitats such as salt marshes, shellfish beds, seagrass beds, rivers, islands, and the seawater itself are the building blocks of this regional ecosystem. These habitats host a vast diversity of animals and plants that depend on each other and the environment for food, shelter, and the other necessities of life.

Healthy habitats in the Gulf of Maine support commercial and recreational fisheries, tourism, and numerous other benefits that add up to a way of life prized by millions of coastal residents. The Gulf of Maine's habitats also provide a range of ecosystem services that, while often less obvious to people, are critical to our wellbeing—such as filtering pollution, trapping sediments, storing carbon, and buffering upland areas from storm damage.

The tradition of people using and enjoying the Gulf of Maine for food, transportation, coastal development, industrial opportunities, spiritual fulfillment, and recreation stretches back centuries to the earliest European settlers in North America and thousands of years before that to the first Native American residents.

At an accelerating rate over the last century, however, human activities have jeopardized the region's habitats and ecosystem services. Human uses of the Gulf of Maine are expanding rapidly in variety and intensity. Climate change is fundamentally altering the way the ecosystem functions. Habitats are an important form of natural capital, and we have drawn down this capital–often unknowingly, sometimes intentionally—instead of living off the interest.

The *U.S. Gulf of Maine Habitat Restoration and Conservation Plan: A Needs Assessment for Maine, New Hampshire, and Massachusetts* builds on the seminal work of the Gulf of Maine Council on the Marine Environment's *Gulf of Maine Habitat Restoration Strategy* (2004), the President's Ocean Policy Task Force recommendations (2010), and many other efforts. This document is the result of a collaborative effort by state, federal, and non-government organizations to quantify the needed investment in five broad issue areas: fish and wildlife habitat, water quality, invasive species, climate change, and long-range planning, science, and communications. This document contains numerous recommendations to reap the economic and environmental benefits of healthy and productive coastal and marine ecosystems.

As detailed on the following pages, the *Plan* is designed to address five long-term Goals:

- Protect and restore fish and wildlife habitats and populations
- Provide clean and healthy coastal waters

- Conduct science, planning, and communication needed for regional ocean management, marine spatial planning, and ecosystem-based management
- Promote resilience to climate change
- Prevent and detect invasive species, and restore affected habitats

The *Plan* recommends a portfolio of 24 Priority Actions to accomplish the Goals and includes estimates of the short-term (5-year) funding needed requirements beyond existing federal and state budgets.

Funded Priority Actions will contribute to regional economic recovery over the short term through job creation and over the long term through increases in fish stocks and other goods and services that people receive from the Gulf of Maine ecosystem.

A key factor across all aspects of implementation of this plan is the need for additional capacity in the state and federal agencies that will be involved. The investments recommended herein are, in some cases, orders of magnitude above current appropriations, and additional agency staff will be needed to effectively administrate the Priority Actions. Those additional costs are included in the accompanying estimates and are ten percent of the total cost.

The Goals, Issues, and Priority Actions are summarized below with short-term (5-year) needs for funding. The Strategy Teams that estimated the funding needs note that these recommendation address only the first 3 to 5 years of implementation, and that long-term, sustained funding is required that could total more than 5 times the short-term recommendation.

TABLE:
Summary of Goals, Issues, and Priority Actions with Short-Term (5-Year) Funding Needs

GOAL 1:
PROTECT AND RESTORE WILDLIFE HABITAT AND POPULATIONS

Issue 1.1: Barriers in Rivers and Streams $62,100,000
Priority Action 1.1.1: Improve stream flow at road crossings (culverts & bridges).
Priority Action 1.1.2: Remove unneeded dams or install fish passage.

Issue 1.2: Degraded Coastal Habitats $84,487,500
Priority Action 1.2.1: Assess and restore degraded habitat by removing dredge spoils, planting vegetation, and other methods.
Priority Action 1.2.2: Hydrologic assessment, remote sensing, mapping and restoration.

Issue 1.3: Decline of Shoreland Habitats $47,000,000
Priority Action 1.3.1: Prioritize, acquire, and protect key parcels of coastal land.

Issue 1.4: Lost Fishing Gear $2,850,000
Priority Action 1.4.1: Locate and remove ghost fishing gear and lobster traps.

Issue 1.5: Habitat Mapping $21,550,000
Priority Action 1.5.1: Conduct mapping of seafloor habitats in the Gulf of Maine and make the maps available for resource management and restoration.

Issue 1.6: Monitoring Fish and Wildlife Populations $49,525,000

Priority Action 1.6.1: Implement a regional, coordinated monitoring program for species of interest for management and restoration. Integrate the results into adaptive management processes.

TOTAL SHORT-TERM (5-YEAR) NEED FOR GOAL 1: $267,512,500

GOAL 2:
PROVIDE CLEAN AND HEALTHY COASTAL WATERS

Issue 2.1: Outdated Sewage Treatment Facilities $2,744,011,000

Priority Action 2.1.1: Upgrade municipal and industrial sewage treatment systems and combined sewer overflow systems to meet ecologically appropriate standards, including nutrient standards.

Issue 2.2: Non-Point Source Pollution $140,430,000

Priority Action 2.2.1: Locate, prioritize, resolve, and prevent causes of non-point source pollution through an integrated program of data collection, mitigation projects, and proactive management practices.

Priority Action 2.2.2: Reduce the impact of stormwater by upgrading stormwater systems and by identifying, correcting, and preventing stormwater sources.

Issue 2.3: Pollution Discharge from Vessels $3,060,000

Priority Action 2.3.1: Designate no-discharge zones in the ocean and provide port facilities for boats and ships to dispose all of their waste streams (wastewater, solid waste, oil).

Issue 2.4: Toxic Sediment $11,500,000

Priority Action 2.4.1: Remediate contaminated sediment at priority sites in coastal waters and rivers.

Issue 2.5: Water Testing $30,625,000

Priority Action 2.5.1: Expand the frequency and geographic coverage of water testing and implement state-of-the-art monitoring protocols.

TOTAL SHORT-TERM (5-YEAR) NEED FOR GOAL 2: $2,929,626,000

GOAL 3:
PROVIDE SCIENCE, PLANNING, AND COMMUNICATION REQUIRED FOR REGIONAL OCEAN MANAGEMENT, MARINE SPATIAL PLANNING, AND ECOSYSTEM-BASED MANAGEMENT

Issue 3.1: Regional Integration of Habitat Restoration, Conservation, and Management Actions $16,500,000

Priority Action 3.1.1: Conduct a regional planning process for implementation of the Priority Actions that (a) engages diverse stakeholders and decision-makers, (b) accurately reflects their values and priorities, (c) integrates across management sectors and geographies, and (d) is based on sound science.

Issue 3.2: Analysis of Ecosystem Changes $1,750,000

Priority Action 3.2.1: Fully implement the Habitat Monitoring Partnership, the Ecosystem Indicator Partnership, and a socioeconomic monitoring program to provide essential information for adaptive management.

Issue 3.3: Communication of Policy- and Management-Relevant Science $3,400,000

Priority Action 3.3.1: Establish a regional communications program that provides (a) educational and outreach opportunities and materials to increase public and decision-maker understanding of coastal resources (e.g, findings from regional habitat monitoring programs and ecosystem indicators), the economic values associated with restoration and conservation, and scientifically sound methods for restoring and sustaining the Gulf of Maine, and (b) a mechanism for stakeholders and decision-makers involved in regional planning to interact meaningfully on an ongoing basis.

Issue 3.4: Data and Decision Support for Ecosystem-Based Management and Marine Spatial Planning $4,300,000

Priority Action 3.4.1: Develop an integrated, regional data management network that is robust with searchable metadata, user friendly, and interoperable with existing state, federal, and non-government data management investments.

Issue 3.5: Oversight, Coordination, and Evaluation of Regional Priority Actions $3,750,000

Priority Action 3.5.1: Establish a program office or other administrative framework and designate personnel for managing, coordinating, and evaluating the regional initiative.

TOTAL SHORT-TERM (5-YEAR) NEED FOR GOAL 3: $29,700,000

GOAL 4:
PROMOTE RESILIENCE TO CLIMATE CHANGE

Issue 4.1: Understanding Impacts of Climate Change on Habitats $8,500,000

Priority Action 4.1.1: Establish a regional scientific program that monitors and assesses climate change impacts on habitats.

Issue 4.2: Preparing for Climate Change $5,000,000

Priority Action 4.2.1: Facilitate a regional climate-smart planning initiative for promoting habitat resilience and adaptation.

Issue 4.3: Mitigate Erosion of Shoreline Habitats $7,800,000

Priority Action 4.3.1: Mitigate erosion and restore dune habitats.

Issue 4.4: Assess and Mitigate Impact of Sea Level Rise on Salt Marshes $12,500,000

Priority Action 4.4.1: Identify and prioritize suitable areas of adjacent uplands as buffers for marsh migration; acquire and/or protect priority sites.

TOTAL SHORT-TERM (5-YEAR) NEED FOR GOAL 4: $33,800,000

GOAL 5:
PREVENT AND DETECT INVASIVE SPECIES, AND RESTORE AFFECTED HABITATS

Issue 5.1: Early Detection of Invasive Species $4,960,000

Priority Action 5.1.1: Establish a comprehensive monitoring program in the Gulf of Maine and its watershed with the capacity to detect invasive species soon after their arrival and to disseminate the information to rapid-response teams.

Issue 5.2: Removal and Prevention of Invasive Species $2,510,000

Priority Action 5.2.1: Establish a regional network of rapid-response teams that control populations of invasive species immediately after detection.

Issue 5.3: Restoration of Habitats Degraded by Invasive Species $1,400,000

Priority Action 5.3.1: Identify, prioritize, and restore habitats adversely affected by invasive species.

TOTAL SHORT-TERM (5-YEAR) NEED FOR GOAL 5: $8,870,000

TOTAL SHORT-TERM (5-YEAR) NEED FOR ALL GOALS 1-5: $3,269,508,500

Introduction

The birth of the United States as a nation can be traced directly to the rich natural resources of the Gulf of Maine. The region's unique abundance of natural resources catalyzed the settlement and independence of the nation and fueled its economic development for centuries.

More than 400 years ago, Europeans mariners were drawn to the Gulf of Maine by the great abundance of codfish. When the Pilgrims landed at Plymouth in 1620, they were able to survive and establish a permanent settlement in part because of the abundance of food from the sea—fish, shellfish, and marine mammals. Subsequently, the Gulf of Maine's plenitude of natural resources built a robust regional economy and generated economic strength that contributed to the success of the American Revolution. Right from the start, even farmers depended on resources from the Gulf of Maine, using salt marsh grasses to feed livestock and barrels of fish to fertilize fields.

Today, fishing remains a major contributor to the region's culture and economy. Many other components of the regional economy rely on the natural wealth of the Gulf of Maine's ocean and coastal habitats. More than two-thirds of the population in Massachusetts, New Hampshire, and Maine lives along the coast, where the ocean and shore help create a highly valued lifestyle. Tourism accounts for more $43 billion in revenues in the three states, much of it attributable to coastal and ocean-related tourism.

Ocean and coastal habitats of the Gulf of Maine also provide a range of ecosystem services that, while often less obvious to people, are critical to our wellbeing—filtering pollution, trapping sediments, storing carbon, and buffering upland areas from storm damage, for example.

BOX with map of Gulf of Maine:

Gulf of Maine at a Glance

Extending from Cape Cod to the southern end of Nova Scotia, the Gulf of Maine is one of the most economically valuable and ecologically productive regions of the world's ocean. The coastlines of Massachusetts, New Hampshire, Maine, New Brunswick, and Nova Scotia define its western and northern boundaries, and the legendary fishing grounds of Georges Bank mark its southern and eastern extent. An area of 69,115 square miles of land in three states and three provinces drains into the Gulf of Maine. The Gulf of Maine's marine and shoreline habitats are home to more than 4,000 species from codfish, cold-water corals, and osprey to North Atlantic right whales, harbor porpoises, and sea turtles.

Pull Quote:

"The Gulf of Maine is one of most productive ecosystems in the world, supporting commercial and recreational fisheries with a combined annual value to the US economy in excess of $1 billion (Steinback et al. 2004) and providing upwards of 26,000 jobs (NMFS 2000)."

From *Maine's Climate Future* (2010)

In recent decades, however, the natural resources of the Gulf of Maine have declined, and the ecosystem's capacity to provide these benefits is tenuous. The most recent EPA National Estuary Program Coastal Condition Report (2007) assessed the overall condition of the Northeast region as poor—the only part of the mainland U.S. to receive that designation. In summer 2010, newspapers in Massachusetts reported frequently on beaches closed due to unhealthy bacteria levels—33 beach closures on August 13 alone (Nicas 2010)—and these beach closures were not associated with rainstorms. In 2005 and 2008, state agencies in Maine, New Hampshire, and Massachusetts closed hundreds of miles of shellfish flats and beaches for weeks because of severe red tides, causing tens of millions of dollars in losses, and in 2009 almost the entire coast of Maine was closed to clam and mussel harvesting (Canfield 2010). Ocean acidification associated with climate change is already eroding the shells of young clams in the Gulf of Maine (Green *et al*. 2009). In July 2010, scientists conducting a survey of invasive species along the Massachusetts coast discovered a population of a large European shrimp—never before seen in North American waters—that poses a serious threat to the Gulf of Maine ecosystem (MA CZM 2010).

Despite these warning signs, many experts consider the Gulf of Maine to be in fundamentally sound health and if the necessary steps are taken now the Gulf will be well positioned for the future. A series of studies, workshops, and reports over the last decade by subregional, regional, and national entities have identified issues and goals for the region.

Emerging as a major regional priority is the need to restore and protect habitats in the Gulf of Maine. Coastal and ocean habitats such as salt marshes, shellfish beds, seagrass beds, islands, rivers, and the seawater itself are the building blocks of this regional ecosystem. These habitats host a vast diversity of animals and plants that depend on each other and the environment for food, shelter, and the other necessities of life.

Healthy habitats in the Gulf of Maine are essential for commercial and recreational fisheries, tourism, aesthetics, and numerous other benefits that add up to a way of life prized by millions of coastal residents. At an accelerating rate over the last century, however, human activities have jeopardized the region's habitats and ecosystem services.

In economic terms, habitats are natural capital, and rather than living sustainably off the interest, people have drawn down the capital–often unknowingly, sometimes intentionally. Drawdown of natural capital happens when unsustainable human activities reduce the long-term ability of habitats to provide ecosystem services required by people. Some of the unsustainable activities happened long ago but still affect habitats today. For example, centuries ago people began to build road crossings over wetlands, creeks, and rivers in the Gulf of Maine watershed, often installing ill-designed culverts, which block the passage of fish that normally would migrate up and down streams. Only recently has it been recognized that these blockages affect other parts of the Gulf of Maine ecosystem, such as offshore fish stocks that feed on small forage fish. Many forage fish spend part of their lives in salt marshes and rivers. An investment in fish passage to provide access to habitat for forage fish could help to restore commercial fisheries in offshore waters. This

is just one example of how natural capital (habitats) can generate interest or benefits (ecosystem services).

Human uses of the Gulf of Maine are expanding rapidly in variety and intensity. For example, offshore wind turbines and tidal power facilities were not a significant management issue in this region a decade ago, but they are now one of the most prominent. While ocean energy offers tremendous potential for socioeconomic and environmental benefits, it adds yet another layer of complexity to managing human activities in the Gulf of Maine. Because of the increasing complexity, new capacity is needed for restoring and protecting the Gulf's habitats. Further raising the stakes, climate change is fundamentally altering the way the ecosystem functions.

The *U.S. Gulf of Maine Habitat Restoration and Conservation Plan: A Needs Assessment for Maine, New Hampshire, and Massachusetts* builds on the seminal work of the Gulf of Maine Council on the Marine Environment's *Gulf of Maine Habitat Restoration Strategy* (2004), the President's Ocean Policy Task Force recommendations (2010), and many other efforts. This document is the result of a collaborative effort by state, federal, and non-government organizations to quantify the needed investment in five broad issue areas: fish and wildlife habitat, water quality, invasive species, climate change, and long-range planning, science, and communications. This document contains numerous recommendations to reap the economic and environmental benefits of healthy and productive coastal and marine ecosystems.

For a similar regional initiative in the Great Lakes, economic analysis showed that an investment of $26 billion in habitat restoration over five years would produce $50 billion in economic benefits (Brookings Institution 2007).

As detailed on the following pages, the *Plan* is designed to address five long-term Goals:

1. Protect and restore fish and wildlife habitats and populations
2. Provide clean and healthy coastal waters
3. Conduct science, planning, and communication needed for regional ocean management, marine spatial planning, and ecosystem-based management
4. Promote resilience to climate change
5. Prevent and detect invasive species, and restore affected habitats

The *Plan* recommends a portfolio of 24 Priority Actions to accomplish the Goals and provides estimates of the short-term (5-year) funding needed beyond existing federal and state budgets. The funding needs were estimated by state agencies based on available financial data and professional judgment. The Goals, Priority Actions, and funding are detailed in the following chapters, and the Appendix provides a spreadsheet with a complete list of the funding needs.

General Recommendations

Participants in development of the *Plan* made the following overarching recommendations on implementation of Priority Actions.

- Administration: Where appropriate, it is important to use existing structures within agencies that are in place and functional, instead of setting up new

structures. For example, the EPA State Revolving Fund, National Estuary program, and non-point source program; the USFWS Coastal and Partners Programs; and the NOAA Open Rivers Initiative and Community-Based Habitat Restoration Program might provide appropriate structures for implementation. However, it is also important that the authorizing language allow flexibility by federal agencies and other organizations to use Priority Action funding for new and innovative approaches or programs.

- Types of Partnerships: Multi-year implementation partnerships of federal, state, and local governments and non-government entities including businesses and non-profit organizations are critical. Partnerships should be funded for a minimum of three years but preferably five or more years. This timeframe enables them to build partner capacity and to hire, train, and maintain staff for continuity and coordination.
- Ecosystem-Level Planning: Coordinated and integrated action across political jurisdictions and agency mission areas is critical. Implementation of Priority Actions should not be conducted in the traditional fragmented and opportunistic way. Rather, a more integrated and holistic approach to ecosystem protection, conservation, and restoration should be the overarching principle for programmatic and scientific structures and processes, such as data collection, mapping, planning for restoration and conservation actions, and identification and analysis of ecosystem condition and stressors.
- Types of Programs to Fund: Funding should be used to both (a) expand existing programs that have high probabilities of success and (b) establish new approaches and projects that have little or no precedent but are critical to progress.
- Remove Barriers to Implementation of Existing Policies: Many federal programs require state or local matching funds, or in the case of State Revolving Funds for waste and stormwater infrastructure repayment by the states. These requirements often prevent states from implementing much-needed projects for lack of matching funds. A key component for the implementation of this plan should be waiving or modifying such requirements.

BOX:

Restoring Habitats, Creating Jobs

Funded Priority Actions will contribute to rebuilding the regional economy both in the short term by creating jobs and over the long term by restoring habitats that support industries such as commercial fishing. The following are a few examples of direct jobs that will be created:

- Heavy equipment operators
- Boat and ship crews
- Research technicians
- Database programmers
- Construction laborers
- Skilled trades

Numerous other economic benefits will result, such as increased tourism, recreational and commercial fishing, and enhanced property values.

BOX:

Promoting Habitat Resilience to Climate Change

Climate change is already affecting the ecosystem and economy in the Gulf of Maine and its watershed. The influence of climate change will increase in the coming years (Frumhoff et al. 2007), and all aspects of marine and coastal management must be considered and implemented in the context of a changing climate. Priority Actions will increase the resilience of the ecosystem and economy to climate change and will reduce the magnitude of negative climate-related impacts. The Priority Actions focus primarily on the need for regional activities to prepare for and mitigate the impacts of climate change, rather than on addressing the cause of climate change. While Goal 4 is focused on climate issues, climate change is a crosscutting issue, and many Priority Actions under other Goals relate directly to it. The following are examples of Priority Actions addressing climate change:

- Monitoring program to assess climate change impacts on habitats and species.
- Climate-smart planning initiative for habitat resilience and adaptation.
- Mitigation of coastal erosion and habitat loss due to sea level rise and increased precipitation due to climate change.
- Protection of upland buffers for salt marsh migration in response to sea level rise.
- Monitoring the spread of invasive species, which may be affected by climate change, and rapid-response teams to eliminate invasive species.
- Upgrading and replacement of culverts not suited for sea level rise or new flood regime due to increased frequency of severe storms.
- Reduction of non-point source pollution, which is expected to increase due to greater storm activity with climate change.
- Upgraded combined sewer overflows and sewage treatment facilities to reduce stormwater and bacterial pollution.

BOX:

Alignment with National Ocean Policy of 2010

The Priority Actions in the *Plan* align closely with the Executive Order signed by President Obama on July 19, 2010, establishing a National Policy for the Stewardship of the Ocean, Coasts, and Great Lakes. The Priority Actions also address recommendations of the U.S. Commission on Ocean Policy (2004) and the Pew Oceans Commission (2003). As recommended by the Ocean Policy Task Force and the two Commissions, the Priority Actions implement components of ecosystem-based management, marine spatial planning, and regional ocean governance.

Goal 1: Protect and Restore Fish and Wildlife Habitats and Populations

Problem Statement

Habitats in the Gulf of Maine are showing the strain of increasingly intensive use by people over the last four hundred years.

- Aging dams and undersized or improperly installed culverts are significant natural resource management issues in the Gulf of Maine watershed. Dams and culverts may create impassable barriers for migrating fish, degrade water quality, and negatively alter ecosystem conditions. In Maine, for example, approximately 4,500 road crossings are severe barriers to fish. This is a pervasive problem that affects the outcomes of other types of river restoration.
- Many acres of salt marshes have been filled, drained, or blocked from the natural ebb and flow of tides. These impacts impair the ability of salt marshes to provide nursery habitat for fish, support coastal food webs, and remove pollutants from the water.
- Eelgrass beds play a critical role in shallow estuarine and coastal marine habitats. Fifty percent of the eelgrass in the North Atlantic has disappeared over the last century. The main causes are nutrient overloading, competing algae, boat propellers, anchors, dredging, drag fisheries that scour the bottom, and wasting disease.
- Seawalls and other structures adjacent to some salt marshes make it impossible for the marshes to shift inland as sea level rises due to climate change.
- For vast areas of the Gulf of Maine, there are no maps of seafloor habitats. Knowing what types of habitats exist and where they are located is fundamental for management and conservation.

BOX:

Habitats Are Interconnected in the Gulf and Beyond

Myriad ecological and oceanographic linkages tie habitats together, and each habitat functions as part of the larger Gulf of Maine system. In addition, the Gulf of Maine ecosystem is linked to the ocean beyond. Whales and seals migrate seasonally into the Gulf of Maine from the north and south. Salmon swim to Greenland, tuna to the Gulf of Mexico, and striped bass to the mid-Atlantic. Within the Gulf of Maine, the movement of water plays a major role in the interconnection of habitats by transporting nutrients, food, larvae, sediments, and pollutants among them. Many marine species rely on different habitats in different parts of their life cycle. For example, lobsters begin life as larvae that drift in the water before settling onto the seafloor, and as juveniles they hide among pebbles or cobbles. As adults, lobsters move into open habitats, such as sandy bottom or rocky outcrop, because they are less vulnerable to predators. The ecological linkages among marine habitats are unlike terrestrial habitats and present a special challenge for resource managers and policy makers who must consider the Gulf of Maine ecosystem as a regional, interconnected system. This integrative approach is the foundation of ecosystem-based management and marine spatial planning, which are major elements of the U.S. national ocean policy.

Long-Term Goal

After implementation of the Priority Actions:

Open and nearshore waters possess a full array of healthy natural habitats required to meet the growth and reproductive needs of fish and wildlife. Open and nearshore waters harbor self-sustaining fish and wildlife communities that include reproducing native fish species. Habitats used by fish are healthy and support sustainable commercial, subsistence, and recreational fisheries.

Wetlands are in healthy condition and provide a full range of ecosystem services including hydrologic retention, nutrient and sediment trapping, spawning, nesting, and nursery habitats, and other habitat needs of fish and wildlife. Fish, wildlife, and plant communities and their habitats are protected and conserved. Wetlands in hydrologically modified environments are maintained and improved. All currently listed wetland wildlife species have self-sustaining, non-endangered population levels.

Lakes, streams, rivers, wetlands, and connecting channels are conserved or restored to ensure their connectivity to floodplains. Intact stream corridors sustain native and migratory fishes, other aquatic biota, and wildlife. Barrier-free access to cold and warm water tributary spawning and nursery habitats is sufficient to sustain migratory fishes. Rivers and streams are adequately buffered to reduce sedimentation and nutrient inflow. Islands with native vegetation support nesting populations of native seabird, waterbird, and shorebird species.

Recommendations

The Strategy Team notes that the funding levels in these recommendations address only the first five years of implementation and that long-term, sustained funding is required that could total more than five times the short-term recommendation.

Issue 1.1: Barriers in Rivers and Streams Short-term (5-year) Need: $62,100,000

Hundreds of rivers and streams have manmade barriers—undersized and improperly installed culverts and unneeded dams—that block fish from their spawning grounds and that impair the health of the ecosystem.

Priority Action 1.1.1: Improve stream flow at road crossings (culverts & bridges).

Priority Action 1.1.2: Remove unneeded dams or install fish passage.

Key Outcomes:

- An increase in forage fish, which spend part of their time in rivers and estuaries, will help the recovery of striped bass, cod, and other fish stocks of economic and recreational importance.
- Imperiled species such as Atlantic salmon and rainbow smelt will be able to reach their historical spawning places in rivers.
- Physical processes are restored to rivers and streams, which are critical in the development and sustenance of key habitats.

Issue 1.2: Degraded Habitats Short-term (5-year) Need: $84,487,500

Vital coastal habitats—salt marshes, seagrass beds, shellfish beds, islands, and

estuaries—have been degraded by centuries of coastal development. Methods are available for restoring these habitats to a healthy condition, but budgetary constraints have limited the number of sites that have been restored.
Priority Action 1.2.1: Assess and restore degraded habitat by removing dredge spoils, planting vegetation, removing tidal restrictions, and other methods.
Priority Action 1.2.2: Hydrologic assessment, remote sensing, mapping, and restoration.
Key Outcomes:

- The economy will be strengthened as many habitat restoration projects are ready to be implemented and will employ workers such as heavy equipment operators, scientific technicians, and others. The fishing industry will benefit because many fish species rely on these habitats for food, shelter, and nurseries.
- Wildlife populations will benefit from healthy native habitats.
- The ecosystem's overall health will improve and become more resilient to climate change and other stressors.

Issue 1.3: Decline of Shoreland Habitats Short-term (5-year) Need: $47,000,000
Healthy shorelands are essential for the survival of many species of birds, fish, and wildlife, and key areas of coastal land must be protected to sustain ecosystem health.
Priority Action 1.3.1: Prioritize, acquire, and protect key parcels of coastal land.
Key Outcome:

- Fish stocks, birds, mammals, and other wildlife that play important roles in the Gulf of Maine ecosystem will recover and be sustained because they will have suitable habitat on coastal lands and in shallow waters.

Note regarding Issue 1.3: Members of the Strategy Team are mindful that a complementary initiative, the Blue Ribbon Commission on Land Conservation, in its 2010 Report to the Governors *[of New England] (http://efc.muskie.usm.maine.edu/docs/2010_clc_report.pdf) identified hundreds of millions of dollars that need to be invested by Congress in a variety of regional and national programs that would conserve critical habitat lands in the Gulf of Maine states. To avoid duplication of effort, the Commission's report is included by reference in this Plan, and its recommendations are in addition to the funds herein identified.*

Issue 1.4: Lost Fishing Gear Short-term (5-year) Need: $2,850,000
Vast numbers of lost and discarded fishing nets and lobster traps have accumulated in the Gulf of Maine. They continue to "ghost fish," needlessly catching fish and lobster, and they maim or kill whales, seals, dolphins, and sea turtles. Some ghost gear ends up on shores and beaches, creating an unsightly and dangerous nuisance. Ghost gear often gets concentrated by ocean currents and creates costly hazards for commercial fishing
Priority Action 1.4.1: Locate and remove ghost fishing gear and lobster traps.
Key Outcomes:

- Fish and lobster stocks will have more opportunity to increase when this cause of mortality is reduced, supporting greater yields for commercial fishing.
- Whales, dolphins, and sea turtles will be protected from this cause of injury and mortality.
- Shores and beaches will be cleaner and safer.

Issue 1.5: Habitat Mapping Short-term (5-year) Need: $21,550,000

Little information is available about where different habitats are located on the seafloor. This information is critical for resource management and restoration. Technologies such as multibeam sonar exist for mapping seafloor habitats, but only a small part of the Gulf of Maine has been habitat-mapped because of insufficient funding.

Priority Action 1.5.1: Conduct mapping of seafloor habitats in the Gulf of Maine and make the maps available for resource management and restoration.

Key Outcome:

- Resource managers and stakeholders will use seafloor habitat maps to improve decision-making in many aspects of protecting and restoring the Gulf of Maine, leading to a healthy ecosystem and economy.

Issue 1.6: Monitoring Fish and Wildlife Populations Short-term (5-year) Need: $49,525,000

Monitoring the size of the region's populations of fish and wildlife is necessary in order to know if they are increasing or decreasing, and to determine if management actions intended to restore them are effective. Currently, little monitoring happens due to insufficient funding.

Priority Action 1.6.1: Implement a regional, coordinated monitoring program for species of interest for management and restoration. Integrate the results into adaptive management processes.

Key Outcome:

- Monitoring will allow faster, stronger recovery of fish and wildlife through adaptive management.

Total Short-Term (5-Year) Need for Goal 1: $267,512,500

Goal 2: Provide Clean and Healthy Coastal Waters

Problem Statement

The health of ocean and coastal waters is determined, for the most part, by levels of dissolved oxygen, nutrients, bacteria, and toxic pollutants, as well as habitat quality and the health of the biological community. Assessments of these parameters help to determine whether waters can support a full and diverse range of marine life and a full range of human uses (recreational and commercial).

When dissolved oxygen levels fall below a certain threshold (which varies for each plant and animal species), marine life will die. Nutrients such as nitrogen can overstimulate the growth of aquatic plants, causing algal blooms that then die, depleting oxygen levels and killing off other species. Bacteria are a natural component of estuarine and marine food chains, but human sewage can contain pathogenic (*i.e.,* disease-causing) bacteria and viruses that pose a risk to public health from contact (swimming) or by consuming seafood. Bacteria-laden stormwater routinely prompts closure of shellfish beds and swimming beaches. Approximately 25 percent of Casco Bay, Maine, for example is typically closed to shellfish harvesting.

Streams and rivers that feed into the Gulf of Maine carry far more than fresh water. They contain polluted sediments and organic matter that react chemically with salt water and settle to the seabed. Toxic contamination from point sources such as industrial and sewage treatment plant discharges has declined in the past three decades, but the Gulf of Maine continues to receive extensive contamination from non-point sources such as stormwater runoff. Unhealthy levels of toxic contaminants found in fish and wildlife tissues demonstrate an environmental legacy of past pollution and also that atmospheric deposition of pollutants and disposal of pharmaceuticals and personal care products is an ongoing cause for concern.

Long-Term Goal

After implementation of the Priority Actions:

> The rivers, lakes, and coastal and ocean waters of the Gulf of Maine and its watershed have healthy water quality without human-caused impairments. Municipal wastewater and stormwater treatment systems are upgraded, and their capacity is sufficient to handle projected needs. Septic systems within the region are upgraded and functioning properly, or are connected to municipal systems. Non-point sources of pollution (e.g., agricultural, urban runoff, marinas, and vessel waste streams) are abated. The majority of potential contaminants are evaluated and addressed such as personal care products and pharmaceuticals (PCPP). No-discharge zones have been designated in coastal waters, and adequate facilities are available for safe discharge and treatment of sewage from ships and vessels in harbors and nearshore waters.

Recommendations

The Strategy Team notes that the funding levels in these recommendations address only

the first five years of implementation and that long-term, sustained funding is required that could total more than five times the short-term recommendation.

Issue 2.1: Outdated Sewage Treatment Facilities Short-term (5-year) Need: $2,744,011,000

Many municipalities and industrial facilities use outdated sewage treatment facilities that release effluent into coastal waters where people swim and harvest seafood. It will take several decades to modernize the existing sewage treatment facilities, unless significant additional funding becomes available.

Priority Action 2.1.1: Upgrade municipal and industrial sewage treatment systems and combined sewer overflow systems to meet ecologically appropriate standards, including nutrient standards.

Key Outcomes:

- Risks to human health will be reduced.
- Commercial shellfish harvesters, recreational harvesters, restaurants, and tourist destinations will benefit economically as better water quality means fewer closures of shellfish beds.
- Fewer beaches will be closed.
- Tourism-related businesses will not suffer the economic impacts associated with poor water quality.
- Fish and wildlife will become more robust with greater potential to increase their numbers, providing benefits for commercial and recreational fishermen.
- Marine species and ecosystems may be more resilient to climate change and other stressors. Healthy water quality produces healthy habitat (salt marshes, seagrass beds, beaches, rivers).

Issue 2.2: Non-Point Source Pollution Short-term (5-year) Need: $140,430,000

Rainwater and snowmelt carry many pollutants—pesticides, petroleum products, fertilizers, and more—from land into rivers and the ocean. This process is called non-point source pollution because it does not come from a clearly identifiable point such as a sewage pipe. Non-point source pollution is a major cause of water pollution in the Gulf of Maine, but existing funding falls far short of addressing this challenging and expensive problem.

Priority Action 2.2.1: Locate, prioritize, resolve, and prevent causes of non-point source pollution through an integrated program of data collection, mitigation projects, and proactive management practices.

Priority Action 2.2.2: Reduce the impact of stormwater by upgrading stormwater systems and by identifying, correcting, and preventing stormwater sources.

Key Outcomes:

- Risks to human health will be reduced.
- Commercial shellfish harvesters, recreational harvesters, restaurants, and tourist destinations will benefit economically as better water quality means fewer closures of shellfish beds.
- Fewer beaches will be closed.
- Tourism-related businesses will not suffer the economic impacts associated with poor water quality.

- Fish and wildlife will become more robust with greater potential to increase their numbers, providing benefits for commercial and recreational fishermen.
- Marine species and ecosystems may be more resilient to climate change and other stressors. Healthy water quality produces healthy habitat (salt marshes, seagrass beds, beaches, rivers).

Issue 2.3: Pollution Discharge from Vessels Short-term (5-year) Need: $3,060,000

Many boats and ships discharge their wastewater, solid waste, and oil directly into the ocean instead of storing or treating the pollutants. Most ports and harbors do not have facilities to receive sewage and other waste streams from vessels.

Priority Action 2.3.1: Designate no-discharge zones in the ocean and provide port facilities for boats and ships to dispose all of their waste streams (wastewater, solid waste, oil).

Key Outcomes:

- Risks to human health will be reduced.
- Commercial shellfish harvesters, recreational harvesters, restaurants, and tourist destinations will benefit economically as better water quality means fewer closures of shellfish beds.
- Fewer beaches will be closed.
- Tourism-related businesses will not suffer the economic impacts associated with poor water quality.
- Fish and wildlife will become more robust with greater potential to increase their numbers, providing benefits for commercial and recreational fishermen.
- Marine species and ecosystems may be more resilient to climate change and other stressors. Healthy water quality produces healthy habitat (salt marshes, seagrass beds, beaches, rivers).

Issue 2.4: Toxic Sediment Short-term (5-year) Need: $11,500,000

Toxic substances—some of which have been banned for decades—persist in seafloor sediments and riverbeds throughout the region, presenting a health risk to people and wildlife.

Priority Action 2.4.1: Remediate contaminated sediment at priority sites in coastal waters and rivers.

Key Outcomes:

- Risks to human health will be reduced.
- Fish and wildlife will become more robust with greater potential to increase their numbers, providing benefits for commercial and recreational fishermen.
- Marine species and ecosystems may be more resilient to climate change and other stressors.

Issue 2.5: Water Testing Short-term (5-year) Need: $30,625,000

Water quality testing throughout the region is conducted to identify places with elevated levels of bacteria; to locate sources of pollution; and to evaluate pollution-control programs. Existing water quality testing is insufficient in geographic scope and frequency to provide the necessary information. In addition, new types of pollution are emerging as

concerns (e.g., prescription drugs and pharmaceuticals), but existing water quality testing programs are unable to monitor these substances. Toxic red tides are becoming more frequent and intense, making it necessary to conduct more water quality testing.

Priority Action 2.5.1: Expand the frequency and geographic coverage of water testing and implement state-of-the-art monitoring protocols.

Key Outcomes:

- Human health will improve.
- Commercial shellfish harvesters, recreational harvesters, restaurants, and tourist destinations will benefit economically as better water quality means fewer closures of shellfish beds.
- Fewer beaches will be closed.
- Tourism-related businesses will not suffer the economic impacts associated with poor water quality.
- Fish and wildlife will become more robust with greater potential to increase their numbers, providing benefits for commercial and recreational fishermen.
- Marine species and ecosystems may be more resilient to climate change and other stressors. Healthy water quality produces healthy habitat (salt marshes, seagrass beds, beaches, rivers).

Total Short-Term (5-Year) Need for Goal 2: $2,929,626,000

Goal 3: Provide Science, Planning, and Communication Required for Regional Ocean Management, Marine Spatial Planning, and Ecosystem-Based Management

Problem Statement

Scientific investigations, planning, and implementation of habitat restoration and protection in the Gulf of Maine are conducted by multiple organizations at different scales and times. However, communication and coordination among organizations is limited and uneven across the states, subregionally, and at the local level. This has important consequences because coastal and marine habitats throughout the Gulf of Maine are linked in a regional-scale ecosystem, which demands a cohesive regional approach to management. The following are consequences of this fragmentation of science, planning, and communication:

- Existing habitat restoration, conservation, and management actions are often not integrated among management sectors and geographies, reducing their combined effectiveness.
- Absence of a Gulf-wide habitat monitoring program and a complete set of ecosystem health indicators prevents us from knowing about changes in the ecosystem, understanding the causes and evaluating the effects of management, restoration, and conservation efforts.
- Existing scientific information and knowledge are underutilized due to insufficient communication of policy- and management-relevant science.
- Numerous aspects of the coastal and marine environment remain unexamined by science, and their implications and interactions are little understood.
- Conflicts among uses of the Gulf's waters (e.g., fishing, recreation, ocean energy, shipping) are accelerating and often span multiple jurisdictions.
- Habitat restoration and land conservation efforts are often opportunistic and lack accepted protocols enabling consistency of approaches.
- Among the public and decision-makers, full appreciation of the region's restoration and conservation challenges is uneven, as is the value of conserving and restoring the coastal resources of the Gulf of Maine and the benefits of these activities to coastal communities.
- Messages about habitat restoration and land conservation are inconsistent and sometimes confusing, potentially reducing the eventual impact of these efforts.

To restore and protect its valuable ecosystem and to sustain its economy, the Gulf of Maine region requires expanded capacity for management-relevant science, integrated planning, and communication. Such capacity is essential for all Goals and Priority Actions in this document, and it is featured in the Executive Order signed by President Obama on July 19, 2010 establishing a National Policy for the Stewardship of the Ocean, Coasts, and Great Lakes. The U.S. Commission on Ocean Policy (2004) and the Pew Oceans Commission (2003) also emphasize the need for integration, coordination, and communication in order to advance regional-scale ocean and coastal management. These capacities lie at the heart of ecosystem-based management, marine spatial planning, and regional ocean governance, as outlined in the Executive Order. The Priority Actions of

Goal 3 address these needs and are required for the Priority Actions to have an impact greater than the sum of their parts.

Long-Term Goal

Following implementation of the Priority Actions:

> The Gulf of Maine ecosystem is vibrant, healthy, and resilient to climate change. A sufficient amount of each habitat is in good condition and capable of fulfilling its natural role in generating ecosystem services that people need and want. People who live and work around the Gulf of Maine find that management of this shared marine resource reflects and is responsive to their values and needs. People engaged in planning and conservation for the Gulf of Maine have easy access to data and information that they need for regional ocean management. They have a network of other stakeholders with whom they can interact to share ideas, information, and viewpoints.

Recommendations

The Strategy Team notes that the funding levels in these recommendations address only the first five years of implementation and that long-term, sustained funding is required that could total more than five times the short-term recommendation.

Issue 3.1: Regional Integration of Habitat Restoration, Conservation, and Management Actions Short-term (5-year) Need: $16,500,000

Existing habitat restoration, conservation, and management actions are often not integrated among management sectors and geographies, reducing their combined effectiveness.

Priority Action 3.1.1: Conduct a regional planning process for implementation of the Priority Actions that (a) engages diverse stakeholders and decision-makers, (b) accurately reflects their values and priorities, (c) integrates across management sectors and geographies, and (d) is based on sound science.

Key Outcome:

- An integrated, comprehensive regional implementation plan for restoring and managing the Gulf of Maine is developed to strengthen the regional economy, restore and sustain the health of ecosystem, and reflect the values and meet the socioeconomic needs of the people who live and work around the Gulf of Maine. The Priority Actions provide a regional framework for action toward the Goals. Implementation will seek to generate the greatest possible net long-term benefit to society from the ecological services provided by the Gulf of Maine.

Issue 3.2: Analysis of Ecosystem Changes Short-term (5-year) Need: $1,750,000

The absence of a Gulf-wide habitat-monitoring program and a set of ecosystem health indicators prevents people from knowing about changes in the ecosystem, understanding the causes, and evaluating the effects of management, restoration, and conservation efforts.

Priority Action 3.2.1: Fully implement the Habitat Monitoring Partnership, the

Ecosystem Indicator Partnership, and a socioeconomic monitoring program to provide essential information for adaptive management.

Key Outcome:

- Critical information will be available for sustainable use and adaptive management of the Gulf of Maine.

Issue 3.3: Communication of Policy- and Management-Relevant Science Short-term (5-year) Need: $3,400,000

Existing scientific information and knowledge are underutilized due to insufficient communication of policy- and management-relevant science in salient, credible, and user-friendly forms. People with a professional or personal interest in the region's ocean issues have no way to engage with each other to become informed and pursue solutions.

Priority Action 3.3.1: Establish a regional communications program that provides (a) educational and outreach opportunities and materials to increase public and decision-maker understanding of coastal resources (e.g, findings from regional habitat monitoring programs and ecosystem indicators), the economic values associated with restoration and conservation, and scientifically sound methods for restoring and sustaining the Gulf of Maine, and (b) a mechanism for stakeholders and decision-makers involved in regional planning to interact meaningfully on an ongoing basis.

Key Outcome:

- Managers, policy makers, and stakeholders will have the information they need to make well-informed decisions on the use and management of the Gulf of Maine, and they will have a mechanism to share information and viewpoints with other people across sectoral and geographic boundaries.

Issue 3.4: Data and Decision Support for Ecosystem-Based Management and Marine Spatial Planning Short-term (5-year) Need: $4,300,000

Competing uses and values of the marine environment (e.g., fishing, ocean energy, shipping, recreation) and cumulative ecological impacts are accelerating and often span multiple jurisdictions. The national ocean policy signed by President Obama in 2010 calls for implementation of ecosystem-based management (EBM) and marine spatial planning (MSP) as frameworks for addressing cumulative impacts and conflicts among uses. EBM and MSP both require access to large amounts of diverse data on a regional scale and tools for using the data to support decision-making.

Priority Action 3.4.1: Develop an integrated, regional data management network that is robust with searchable metadata, user friendly, and interoperable with existing state, federal, and non-government data management investments.

Key Outcome:

- Implementation of ecosystem-based management and coastal and marine spatial planning will be timely, efficient, and based on the best available information, leading to reduction in conflicts among ocean uses and deleterious cumulative impacts.

Issue 3.5: Oversight, Coordination, and Evaluation of Regional Priority Actions Short-term (5-year) Need: $3,750,000

Implementation of restoration and conservation at the regional scale requires oversight,

coordination, and evaluation. There is no mechanism currently in place to serve these functions.

Priority Action 3.5.1: Establish a program office or other administrative framework and designate personnel for managing, coordinating, and evaluating the regional initiative.

Key Outcome:

- The regional initiative for restoration and conservation of the Gulf of Maine will be implemented effectively and produce successful, measurable outcomes.

Total Short-Term (5-Year) Need for Goal 3: $29,700,000

Goal 4: Promote Resilience to Climate Change

Problem Statement

Climate change already affects the Gulf of Maine and its watershed, and its influence will continue to grow. All aspects of marine and coastal management must now be viewed as occurring in the context of a changing climate.

Experts predict that during the next hundred years, sea surface temperature in the Gulf of Maine will rise 1.1°C (2°F) to 3.3°C (6°F), and sea level will rise at rates of ~17.8 mm (0.7 in) to 58.4 mm (2.3 in) per year, depending on season, location, and emission levels (Frumhoff et al. 2007).

Anticipated responses of marine and coastal ecosystems to climate change will have serious implications for those living on or near the coast (Frumhoff et al. 2007). For the Gulf of Maine, changes in ocean currents, melting of sea ice, freshwater runoff, acidification, and nutrient distributions are likely to affect fisheries, particularly cod, lobsters, and Georges Bank scallops and groundfish; coastal development and infrastructure; harmful algal blooms; non-native species invasions; and the rate of spread of pathogens and diseases (Fisher et al. 2008; Frumhoff et al. 2007; Trenberth 2005; Wake et al. 2006).

By the end of the century, predicted changes to the ocean and coasts due to climate change will influence economic development, human uses of the ocean, and biological diversity of the seas. The challenge for policy makers is to understand and manage around uncertainties related to climate change and its impacts.

The *Plan* focuses primarily on the need for regional action to prepare for and mitigate the impacts of climate change, rather than on addressing the cause of climate change. The Priority Actions will provide the ecosystem and economy with resilience to climate change and reduce negative impacts.

Long-Term Goal

Following implementation of Priority Actions:

> People have a strong base of information about the impacts of climate change on habitats in the Gulf of Maine. A science-based plan developed with broad participation of decision-makers and stakeholders guides coordinated regional efforts to adapt and promote resilience to climate change. Interactive decision support systems help people to use accurate information to understand possible future scenarios and to weigh tradeoffs among management alternatives. Erosion of coastal habitats due to sea level rise is mitigated and priority habitats, such as bird nesting areas of dunes, are restored. As sea level rises, salt marshes are able to migrate into higher land areas, which have been protected for this purpose, and continue to perform their valuable ecological functions, particularly in support of fish

stocks.

Recommendations

The Strategy Team notes that the funding levels in these recommendations address only the first five years of implementation and that long-term, sustained funding is required that could total more than five times the short-term recommendation.

Issue 4.1: Understanding Impacts of Climate Change on Habitats Short-term (5-year) Need: $8,500,000

Planning for and adapting to climate change requires accurate, reliable information about climate change impacts on ocean and coastal resources, but little of this information is available and no mechanism exists for providing it.

Priority Action 4.1.1: Establish a regional scientific program that monitors and assesses climate change impacts on habitats.

Key Outcome:

- Critical information will be provided for ocean and coastal management and policy in the context of climate change.

Issue 4.2 Preparing for Climate Change Short-term (5-year) Need: $5,000,000

Coordinated regional analysis and planning are required to prepare for and respond to the impacts of climate change on habitats. Existing efforts do not have the necessary capacity.

Priority Action 4.2.1: Facilitate a regional climate-smart planning initiative for promoting habitat resilience and adaptation.

Key Outcome:

Organizations in the region carry out integrated, coordinated actions that increase the resilience and adaptation of habitats to climate change. These actions sustain the ecosystem's capacity to provide ecologically and socioeconomically important services.

Issue 4.3 Mitigate Erosion of Shoreline Habitats Short-term (5-year) Need: $7,800,000

Rapidly increasing sea level and increased storm activity are leading to significant erosion of beaches, dunes, and other shoreline habitats.

Priority Action 4.3.1: Mitigate erosion and restore dune habitats.

Key Outcome:

- Dunes and other shoreline habitats will continue to provide habitat for species such as nesting shorebirds.

Issue 4.4 Sea Level Rise and Salt Marshes Short-term (5-year) Need: $12,500,000

Salt marshes are extraordinarily rich and productive habitats. They serve as nurseries for young fish, filter pollutants from the water, protect uplands from storm surge, and provide food and shelter for birds and wildlife. However, many salt marshes will drown under rising seas unless there is higher land next to them into which they can migrate.

Priority Action 4.4.1: Identify and prioritize suitable areas of adjacent uplands as buffers for marsh migration; acquire and/or protect priority sites.

Key Outcome:

- Salt marshes will continue to fulfill their vital roles in providing ecosystem

health and socioeconomic benefits.

Total Short-Term (5-Year) Need for Goal 4: $33,800,000

Goal 5: Prevent and Detect Invasive Species, and Restore Affected Habitats

Problem Statement

Marine habitats in the Gulf of Maine support an ever-growing suite of marine invasive species, defined as non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health (ISAC 2006). Invading marine species were first introduced to the northwest Atlantic region by early explorers, either purposely for food sources or accidentally through fouling on the hulls of wooden ships and other means. In modern times, there are a wide variety of transfer mechanisms (vectors) available for hitchhiking marine invaders to travel and spread. At least 64 invasions have occurred in the Gulf of Maine ecosystem, and more are likely to be discovered. Pressures such as habitat modification, aquaculture, shipping, and climate change will continue to have unintended impacts on the system and further influence the survival of non-native species.

Impacts from marine invasive species in the Gulf of Maine include loss of native species, changes in ecosystem function and ecological services, negative effects on fish stocks, and fouling of infrastructure and fishing gear. Management of invading species in the marine environment is a relatively new endeavor. Current responses are moving toward a more effective management approach that includes a focus on early detection, rapid response, research, and education. The following Priority Actions will help to understand the impacts of marine invasive species and to protect the Gulf of Maine ecosystem and economy.

Long-Term Goal

Following implementation of the Priority Actions:

> Invasive animals and plants in the Gulf of Maine are monitored closely, and up-to-date information about their presence, abundance, impacts, and distribution is readily available. New populations are detected soon after they appear, and rapid-response teams control the new invaders before they become established. Courtesy inspections at boat launch sites help prevent the further spread of invaders that are already established in the region.

Recommendations

The Strategy Team notes that the funding levels in these recommendations address only the first five years of implementation and that long-term, sustained funding is required that could total more than five times the short-term recommendation.

Issue 5.1 Early Detection of Invasive Species Short-term (5-year) Need: $4,960,000

Detecting the arrival of invasive species and removing them before they become established is one of the most effective and least costly lines of defense, but the region does not yet have an invasive-species monitoring program that is capable of early detection.

Priority Action 5.1.1: Establish a comprehensive monitoring program in the Gulf of Maine and its watershed with the capacity to detect invasive species soon after their arrival and to disseminate the information to rapid-response teams.
Key Outcome:

- Invading species will be discovered early, and information about their presence will be provided to rapid-response teams.

Issue 5.2 Removal and Prevention of Invasive Species Short-term (5-year) Need: $2,510,000
Speedy, targeted action is necessary to stop the spread of invasive species after they arrive.
Priority Action 5.2.1: Establish a regional network of rapid-response teams that control populations of invasive species immediately after detection.
Key Outcome:

- Economic and ecological impacts will be minimized as newly arrived invasive species are eliminated and established populations are contained to prevent further spread.

Issue 5.3 Restoration of Habitats Degraded by Invasive Species Short-term (5-year) Need: $1,400,000
Invasive species are already established in many wetlands and other habitats, causing major ecological and economic impacts. Although proven methods are available to restore these habitats, restoration efforts have been constrained by funding.
Priority Action 5.3.1: Identify, prioritize, and restore habitats adversely affected by invasive species.
Key Outcome:

- Salt marshes and other vital habitats will be restored to health, enabling them to serve their natural roles as fish nurseries, buffers against storm surge, and other valuable functions.

Total Short-Term (5-Year) Need for Goal 5: $8,870,000

Conclusion

Implementation of the *U.S. Gulf of Maine Habitat Restoration and Conservation Plan* will provide immediate and long-term benefits. The Priority Actions will rebuild and maintain the capacity of the Gulf of Maine to provide the ecosystem services and functions for which it has been renowned for hundreds of years. Investing in the natural capital of coastal habitats will strengthen people's health and wellbeing, create thousands of direct jobs in the near term, and build economic stability for the future.

TOTAL SHORT-TERM (5-YEAR) NEED FOR ALL GOALS 1-5: $ 3,269,508,500

Appendix:
Short-Term (5-Year) Needs for Goals, Issues, and Priority Actions

Goal	Issue	Priority Action	Short-Term Need (5 years)
1: PROTECT AND RESTORE WILDLIFE HABITAT AND POPULATIONS			**267,512,500**
	1.1: Barriers in Rivers and Streams		62,100,000
		1.1.1: Improve streamflow at road crossings (culverts & bridges).	14,500,000
		1.1.2: Remove unneeded dams or install fish passage.	47,600,000
	1.2: Degraded Coastal Habitats		84,487,500
		1.2.1: Assess and restore degraded habitat by removing dredge spoils, planting vegetation, removing tidal restrictions, and other methods.	42,750,000
		1.2.2: Hydrologic assessment, remote sensing, mapping, and restoration.	41,737,500
	1.3: Decline of Shoreland Habitats		47,000,000
		1.3.1: Prioritize, acquire, and protect key parcels of coastal land.	47,000,000
	1.4: Lost Fishing Gear		2,850,000
		1.4.1: Locate and remove ghost fishing gear and lobster traps.	2,850,000
	1.5: Habitat Mapping		21,550,000
		1.5.1: Conduct mapping of seafloor habitats in the Gulf of Maine and make the maps available for resource management and restoration.	21,550,000
	1.6: Monitoring Fish and Wildlife Populations		49,525,000
		1.6.1: Implement a regional, coordinated monitoring program for species of interest for management and restoration. Integrate the results into adaptive management processes.	49,525,000
GOAL 2: PROVIDE CLEAN AND HEALTHY COASTAL WATERS			**2,929,626,000**
	2.1: Outdated Sewage Treatment Facilities		2,744,011,000
		2.1.1: Upgrade municipal and industrial sewage treatment systems and combined sewer overflow systems to meet ecologically appropriate standards, including nutrient standards.	2,744,011,000
	2.2: Non-Point Source Pollution		140,430,000
		2.2.1: Locate, prioritize, resolve, and prevent causes of non-point source pollution through an integrated program of data collection, mitigation projects, and proactive management practices.	96,510,000
		2.2.2: Reduce the impact of stormwater by upgrading stormwater systems and by identifying, correcting, and preventing stormwater sources.	43,920,000
	2.3: Pollution Discharge from Vessels		3,060,000
		2.3.1: Designate no-discharge zones in the ocean and provide port facilities for boats and ships to dispose all of their waste streams (wastewater, solid waste, oil).	3,060,000
	2.4: Toxic Sediment		11,500,000
		2.4.1: Remediate contaminated sediment at priority sites in coastal waters and rivers.	11,500,000
	2.5: Water Testing		30,625,000
		2.5.1: Expand the frequency and geographic coverage of water testing and implement state-of-the-art monitoring protocols.	30,625,000
GOAL 3: PROVIDE SCIENCE, PLANNING, AND COMMUNICATION REQUIRED FOR REGIONAL OCEAN MANAGEMENT, MARINE SPATIAL PLANNING, AND ECOSYSTEM-BASED MANAGEMENT			**29,700,000**
	3.1: Regional Integration of Habitat Restoration, Conservation, and Management Actions		16,500,000
		3.1.1: Conduct a regional planning process for implementation of the Priority Actions that (a) engages diverse stakeholders and decision-makers, (b) accurately reflects their values and priorities, (c) integrates across management sectors and geographies, and (d) is based on sound science.	16,500,000
	3.2: Analysis of Ecosystem Changes		1,750,000
		3.2.1: Fully implement the Habitat Monitoring Partnership, the Ecosystem Indicator Partnership, and a socioeconomic monitoring program to provide essential information for adaptive management.	1,750,000
	3.3: Communication of Policy- and Management-Relevant Science		3,400,000
		3.3.1: Establish a regional communications program that provides (a) educational and outreach opportunities and materials to increase public and decision-maker understanding of coastal resources (e.g, findings from regional habitat monitoring programs and ecosystem indicators), the economic values associated with restoration and conservation, and scientifically sound methods for restoring and sustaining the Gulf of Maine, and (b) a mechanism for stakeholders and decision-makers involved in regional planning to interact meaningfully on an ongoing basis.	3,400,000
	3.4: Data and Decision Support for Ecosystem-Based Management and Marine Spatial Planning		4,300,000
		3.4.1: Develop an integrated, regional data management network that is robust with searchable metadata, user friendly, and interoperable with existing state, federal, and non-government data management investments.	4,300,000
	3.5: Oversight, Coordination, and Evaluation of Regional Priority Actions		3,750,000
		3.5.1: Establish a program office or other administrative framework and designate personnel for managing, coordinating, and evaluating the regional initiative.	3,750,000
GOAL 4: PROMOTE RESILIENCE TO CLIMATE CHANGE			**33,800,000**
	4.1: Understanding Impacts of Climate Change on Habitats		8,500,000
		4.1.1: Establish a regional scientific program that monitors and assesses climate change impacts on habitats.	8,500,000
	4.2: Preparing for Climate Change		5,000,000
		4.2.1: Facilitate a regional climate-smart planning initiative for promoting habitat resilience and adaptation.	5,000,000
	4.3: Mitigate Erosion of Shoreline Habitats		7,800,000
		4.3.1: Mitigate erosion and restore dune habitats.	7,800,000
	4.4: Assess and Mitigate Impact of Sea Level Rise on Salt Marshes		12,500,000
		4.4.1: Identify and prioritize suitable areas of adjacent uplands as buffers for marsh migration; acquire and/or protect priority sites.	12,500,000
GOAL 5: PREVENT AND DETECT INVASIVE SPECIES, AND RESTORE AFFECTED HABITATS			**8,870,000**
	5.1: Early Detection of Invasive Species		4,960,000
		5.1.1: Establish a comprehensive monitoring program in the Gulf of Maine and its watershed with the capacity to detect invasive species soon after their arrival and to disseminate the information to rapid-response teams.	4,960,000
	5.2: Removal and Prevention of Invasive Species		2,510,000
		5.2.1: Establish a regional network of rapid-response teams that control populations of invasive species immediately after detection.	2,510,000
	5.3: Restoration of Habitats Degraded by Invasive Species		1,400,000
		5.3.1: Identify, prioritize, and restore habitats adversely affected by invasive species.	1,400,000

OVERALL TOTAL (GOALS 1-5):	**3,269,508,500**