

Woods Hole Oceanographic Institution Sea Grant 2028-2031 Strategic Plan: Science-Based Solutions for Massachusetts' Coastal Communities



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1. Introduction

Massachusetts is one of the nation's smallest states by land area (7,801 square miles) but among the most densely populated, with more than 7.1 million residents. More than three-quarters of the Commonwealth's population lives in coastal counties, placing increasing demands on coastal watersheds, ecosystems, infrastructure, and natural resources. The Commonwealth's 1,980 miles of shoreline encompass extensive salt marshes, tidal flats, barrier beaches, dunes, estuaries, and coastal wetlands that support diverse habitats while providing critical economic, recreational, and cultural benefits.

Massachusetts' coastal and marine economy is a major contributor to the state's prosperity. According to NOAA's Open Economics: National Ocean Watch (ENOW) data, the Commonwealth's blue economy expanded to support more than 90,000 jobs, generate approximately \$4.6 billion in wages, and contribute over \$9.1 billion to the state's gross domestic product (GDP) in 2024 (NOAA Office for Coastal Management, 2024). Tourism and recreation account for the largest share of marine employment, while commercial and recreational fisheries, aquaculture, marine transportation, marine technology, scientific research, and coastal construction all contribute substantially to the state's economy. Maintaining the long-term vitality of these sectors, along with the homes, working waterfronts, and coastal communities connected to them, depends on healthy coastal ecosystems, sustainable resource management, technological innovation, and a well-prepared workforce.

The protection and sustainable use of Massachusetts' coastal resources require informed planning and science-based decision making across all levels of government and society. Coastal decisions are made by municipal officials, natural resource managers, businesses, nonprofit organizations, and residents. Many of these parties must balance environmental protection, economic development, public access, infrastructure, and competing resource uses in their decision-making. Massachusetts' long tradition of municipal "home rule" places significant responsibility for coastal management at the local level, making access to credible scientific information, technical expertise, and effective outreach essential for informed decision making.

Massachusetts is served by two Sea Grant College Program programs: MIT Sea Grant and Woods Hole Oceanographic Institution (WHOI) Sea Grant. Through its research, extension, education, and communications programs, WHOI Sea Grant primarily serves southeastern Massachusetts—including Cape Cod, Martha's Vineyard, Nantucket, the South Shore, and the South Coast—while supporting research and partnerships that benefit coastal communities throughout the Commonwealth. This region is home to nationally recognized marine science institutions and supports a wide-ranging coastal economy based on fisheries, aquaculture, tourism, marine technology, maritime transportation, and scientific research. Working in partnership with universities, state and federal

agencies, municipalities, industry, nonprofit organizations, and coastal communities, WHOI Sea Grant translates scientific knowledge into practical solutions that strengthen environmental stewardship, economic vitality, and community resilience.

Many of the challenges facing Massachusetts are shared by coastal regions throughout the United States, including maintaining healthy coastal ecosystems, sustaining working waterfronts and fisheries, supporting resilient communities, preparing a skilled workforce, and balancing economic development with environmental stewardship. Massachusetts continues to advance these efforts through state-level frameworks, including the ResilientMass Plan and the ongoing Massachusetts Ocean Management Plan review process (Commonwealth of Massachusetts, 2023). WHOI Sea Grant's strategic priorities complement these localized efforts while supporting the National Sea Grant College Program's mission of developing and applying science-based solutions to the nation's coastal challenges.

This strategic plan identifies four integrated focus areas that will guide WHOI Sea Grant's investments over the next four years: Environmental Literacy and Workforce Development; Healthy Coastal Ecosystems; Sustainable Fisheries and Aquaculture; and Resilient Coastal Communities and Economies. These pillars serve as a unified framework to advance coastal science, empower local communities, and protect the Commonwealth's vital marine economy.

2. Vision

WHOI Sea Grant envisions healthy coastal ecosystems, resilient communities, and sustainable coastal economies supported by science-based decision making, environmental stewardship, and an informed and engaged public.

3. Mission

WHOI Sea Grant's mission is to enhance the practical use and conservation of coastal and marine resources by supporting research, education, extension, and communications that develop and apply science-based knowledge for the benefit of Massachusetts communities. We fulfill this mission by:

- Supporting interdisciplinary research that advances understanding of coastal and marine systems and informs resource management
- Translating scientific knowledge into practical information, tools, and technical assistance for coastal decision makers, industries, educators, and communities
- Building environmental literacy and preparing a skilled workforce through formal and informal education, professional development, and public engagement

- Fostering partnerships among academic institutions, government agencies, industry, nonprofit organizations, and coastal communities to address priority coastal challenges

WHOI Sea Grant carries out this mission through a cooperative partnership between Woods Hole Oceanographic Institution and Barnstable County Cape Cod Cooperative Extension, and by working closely with local, state, federal, tribal, academic, industry, and nonprofit partners throughout Massachusetts.

4. Strategic Plan Development

WHOI Sea Grant's 2028–2031 Strategic Plan builds upon the program's previous strategic plan while incorporating new priorities identified through discussions with program staff and members of the Marine Outreach Guidance Group (MOGG). The MOGG represents a broad cross-section of coastal interests, including Tribal nations and representatives, municipal and state resource managers, educators, researchers, industry representatives, communicators, and nonprofit organizations. Their input helped identify emerging issues, evolving community needs, and opportunities where WHOI Sea Grant can provide the greatest benefit to Massachusetts' coastal communities. To address these opportunities, this plan is organized around the four core focus areas, defining specific goals, actions, and desired outcomes that will guide the program's work over the next four years.

5. Regional Sea Grant Coordination

WHOI Sea Grant works collaboratively with Sea Grant programs throughout the Northeast through the Northeast Sea Grant Consortium (NESGC). This collaboration strengthens the region's ability to address shared coastal and marine challenges while allowing individual programs to remain responsive to state priorities. During the 2028–2031 strategic period, NESGC will strengthen communication, identify common thematic areas of importance, facilitate cross-program collaboration, and pursue strategic partnerships that leverage additional resources and expand impact. Regional efforts will enhance the visibility of shared accomplishments, support the exchange of knowledge and best practices across programs, and align with national priorities while preserving each program's flexibility and responsiveness to state needs.

6. Program Focus Areas and Goals

The WHOI Sea Grant Program channels the expertise of scientists, engineers, extension professionals, educators, communicators, and partners to address the research needs and information gaps of coastal communities and marine resource users. Public and private institutions throughout Massachusetts, together with collaborators across the region and nation, contribute to the program's

success. Our program is guided by these core values:

- *Innovation* – We support innovative solutions to address coastal monitoring, resilience planning, and protection of valuable coastal resources.
- *Collaboration* – We seek partnerships that broaden and deepen our reach and complement our strengths, especially within southeastern Massachusetts and throughout the northeastern U.S.
- *Sustainability* – We work with communities to promote the long-term use and protection of natural resources.
- *Accountability* – We conduct all activities with integrity and transparency.
- *Scientific Neutrality* – We provide unbiased information, tools, and services to inform decision making.
- *Responsiveness* – We quickly address emerging issues and evolving community needs.

WHOI Sea Grant advances its mission through four integrated program functions: research, extension, education, and communications. Researchers conduct applied research that responds to community-identified needs and emerging coastal challenges; extension professionals co-develop practical solutions with communities, industries, and resource managers; educators build environmental literacy and workforce capacity; and communications professionals translate scientific findings and program activities into accessible, trusted information that supports informed decision making. The WHOI Sea Grant Extension Program is conducted in partnership with Barnstable County Cape Cod Cooperative Extension, strengthening the program’s ability to work directly with coastal communities, industries, and resource managers throughout southeastern Massachusetts and beyond. Across all four functions, the program emphasizes interdisciplinary collaboration, responsiveness to community needs, and measurable benefits for coastal communities.

WHOI Sea Grant organizes its strategic investments around four interconnected focus areas: Environmental Literacy and Workforce Development; Healthy Coastal Ecosystems; Sustainable Fisheries and Aquaculture; and Resilient Coastal Communities and Economies. Together, these focus areas reflect the highest-priority challenges and opportunities facing Massachusetts’ coastal communities. The specific goals and objectives outlined within each focus area serve to operationalize these priorities, guiding our programmatic activities and partnerships over the next four years.

Environmental Literacy and Workforce Development

WHOI Sea Grant recognizes that environmental literacy is fundamental to the long-term stewardship and sustainable use of coastal and marine resources. Environmental Literacy and Workforce Development supports this mission by integrating research, education, outreach, and communication to build knowledge, inspire stewardship, and prepare the current and future coastal workforce. Our programs engage learners from a wide range of backgrounds and experiences across Massachusetts' coastal communities through partnerships with educators, community organizations, industry, municipalities, and other organizations. Because Environmental Literacy and Workforce Development supports every WHOI Sea Grant focus area, educational and workforce development activities are integrated throughout our research, extension, communications, and community partnerships.

Environmental literacy is woven throughout our programs by sharing science-based information with educators, students, coastal professionals, commercial and recreational fishermen, aquaculture producers, natural resource managers, local officials, and the public to support informed decisions about coastal and marine resources. Our program accomplishes this through professional development and educator workshops for formal and nonformal educators, classroom programs, experiential learning opportunities, public events, conferences, technical trainings, communication products, museum exhibits, and other formal and informal educational activities. These efforts foster the exchange of knowledge among scientists, coastal users, decision makers, and communities while promoting stewardship of Massachusetts' coastal and marine environments.

Workforce development is similarly integrated across our program. Through internships, fellowships, research experiences, career exploration, and hands-on training opportunities, WHOI Sea Grant prepares K–12, undergraduate, graduate, and postdoctoral students, as well as adult learners, for careers in the marine economy. Our program's workforce development programs connect participants with researchers, educators, employers, and coastal professionals, helping to build the skills and expertise needed to address current and emerging challenges facing Massachusetts' coastal communities.

These environmental literacy and workforce development efforts advance WHOI Sea Grant's mission by developing and sharing science-based knowledge that supports the sustainable use, conservation, and management of coastal and marine resources while strengthening Massachusetts' coastal communities.

Goal 1.1: Promote ocean and coastal literacy across all ages and communities.

Objectives:

- Develop and deliver formal and informal education, outreach, and communication programs that meet the needs of Massachusetts coastal communities while increasing understanding of coastal and marine environments and promoting stewardship.
- Engage educators, students, coastal professionals, and the public through classroom visits, fellowships, internships, educator workshops, public events, community-based learning, and communication products.
- Provide science-based resources that support the integration of marine topics into K–12 education and lifelong learning.

Expected Outcomes:

- Educators, students, professionals and members of the public have an increased awareness and understanding of coastal and marine issues in Massachusetts.
- Educators and learners have greater access to current science-based resources.
- Communities demonstrate increased engagement in stewardship and informed decision making.

Goal 1.2: Support a skilled workforce prepared for careers in marine and coastal fields.

Objectives:

- Offer internships, research experiences, fellowships, and career exploration opportunities for K–12, undergraduate, graduate, and postdoctoral students, as well as adult learners.
- Collaborate with academic institutions, employers, and partner organizations to promote career pathways in coastal science, policy, management, and related marine industries.
- Provide professional development and technical training opportunities that strengthen the capacity of educators, scientists, resource managers, decision makers, and other coastal professionals.

Expected Outcomes:

- Students and adult learners are better prepared for careers in marine and coastal sectors.
- Scientists, educators, and coastal professionals are better equipped to respond to the needs of Massachusetts' coastal communities.
- Decision makers apply science-based knowledge in resource planning and management.
- Coastal communities benefit from a workforce equipped to address emerging environmental and economic challenges.

Healthy Coastal Ecosystems

Massachusetts' coastal ecosystems face many of the same challenges occurring throughout the nation's coastal regions, including declining water quality, habitat loss and degradation, invasive species and contaminants of emerging concern, and increasing pressure from human activities. Nutrient enrichment from wastewater and fertilizers continues to impair many estuaries, contributing to the loss of eelgrass meadows and salt marshes, changes in ecosystem function, harmful algal blooms (HABs), and increased biological stress on shell-forming organisms. Coastal habitats, including salt marshes, submerged aquatic vegetation, shellfish reefs, and migratory fish habitat, provide critical ecosystem services that support fisheries, improve water quality, reduce flooding and erosion, store carbon, and sustain coastal communities. Ensuring the long-term health of these ecosystems requires continued research to better understand restoration effectiveness, habitat transitions, and management strategies under changing environmental conditions.

Emerging environmental issues such as PFAS, microplastics, pathogens, estuarine cyanobacteria, and other contaminants of emerging concern are receiving increased scientific, management, and public attention. At the same time, advances in monitoring technologies, remote sensing, and automated data analysis are creating new opportunities to improve ecosystem assessment, restoration, and management. These evolving challenges highlight the need for science-based information, decision-support tools, and effective education and communication to help resource managers, municipalities, industry, and coastal communities make informed decisions.

Healthy Coastal Ecosystems activities emphasize translating scientific understanding into practical applications that support ecosystem protection, restoration, and stewardship. Priorities include improving water quality monitoring and assessment, evaluating habitat restoration and management approaches, supporting science-based conservation of coastal habitats and fisheries, and developing tools that inform natural resource management. Many Healthy Coastal Ecosystems priorities are closely integrated with the other WHOI Sea Grant focus areas, reflecting the interconnected nature of coastal resource management and the importance of collaborative approaches to addressing complex coastal challenges.

Goal 2.1: Support science-based protection, restoration, and management of coastal ecosystems.

Objectives:

- Fund applied research addressing water quality, coastal habitats, harmful algal blooms, contaminants of emerging concern, invasive species, and other ecosystem stressors.

- Develop monitoring, modeling, decision-support tools, and synthesized data products that inform local and regional ecosystem management, restoration, and conservation.
- Collaborate with partner organizations to share research findings, evaluate restoration approaches, and promote science-based management practices.

Expected Outcomes:

- Local decision makers have improved access to science, data, and tools for managing coastal ecosystems.
- Research findings inform restoration, conservation, and adaptive management efforts.
- Coastal habitats and the ecosystem services they provide are protected, restored, and sustained.

Goal 2.2: Facilitate the use of coastal ecosystem science through outreach and community engagement.

Objectives:

- Develop and disseminate resources that translate ecosystem research into practical guidance for resource managers, coastal communities, and other coastal resource users.
- Support collaborative partnerships with municipalities, nonprofit organizations, industry, community groups, and other partners to promote ecosystem stewardship and informed decision-making.
- Encourage public participation in ecosystem monitoring, habitat restoration, and stewardship through education, outreach, and citizen science opportunities.

Expected Outcomes:

- Resource managers and coastal communities apply scientific information to improve ecosystem management and restoration.
- Community participation strengthens long-term monitoring, stewardship, and public understanding of coastal ecosystems.
- Coastal resource users adopt science-based practices that enhance ecosystem health and resilience.

Sustainable Fisheries and Aquaculture

Massachusetts supports diverse commercial and recreational fisheries as well as a significant marine aquaculture sector. Southeastern Massachusetts contains 98% of the Commonwealth's marine aquaculture growers and 99% of its licensed acreage. The aquaculture industry is based primarily on two bivalve species, the quahog (*Mercenaria mercenaria*) and the eastern oyster (*Crassostrea virginica*), with increasing interest in farming additional shellfish species and seaweeds. According to the Massachusetts Division of Marine Fisheries (MA DMF), the value of the Commonwealth's cultured shellfish industry has grown from approximately \$3.7 million in 2004 to more than \$32.8 million in 2024. Since the mid-1990s, oyster aquaculture has been the primary driver of industry growth in Massachusetts, a charge led by a network of predominantly independent, small-scale growers.

Massachusetts also supports active commercial and recreational fisheries that contribute to the state's economy, food systems, and coastal heritage. Municipal shellfish departments work in partnership with the Massachusetts Division of Marine Fisheries to manage local shellfish resources through propagation, enhancement, and public access programs. Recreational shellfishing remains an important tradition throughout the Commonwealth, with Barnstable County towns alone issuing more than 17,000 recreational shellfishing permits annually.

Recognizing the economic, ecological, and cultural importance of fisheries and aquaculture, WHOI Sea Grant supports research, extension, and technology transfer that advance sustainable seafood production, healthy marine resources, and resilient coastal economies. Working with seafood harvesters, aquaculture producers, municipal shellfish managers, researchers, and state and federal partners, the program conducts applied research, develops decision-support tools, provides technical assistance, and translates scientific findings into practical applications through education, outreach, and communications.

In coordination with activities described under the Healthy Coastal Ecosystems focus area, WHOI Sea Grant supports science that improves seafood safety, strengthens aquatic animal health and biosecurity, and enhances the resilience of Massachusetts' fisheries and aquaculture. The program also assists the aquaculture industry in evaluating emerging production methods, markets, and management approaches for alternative species—including seaweeds, surf clams, and other native species—to strengthen the long-term resilience and diversification of the industry.

WHOI Sea Grant regularly engages with seafood producers, natural resource managers, and other partners through workshops, technical meetings, advisory groups, and digital education and communication tools to identify emerging needs, exchange information, and promote collaboration. When appropriate, the program also supports implementing priorities identified in the Massachusetts Department of Fish and Game 2025–2030 Strategic Plan, particularly those related to strengthening

coastal and marine habitats and increasing food security through sustainable fisheries and aquaculture (Massachusetts Department of Fish and Game, 2024).

Goal 3.1: Support safe, sustainable, and economically viable seafood production and harvest in Massachusetts.

Objectives:

- Provide technical support and training on best practices and emerging technologies that meet the needs of the fishing community, aquaculture growers, shellfish managers, and seafood harvesters.
- Conduct and communicate applied research related to seafood safety, water quality as it relates to shellfish harvest and aquaculture, aquatic animal health and biosecurity, production efficiency, and other emerging challenges.
- Support product diversification by evaluating production methods, markets, and management approaches for alternative species.

Expected Outcomes:

- Fisheries and aquaculture operations maintain safe and sustainable practices.
- Growers and harvesters adopt innovations that improve productivity, resilience, and profitability.
- Massachusetts seafood producers are better positioned to meet market opportunities and regulatory requirements.

Goal 3.2: Strengthen knowledge-sharing and coordination across the fisheries and aquaculture sectors.

Objectives:

- Engage regularly with seafood producers, natural resource managers, researchers, and regulatory partners to identify priorities and share information.
- Translate scientific findings into practical guidance, decision-support tools, and technical resources that support resource management, seafood safety, and permitting.
- Facilitate workshops, trainings, and collaborative forums that strengthen communication across commercial, recreational, municipal, and aquaculture communities.

Expected Outcomes:

- Improved communication and coordination among seafood producers, managers, researchers, and regulatory agencies.

- Science-based information and decision-support tools inform fisheries and aquaculture management decisions.
- Partnerships strengthen the long-term sustainability and resilience of Massachusetts fisheries, aquaculture, and working waterfronts.

Resilient Communities and Economies

The coastal geological environment of southeastern Massachusetts consists primarily of thick glacial deposits in the form of outwash plains and moraines. This landscape is generally characterized by low relief and easily erodible, unconsolidated sediments. Over geologic time, sea-level rise and coastal processes have shaped sandy beaches, sea cliffs, barrier beaches, and extensive salt marshes that provide valuable habitat while helping protect coastal communities. Today, these dynamic coastal landforms are particularly vulnerable to accelerated sea-level rise, shoreline erosion, and intense storm damage.

As a result, Massachusetts communities face a complex balancing act. Local decision-makers must protect private property and critical infrastructure while simultaneously preserving public shoreline access, supporting working waterfronts, and protecting the natural coastal processes—such as sediment transport—that sustain these ecosystems. Addressing these challenges requires informed planning, sound decision-making, and coordinated action across local and regional scales.

WHOI Sea Grant addresses these challenges through applied research, education, communication, and technical assistance that support coastal communities in understanding, preparing for, and adapting to changing coastal conditions. The program provides coastal managers, municipal officials, businesses, and residents with science-based information, decision-support tools, and practical guidance on coastal hazards, floodplain management, shoreline change, and community resilience. Through partnerships with state agencies, regional organizations, municipalities, and local communities, WHOI Sea Grant develops and delivers resources that help communities prepare for, respond to, and adapt to coastal change while supporting long-term economic resilience.

Goal 4.1: Provide communities with tools, training, and information to reduce risk from coastal hazards.

Objectives:

- Identify and assess the needs and experiences of Massachusetts coastal communities to inform effective risk reduction strategies.

- Develop and disseminate educational resources and decision-support tools that improve understanding of coastal hazards and resilience strategies.
- Support communities in understanding flood risk and strengthening floodplain management and other approaches that reduce vulnerability to coastal hazards.
- Provide technical assistance and training on coastal erosion, flooding, storm impacts, and relevant policies, regulations, and planning approaches.

Expected Outcomes:

- Local officials and residents have improved knowledge of coastal hazard risks and response strategies.
- Coastal communities implement practices and policies that increase resilience and reduce vulnerability to coastal hazards.
- Municipalities enhance their preparedness and capacity to plan for coastal hazards through access to science-based guidance and decision-support tools.

Goal 4.2: Promote sustainable coastal land use and community planning that protect coastal resources and support long-term community well-being.

Objectives:

- Share information on coastal processes, landforms, and the effects of development and infrastructure on natural systems in accessible formats for all members of Massachusetts coastal communities, including residents, decision makers, and resource managers.
- Support community resilience through applied research, technical assistance, and collaborative planning related to coastal hazards and land use.
- Engage planning boards, conservation commissions, and other local organizations to assess community needs, build knowledge, and support informed decision making.

Expected Outcomes:

- Communities adopt strategies that support resource protection and responsible growth.
- Local decision makers incorporate science-based guidance into land use planning and coastal development decisions.
- Coastal communities implement management approaches that support resilient natural and built environments.

7. References

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