Woods Hole Oceanographic Institution Sea Grant
2024-2027 Strategic Plan

Enabling Healthy Massachusetts Coastal Communities and Economies Through Marine Science Research and Outreach

1. Introduction

The Commonwealth of Massachusetts is one of the smallest states in the U.S. with only 7,800 square miles of total area, yet is the third most densely populated state, with a population of over 7 million people (U.S. Census, 2020). Coastal communities in Massachusetts have seen dramatic growth when compared to the rest of the state. The population in the coastal communities of southeastern Massachusetts (Barnstable, Bristol, Dukes, Nantucket, and Plymouth counties) represents 20% of the total population, and Boston and the North Shore (Essex, Middlesex, Norfolk, and Suffolk counties) represent another 56%. The Commonwealth's 1,980 miles of coastline include extensive wetlands, tidal flats, dune systems, and salt marshes, totaling 12% of the landmass. Thus, over three-quarters of the state population places pressure on coastal watersheds and ecosystems.

The Commonwealth's coastal communities are among its most valuable natural and economic resources, providing jobs, transportation, and recreation to residents and visitors. In 2019, the Massachusetts marine economy accounted for $8.2 billion in gross domestic product (GDP), equal to more than one-third of the northeastern U.S. Blue Economy (NOAA, 2022). Sectors include commercial and recreational fishing, tourism, shellfish aquaculture, sand and gravel mining, marine technology, marine shipping, coastal construction and real estate, and recreational boating, totaling more than 100,000 employees. From 2009-2019, employment and GDP in the MA Blue Economy increased by 27% and 38%, respectively. Despite the strength of the marine economy within Massachusetts, there are concerns that need to be addressed to ensure future growth and prosperity. These issues include education and job training, maintaining port infrastructure for commercial fisheries and building new infrastructure for emerging and expanding industries such as offshore renewable energy, and improved water quality to sustain

tourism and recreation, which produces 60% of the state's GDP and 80% of its employees in this sector. Furthermore, COVID-19 has led to fundamental changes in how these marine-focused business sectors operate, with implications for their needs moving forward.

The protection of Massachusetts' coastal watersheds, waterbodies, and landforms requires wise planning of both land and aquatic resources. Such planning efforts are in the hands of coastal decision makers, who range from professional natural resource managers to boards or committees consisting of elected or appointed individuals with varying levels of expertise. In addition, many required or desired actions require taxpayer resources and support, which can only be achieved if coastal communities have a sufficient level of environmental awareness. The fact that towns in Massachusetts have the right to self-governance in local matters (the so-called "home rule") further highlights the need for planners and community-members of all backgrounds to have access to the latest science information to inform decision making.

Massachusetts is served by two Sea Grant programs – Massachusetts Institute of Technology Sea Grant and Woods Hole Oceanographic Institution (WHOI) Sea Grant. In its extension and outreach activities, WHOI Sea Grant primarily serves southeastern Massachusetts, including Cape Cod, the islands of Martha's Vineyard and Nantucket, the South Shore along Cape Cod Bay, and the South Coast along Buzzards Bay. This region is a center of marine science related industries, including marine instrumentation, research, fishing, aquaculture, and coastal tourism. People on Cape Cod and the Islands have been engaging in work to recognize and foster the concept of a "Blue Economy". The Blue Economy work of the Cape Cod Chamber of Commerce includes an array of projects, ranging from sustainable tourism to advanced marine technology, and they are undertaking work in three thematic areas: a vibrant maritime and technology economy, water-healthy communities, and a prepared and educated workforce for the future. WHOI Sea Grant plays a critical role in supporting these aspects of the Blue Economy

that ensure sustainable and resilient communities, not only for southeastern Massachusetts but the entire state.

Many of the challenges the Commonwealth of Massachusetts faces to maintain sustainable and resilient communities are similar to challenges identified in coastal regions throughout the U.S. and are discussed extensively in the Pew Oceans Commission report, *America's Living Oceans: Charting a Course for Sea Change*, and the U.S. Commission on Ocean Policy report, *An Ocean Blueprint for the 21st Century*. In 2009, the Commonwealth of Massachusetts became the first state in the nation to pass a comprehensive Ocean Management Plan. The plan was amended in 2015 and fully revamped in 2022. The new plan focuses on the advances made in both management and science priorities since 2015 and sets the stage for regional priorities and programs. In 2016, the Northeast Region Ocean Council (NROC) approved the first regional ocean plan, *Northeast Ocean Plan*, with major program objectives directed at improved understanding of critical coastal habitats and resources, tribal cultural resources, socioeconomic conflicts in coastal regions, coastal community vulnerability, climate change impacts to coastal habitats and communities, and ecosystem-based management. The work laid out in WHOI Sea Grant's 2024-2027 strategic plan not only aligns with state needs, but will also advance these larger, regionally-focused efforts by coordinating with our partner programs in the Northeast Sea Grant Consortium.

2. Vision

WHOI Sea Grant envisions diverse, thriving coastal ecosystems, communities, and economies that are resilient in the face of change because they are supported by an environmentally literate public and informed decision makers.

The WHOI Sea Grant vision complements the vision articulated in the NOAA Sea Grant strategic plan, which in turn was informed by the Department of Commerce's Strategic Plan, NOAA's strategic plan and the NOAA Oceanic and Atmospheric Research Strategy.

3. Mission

WHOI Sea Grant's mission is **to enhance the practical use and conservation of coastal and marine resources by developing and sharing science-based knowledge to create a sustainable economy and environment for the diverse communities of Massachusetts**. To fulfill this mission requires: (1) acquisition of science-based information on how ecosystems function and how human activities affect habitats and living resources; (2) education of people to inform them of the complexities of coastal environments and the interactions between human use and coastal ecosystem health; (3) development of decision-making processes that include the best scientific and technical information, the engagement of interested parties, and mechanisms to evaluate trade-offs between human and environmental needs; and (4) incorporation of the social sciences into ecosystem-based management decisions.

Furthermore, we seek input and advice from state and federal agencies, resource users, and the public, and recruit talent and expertise from public and private academic institutions throughout the Commonwealth of Massachusetts. Our outreach efforts are conducted in a cooperative partnership between the Woods Hole Oceanographic Institution and Barnstable County Cape Cod Cooperative Extension. Regional initiatives are pursued in collaboration with member programs of the Northeast Sea Grant Consortium and their partners.

4. Strategic Plan Development

The foundation of this strategic plan is the 2024-2027 National Sea Grant College Program Strategic Plan, which has identified four topical areas of focus: Environmental Literacy and Workforce Development (ELWD), Healthy Coastal Ecosystems (HCE), Sustainable Fisheries and Aquaculture (SFA), and Resilient Communities and Economies (RCE). Here, we add two major cross-cutting principles: climate change and DEIJA (diversity, equity, inclusion, justice, and accessibility). These focus areas and principles build on strategic goals of NOAA and the unique strengths and capabilities of the Sea Grant network, including that of our program. Most importantly, they encompass the most critical needs in coastal regions of the United States as well as issues that are of greatest importance to the Commonwealth of Massachusetts and the Northeast region.

This strategic plan was further informed by a 2020 WHOI Sea Grant survey that solicited input on issues of concern from local community members and organizations including coastal property owners, coastal business owners, natural resource managers, regulators, educators, researchers, commercial and recreational fisheries members, and environmental group representatives throughout the Commonwealth of Massachusetts. The plan includes input from members of our advisory board, the Marine Outreach Guidance Group (MOGG), which consists of regulators at the state and local level, business owners, educators, researchers, and communicators, among others. Lastly, the plan aligns with WHOI's strategic plan: *Vision 2030: Ocean Science for the Global Good*, in particular its DEIJA principles and "advancement of science based solutions to societally relevant problems".

5. Program Focus Areas and Goals

The WHOI Sea Grant Program is based at the Woods Hole Oceanographic Institution and supports research, education, outreach, and extension projects that encourage environmental

stewardship, long-term economic development, and responsible use of the nation's coastal and ocean resources. The program's affiliation with WHOI began in 1971 with support for several individual research projects. In 1973, WHOI was designated a Coherent Sea Grant Program and, in 1985, was elevated to an Institutional Sea Grant Program.

The WHOI Sea Grant Program channels the expertise of world-renowned ocean scientists and engineers toward meeting the research and information needs of users of the marine environment. Public and private institutions throughout the Commonwealth of Massachusetts, and collaborators outside of Massachusetts, participate in the WHOI Sea Grant Program. Inherent to the National Sea Grant College Program and individual state programs is integrity and scientific neutrality, with a commitment to distributing information to a diverse range of interested parties that rely on us as a trusted broker of information. Our program embraces the core values of the National Sea Grant College Program – vision, collaboration, sustainability, accountability, non-advocacy, and DEIJA – with one addition (nimbleness):

- *Vision* – WHOI Sea Grant supports innovative solutions to address coastal monitoring, resilience planning, and protection of valuable coastal resources.
- *Collaboration* – WHOI Sea Grant seeks partnerships that leverage our strengths, especially within southeastern Massachusetts, but also throughout the entire northeastern U.S.
- *Sustainability* – WHOI Sea Grant works with communities to promote sustainable use of natural resources.
- *Accountability* – WHOI Sea Grant conducts all activities with integrity and transparency.
- *Non-advocacy* – WHOI Sea Grant strives to avoid bias and advocacy in the development and delivery of information, tools, and services.

- *DEIJA* – WHOI Sea Grant is committed to building inclusive programs that serve people with unique backgrounds, circumstances, needs, perspectives, and ways of thinking.
- *Nimbleness* – WHOI Sea Grant can quickly respond to emerging issues and address unforeseen needs.

WHOI Sea Grant is organized around four core functional areas of extension, education, research, and communications. The WHOI Sea Grant Extension Program is carried out in partnership with the Barnstable County Cape Cod Cooperative Extension (CCCE) Service. This program emphasizes the application of research in social and natural science to coastal resource issues. Our educational activities are designed to reach people of all ages and abilities to prepare them to make informed decisions regarding coastal resources, communities, and economies. The research portfolio is developed through proposal solicitations that are informed by an extensive feedback process to help address issues of concern that relate to coastal and marine resources. Finally, WHOI Sea Grant's communications program develops products to provide users/managers of marine and coastal resources with technical assistance and sound information through a wide range of methods, including our newsletter, website, and social media platform.

WHOI Sea Grant's relatively small staff leverages expertise and talent at the parent organizations and extends opportunities throughout the Commonwealth of Massachusetts, with a focus on the southeastern portion of the state including Cape Cod and the Islands. Our advisory board (MOGG) provides oversight of program plans and strategic planning. Through these efforts the WHOI Sea Grant Program strives to maintain organizational excellence, engage partners throughout the Northeast region to support program goals, and ensure diversity and inclusion by engaging with underrepresented or underserved communities throughout the region.

Cross-cutting Principles: Climate Change and DEIJA

Climate change and DEIJA are concepts that cut across all four of the following focus areas and therefore guide much of the work that WHOI Sea Grant conducts during 2024-2027. In our 2020 survey, there was broad interest in understanding how climate change will affect coastal areas in Massachusetts in terms of sea level rise, wetland resilience, and water quality. At the same time, we recognize that there must be a corresponding interest and investment in mitigating and adapting to the coming changes while minimizing impacts to economic and cultural values. Examples include preservation and restoration of salt marshes that store carbon and serve as buffers to rising seas, and more controversial topics like managed retreat, which is both a scientific problem of assessing risk and a social problem involving property ownership. In the fisheries and aquaculture space, we must communicate unbiased information, along with potential adaptation strategies, to interested parties about potential climate change impacts to both wild caught and farmed species.

Cultivating partnerships and enhancing diversity, equity, inclusion, justice, and accessibility in all program activities will be a major point of emphasis in our implementation of this 2024-2027 Strategic Plan. WHOI Sea Grant views DEIJA as our most important cross-cutting activity for which we will utilize best practices when engaging with underserved and underrepresented groups in a respectful, effective, and coordinated manner. This will require that program staff develop new skills and access new knowledge in the DEIJA space that allow us to incorporate best practices for engaging underserved and underrepresented groups and develop programming inclusive of traditional knowledge. Furthermore, WHOI Sea Grant and its advisory board will regularly review and discuss efforts to reach underserved and underrepresented groups through their programming and activities.

To achieve our vision in this space, we have developed a set of DEIJA program goals to guide us across three of our functional areas of research, extension, and education (Table 1). In forming these strategic planning goals, we used a framework offered by the Sea Grant DEIJA Network Visioning document, "*Reaching Outward and Looking Inward Building Sea Grant Resilience from the Lens of Diversity, Equity, and Inclusion*" (2018). The goals are the culmination of a multi-pronged planning effort conducted during 2020 that involved all-staff discussions, a breakout group during our advisory board meeting, and the wide-ranging and extensive DEIJA-related responses from the survey.

Table 1. Program goals related to Diversity, Equity, Inclusion, Justice, and Accessibility.

National DEI Vision Goals Specific to Functional Areas[1]	National Desired Outcomes[1]	Program Goal
Research: Sea Grant addresses issues of diversity and underrepresentation of its research reviewers, panelists, and awardees**.**	Sea Grant FFOs and RFPs include language that encourages diversity among applicants and communities served.	Research funding competitions include language that encourages diversity among applicants as well as activities to promote DEI in the research endeavor.
	SG directors and research coordinators are aware of strategies aimed at broadening participation strategies.	Recruit diverse talent to apply for research and fellowship opportunities by conducting outreach to and building relationships with institutions of higher learning in the state of Massachusetts including those that serve students from underserved and underrepresented populations. Research and fellowship proposal reviewers reflect the
	Diverse institutions, faculty, and students including those that have been underrepresented in prior research portfolios, are aware of and apply for SG research opportunities.	

[1] Modified from: National Sea Grant College Program. 2018. "*Reaching Outward and Looking Inward: Building Sea Grant Resilience from the Lens of Diversity, Equity, and Inclusion.* DEI Network Visioning Document. Silver Spring, Maryland.

		diversity of the scientific community.
Research: Sea Grant takes a leadership role in stimulating research and scholarship to address topics of value to diverse communities.	FFOs and RFPs are informed by and developed to engage diverse groups. Interested parties participate in pre-proposal stage evaluation of the relevance of proposed research projects.	Advisory board members that represent the range of interested parties are engaged in the development of research funding competitions and participate in the pre-proposal review process.
	Diverse groups and individuals are engaged in SG research, including participatory or use-inspired research.	Community science programs and funded researchers include participation from diverse groups and individuals.
	Enhanced accountability and tracing of SG-supported broadening participation efforts through several mechanisms.	Principal investigators are asked for demographic information for all project personnel associated with funded research proposals.
Extension: Sea Grant extension staff have the capacity and skills, including knowledge of best practices and demographic data to effectively serve diverse communities.	SG extension staff are aware of best practices for engaging underserved and underrepresented groups. SG extension staff have the knowledge to undertake programming that is inclusive of traditional knowledge and is culturally relevant.	Utilize best practices for engaging underserved and underrepresented groups and developing programming inclusive of traditional ecological knowledge.
	SG extension staff use best DEI practices to engage underserved and underrepresented groups.	
	SG extension staff undertake programming that is inclusive of traditional knowledge and culturally relevant; they engage audiences and address coastal challenges with socioeconomic and historic lens.	

	SG extension staff share best practices and improve their extension programming based on lessons learned from engagement with underserved and underrepresented communities.	Extension programming is modified using best practices to reach underserved and underrepresented groups.
Education: Sea Grant educators and fellowship administrators have the capacity, skills, and knowledge of best practices and demographic data to effectively serve diverse communities.	Increase in number of SG educators and fellowship administrators that have participated in education- and fellowship-related DEI programs.	Develop, facilitate, and deliver relevant STEM resources and opportunities for faculty and administrators at underserved and underrepresented-serving educational organizations.
	Administrators/faculty at K-12 institutions, homeschool groups, technical schools, community colleges, HBCUs, MSIs, tribal colleges, community-based organizations, and other underserved and underrepresented-serving organizations are aware of SG teacher trainings and student programming, internship, research, and fellowship programs.	
	SG educators and fellowship administrators have strong relationships and partnerships with organizations serving underserved and underrepresented communities.	
	SG educators and fellowship administrators are aware of DEI best practices to build capacity for education efforts and fellowship programs that incorporate DEI considerations.	Participate in DEI training through the Sea Grant Network and our home institution to stay current with best practices.
	Models of best practices for environmental education that reflect DEI considerations are widely available to SG educators.	DEI considerations will be given for all existing and new educational programming with lessons learned to be shared with the Sea Grant Education

		Network to foster a culture of best practices.
Education: Sea Grant trains a coastal and marine workforce that represents the demographics of the locations where Sea Grant programs operate.	K-16 and informal educators who serve underserved and underrepresented communities are aware of coastal and marine STEM career pathways.	Create opportunities for high school and college students, including those from underserved and underrepresented groups, to explore and pursue careers that support coastal communities and the scientific workforce.
	Students from underserved and underrepresented groups are aware of SG fellowship, internship, and research assistantship programs, and have access to resources to be competitive applicants.	Maintain a list of student fellowship, internship, and research opportunities, reaching out to those from underserved and underrepresented groups through targeted communications.
Education: Sea Grant prepares an environmentally literate and informed citizenry that is reflective of diverse populations	SG educators are aware of needs of underserved and underrepresented partner organizations as related to SG focus areas.	Engage the advisory board and conduct periodic surveys of interested parties to assess the needs of underserved and underrepresented partner organizations and develop programming that addresses their needs.
	SG programming reflects education needs and priorities of underserved and underrepresented communities.	

Environmental Literacy and Workforce Development

WHOI Sea Grant recognizes the important role of science education in supporting, promoting, and coordinating formal and informal educational activities at all levels to enhance public awareness and understanding of coastal ocean resources. To this end, we aim for integration of research, education, and outreach to develop an environmentally literate citizenry that will make informed decisions about coastal resilience.

In Massachusetts, citizens use coastal and marine resources in a variety of ways. Our team members will work to improve the environmental literacy of all community members through coastal conferences that bring scientists and decision makers together. Teacher workshops will be designed to inform teachers and informal educators of new advances in science and technology and share the importance of the ocean and incorporating marine systems in instruction. We will engage K-12 students through classroom visits and experiential learning opportunities to inspire them and give them access to our research and the marine resources in their community. Science education also plays a role in preparing students to access further training and jobs in the Blue Economy, a growing business sector in Massachusetts (Cape Cod Commission, 2019).

Trainings will be provided to inform decision makers of advances in science that inform policy, while research projects will support the research experiences of undergraduate, graduate, and postdoctoral students. Each of these diverse audiences requires a different approach in providing technical information that will enhance opportunities for learning. To this end, we aim for integration of research, education, and outreach to develop environmentally literate community members to enable them to make informed decisions about use of coastal and marine resources. In addition, our programming for students will make them aware of the range of marine-based careers available to them and the training required to prepare from them. Our program goals for **Environmental Literacy and Workforce Development** are listed in Table 2.

Table 2. Program goals for the Environmental Literacy and Workforce Development focus area.

National Plan Goals[2]	National Plan Action[2]	National Desired Outcomes[2]	Program Goal
A diverse, environmentally literate public participates in lifelong formal and nonformal learning opportunities.	Create and implement educational resources and opportunities that are diverse, equitable, inclusive, just and accessible for formal and nonformal learners to explore multiple ways of learning and knowing and to develop their curiosity and learning abilities throughout their lives.	Individuals consider themselves environmentally literate lifelong learners who utilize knowledge to support, build and restore healthy natural and human communities.	Promote environmental literacy and stewardship activity in coastal communities, including those underserved, through ocean and climate education programs that utilize the latest scientific research.
	Develop, provide, and assess research, curricula, tools and other resources for educators, students, and lifelong learners to support personal choice, participatory decision-making, and community planning processes.	Educators, students, and lifelong learners have current information and innovative tools that meet or exceed relevant standards and practices.	Develop, facilitate, and deliver relevant STEM K-12 educational resources and opportunities that support more effective environmental literacy learning and instruction.
		People know and can act on issues that impact their lives, communities, and environments.	Create or facilitate trainings of natural resource and emergency managers, as well as building officials, to understand, synthesize, and apply best available science and information to improve coastal resiliency and advance/support environmental justice.

[2] National Sea Grant College Program. 2022. *National Sea Grant College Program 2024-2027 Strategic Plan: All Hands on Deck*. Silver Spring, Maryland.

	Strengthen the ability of individuals, organizations, and communities so that they have the knowledge, dispositions, skills and abilities to make informed and responsible decisions regarding coastal and Great Lakes environmental issues.	Individuals, organizations, and communities create innovative opportunities, businesses and communities that respect diverse ways of knowing and learning, address systemic problems in equitable and just ways and integrate traditional and novel cultures.	Provide interested parties with learning opportunities and resources that will promote sustainable use of watershed, coastal, and marine resources.
A diverse, skilled, and environmentally literate workforce that is engaged and able to build prosperous lives and livelihoods in a changing world through traditional and innovative careers.	Identify and remove barriers to accessing training and learning opportunities so that the nation's diverse population is connected to and prepared for the range of career paths that support the needs of coastal and Great Lakes communities.	All members of a community are enabled to explore and pursue the variety of occupations that are essential to sustain coastal and Great Lakes communities, economies, and ecosystems.	Create opportunities for high school and college students, including those from underserved groups, to explore and pursue careers that support coastal communities and the scientific workforce.
	Increase opportunities for students at all levels (P-12, undergraduate, graduate, post-graduate and technical and vocational) to gain knowledge and experience addressing issues that are important to our ocean, coasts and Great Lakes and their respective watersheds.	Sea Grant student opportunities provide increased literacy, experience, and preparedness in critical disciplines, skills, and issues.	Develop and provide experiential learning opportunities in coastal and ocean science through internships and classes at both the undergraduate and graduate level.
		Students from all backgrounds and with diverse needs are thoughtfully and intentionally supported in and have access to formal and experiential learning, training, and research experiences.	Support undergraduate and graduate students, particularly those from underrepresented groups, by providing access to formal and experiential learning, training, and research experiences.

	Develop and carry out programs that help people discover, create and grow within careers that support the current and future needs of coastal communities and ecosystems and to adapt and thrive in changing conditions.	Employment in coastal, Great Lakes and watershed communities expands and diversifies.	Provide or facilitate training and continuing education opportunities in aquaculture that also encourage safe and sustainable growing and harvesting practices.
		The existing and future workforce is able to adapt and thrive in changing environmental, social, and economic conditions.	Provide or facilitate training and continuing education opportunities for coastal decision makers to increase their ability to implement environmentally sound and just policies.

Healthy Coastal Ecosystems

The coastal ecosystems of Massachusetts are experiencing trends also seen in many other areas of the U.S.: decline in water quality, loss of habitat, invasion of non-native species, and increasing pressure on coastal resources. More specifically, nutrient over-enrichment of coastal waters from wastewater and fertilizer have led to dramatic shifts in the marine ecosystems of coastal embayments, for example, loss of eelgrass beds and the commercially important species that use them for refuge. Nutrient runoff has also exacerbated acidification of coastal waters, which increases the biological stress felt by shell building organisms like oysters, as well as the prevalence and geographic range of harmful algal blooms (HABs). Marine debris, including microplastics, is a rising threat to the health of a diverse range of marine organisms from quahogs to whales. These are problems that not only impact the environment, but also tourism and fisheries, two integral components of our Massachusetts coastal or Blue Economy.

Solving or mitigating these fundamental threats to healthy coastal ecosystems requires

scientific and engineering-based solutions. WHOI Sea Grant is committed to funding research that addresses these needs and providing the extension services that will ensure that such protection, enhancement, and restoration measures are put into practice by natural resource managers and other key interested parties.

WHOI Sea Grant extension and outreach personnel are well positioned to provide the tools and services needed to sustain coastal ecosystems. We will continue to maintain a network of water quality sensors in southeastern Massachusetts estuaries and make the data available to the public, including local shellfish farmers. Our extension program staff will coordinate a network for river herring managers designed to help current wardens solve problems, set goals, manage conflicts, and facilitate discussions with harvesters and other interested parties. Teacher workshops organized by our education specialist will be designed to help the next generation of coastal stewards understand how climate change will impact coastal ecosystems. Outreach specialists will educate the public on marine debris impacts and prevention. New topics, techniques and approaches will be added to this portfolio as discussions with community members help identify new challenges. Specific goals, outcomes and targets for the Healthy Coastal Ecosystems focus area are listed in Table 3.

Table 3. Program goals related to the Healthy Coastal Ecosystems focus area.

National Plan Goals[3]	National Plan Action[3]	National Desired Outcomes[3]	Program Goal
Coastal and Great Lakes habitats, ecosystems, and the services they provide are	Co-develop, improve, and share knowledge, decision-support tools,	Evidence-based science, traditional and local knowledge and innovative solutions inform and	Identify, generate, and communicate technical information required to help local natural resource managers protect

[3] National Sea Grant College Program. 2022. *National Sea Grant College Program 2024-2027 Strategic Plan: All Hands on Deck*. Silver Spring, Maryland.

protected, enhanced and/or restored.	technologies, and approaches to protect, enhance, and restore ecosystems.	improve the management and conservation of coastal habitats.	and restore ecosystems.
		Coastal and Great Lakes ecosystem science and conservation needs are identified and prioritized through diverse participation by interested parties.	Broad engagement of interested parties through workshops and conferences will identify priorities for research and management in coastal habitats and ecosystems.
		Communities have greater awareness and understanding of ecosystem functions and the services they provide.	Disseminate conservation and sustainable best management practices through lectures and conferences that enhance public awareness of environmental challenges that degrade coastal ecosystems.
		Coastal and Great Lakes biodiversity, habitats and ecosystem functions and services are restored and sustained.	Support the development of information and tools that will help coastal communities work to improve water quality such that biodiversity, habitats, and ecosystem functions are sustained or restored.
		Collaborative and inclusive planning and decision-making leads to enhanced stewardship and community benefits, especially for the most vulnerable.	Collaborate with federal, state, and local agencies and environmental non-profit groups to address marine resource management issues.
Land, water, and living resources are managed by applying science, tools, and services to sustain resilient coastal and Great	Support a science- and management-driven framework that integrates research, observations, monitoring and modeling and that includes community	Community science initiatives are utilized and contribute to improving our knowledge with respect to stewardship of ecosystems and their contributions to	Interested parties contribute directly to the social and natural science knowledge base through community science initiatives.

Lakes ecosystems.	engagement and traditional and local knowledge to provide a scientific basis for informed decision-making.	coastal and Great Lakes communities and economies.	
		Coastal and Great Lakes communities and resource managers have access to and use science, data, tools, and training to be effective in planning and decision-making processes.	Provide coastal communities with access to and understanding of long-term monitoring data and leading-edge research to improve coastal decision-making.
		Resource managers understand the risks, options, tradeoffs, and impacts of their decisions.	Identify, generate, and demonstrate management tools for decisions on land, water and living resources protection and restoration.
	Identify and advance successful strategies that enhance resilient ecosystems and watersheds in the context of changing conditions, including environmental variability and climate change.	Communities share, access, understand and use information regarding projected changes and related impacts within ecosystems.	Provide all demographic components of coastal communities with an understanding of current and future climate change impacts on coastal ecosystems.
		Communities can apply knowledge from case studies, training, and tools to improve their ability to plan, prepare and adapt to environmental variability and climate change.	Identify and generate tools to help communities prepare for and adapt to climate change impacts to coastal ecosystems.

Sustainable Fisheries and Aquaculture

The southeastern Massachusetts region contains 98% of the Commonwealth's marine aquaculture growers and 99% of the acreage. The industry is primarily based on two bivalve species: the quahog, *Mercenaria mercenaria*, and the American oyster, *Crassostrea virginica;*

however, there is increasing interest in farming other shellfish species as well as seaweed. The total value of Massachusetts shellfish aquaculture production grew from $3,691,182 in 2004 to over $29,858,281 in 2019 (Division of Marine Fisheries, 2004, 2019). Since 1996, oysters have been the primary species contributing to the establishment of new shellfish farming communities throughout coastal Massachusetts. In contrast with other states, the aquaculture industry is composed mostly of independent, small-scale growers.

The coastal communities of Massachusetts maintain active recreational shellfisheries and regulate them in partnership with the state Division of Marine Fisheries. Municipal shellfish departments engage in enhancement and propagation activities to provide a constant supply of oysters and quahogs to residents of the Commonwealth. In Barnstable County, the 15 towns issue more than 17,000 recreational permits every year.

Given the economic and cultural importance of commercial and recreational fishing and aquaculture to the region, WHOI Sea Grant will continue to work with both the Division of Marine Fisheries, the lobster industry, the aquaculture industry and municipal natural resources and shellfish managers to provide technical information, engage in cooperative research, translate research results into practice, and maintain long term monitoring datasets on water quality and shellfish growth. Efforts will also be put toward assisting the aquaculture industry with diversifying their crops by developing culture and marketing techniques for seaweeds and surf clams. Open communication will be maintained with industry members and natural resource managers through workshops, industry-sponsored meetings, and discussions to assess needs.

During 2019-2021, WHOI Sea Grant staff played a leading role in the development of the Massachusetts Shellfish Initiative's strategic plan. When appropriate, the program will assist state agencies and local managers with projects and objectives under the 6 categories listed in the plan: (1) fostering communication and coordination among local, state, and federal

managers and developing improved guidance for such communication; (2) building capacity to support shellfish resources and shellfish fisheries; (3) development of management, research, and industry resources; (4) supporting and promoting balanced and sustainable economic opportunities around shellfish; (5) supporting and promoting cultural and historical uses of shellfish; and (6) ensuring ecologically sound management and enhancement of shellfish resources and coastal ecosystems.

WHOI Sea Grant's program goals for Sustainable Fisheries & Aquaculture are listed in Table 4.

Table 4. Program goals related to the Sustainable Fisheries and Aquaculture focus area.

National Plan Goals[4]	National Plan Action[4]	National Desired Outcomes[4]	Program Goal
Domestic fisheries, aquaculture and other coastal and freshwater living resources supply food, jobs and economic and cultural benefits.	Promote and support harvesting, culturing and processing techniques that lead to safe, sustainable, high-quality food as well as economic, social and ecosystem benefits.	Coastal and Great Lakes residents and U.S. seafood consumers understand the benefits of domestically produced seafood, both wild and farmed, for individual and environmental health.	Provide communities with unbiased information on local seafood, how it is harvested and grown, its health and environmental benefits, and its seasonal availability
		Coastal and Great Lakes resource industries employ technologies and reinforce strategies to ensure safe and sustainable	Engage in cooperative research, monitoring, and education programs to assist the aquaculture industry with maintaining and enhancing production in a safe and sustainable manner.

[4] National Sea Grant College Program. 2022. *National Sea Grant College Program 2024-2027 Strategic Plan: All Hands on Deck*. Silver Spring, Maryland.

		seafood and products.	
		Coastal and Great Lakes resource industries employ strategies that balance economic, community, cultural and conservation goals.	Identify, generate, and communicate best management practices to ensure a safe and sustainable seafood supply.
Natural resources are sustainably managed to support coastal communities and working waterfronts, including commercial, recreational, subsistence fisheries and aquaculture.	Ensure the best available science, services and tools are available to and trusted by resource managers, the fishing and aquaculture communities and consumers.	Commercial and recreational fishers and aquaculturists are knowledgeable about efficient, sustainable, and responsible tools, techniques, and uses of coastal and freshwater resources.	Identify, generate, and communicate technical information to help local natural resource managers, harvesters, and growers manage the fisheries resources in their communities for continued sustainable production.
		Resource managers and fishing and aquaculture communities have access to and share diverse knowledge and tools to increase their capability to adapt to changing resource management needs, including those driven by climate change.	Assist the local seafood industry with adapting to and recovering from short- and long-term disruptions and changes in markets, production, and distribution.

Resilient Communities and Economies

Coastal communities in the U.S. support a wide range of economic, social, and recreational opportunities. In Massachusetts seventy-five percent of the population lives in

coastal counties. The coastal geological environment in the southeastern part of the Commonwealth consists primarily of thick glacial deposits in the form of outwash plains and moraines. Typically, this terrain has low topography and consists of easily erodible, unconsolidated sediment. Erosional forces (such as wave action) associated with sea level rise over geologic time have produced sandy shores fronting sea cliffs and downdrift barrier beaches. Extensive salt marshes have developed in the protected lagoons and bays that lay behind the barrier beaches. All these landforms are particularly vulnerable to storm damage, flooding, and erosion.

Coastal ponds, embayments, open coasts, and coastal resources are impacted by commercial, recreational, and residential activities. Furthermore, coastal communities in Massachusetts are increasingly being threatened by climate change as the northeastern U.S. coastline is experiencing sea-level rise at a rate 3-4 times the global average (Sallenger et al., 2012). Other major impacts include shoreline erosion, conflicts between the protection of waterfront upland property and the preservation of the beneficial functions of coastal landforms and resources, conflicts between private ownership of the coast and public access, and recreational demands on the coast through boating, fishing, shellfishing, and the use of beaches for swimming and sunbathing. Emerging interests in coastal wind farms present new opportunities to support science needs and gather information on scientific, social, and economic concerns of their siting and development.

Our Resilient Communities & Economies efforts aim to ameliorate this resource management dilemma through education, applied research, and technical assistance. In implementing this strategic plan focus area, WHOI Sea Grant will share information with coastal resource managers and the public about the forces that shape the coastal environment, provide technical information to local regulators and planners, and assist communities with applying to

and maintaining participation in the Community Rating System (CRS). We will also engage in work to determine new floodplain management activities that will improve flood safety, provide technical assistance on the National Flood Insurance Program, and produce extension bulletins and other information on sea level rise, coastal erosion, flooding, hurricanes, and other storms. The distribution of the Massachusetts Homeowner's Handbook to Prepare for Coastal Hazards, now in its 3rd edition, will also be a focus of the program. Our program goals for Resilient Communities and Economies are listed in Table 5.

Table 5. Program goals related to the Resilient Communities and Economies focus area.

National Plan Goals[5]	National Plan Action[5]	National Desired Outcomes[5]	Program Goal
Coastal and Great Lakes communities have the capability and resources to prepare for and adapt to extreme and chronic weather and coastal hazards, climate change, economic disruptions and other threats to community health and well-being.	Improve and expand exchanges of knowledge to better identify the diverse needs of communities and to increase the public's understanding of changing conditions and related impacts.	Scientific understanding, including traditional and local knowledge, provides foundational information, and all community members understand the impacts of changing conditions and coastal hazards and have the capability to prepare, respond and adapt.	Identify, generate, and communicate tools, traditional knowledge, and nature-based strategies that promote resilience of communities to natural hazards.
	Work with communities to advance collaborative comprehensive planning, actionable science, and adaptive	Inclusive collaborations with diverse interested parties and partners support mitigation and adaptation efforts built on	Identify and communicate information on coastal hazards (climate change-driven or otherwise), community resilience, and

[5] National Sea Grant College Program. 2022. *National Sea Grant College Program 2024-2027 Strategic Plan: All Hands on Deck*. Silver Spring, Maryland.

	management strategies.	knowledge from and responsive to the needs of all, especially the most vulnerable.	adaptation strategies through workshops.
			Through improved understanding of floodplain management, coastal communities and their diverse members adopt or modify regulations to improve their resilience.
	Work with communities to explore and support diversification, strengthening, sustainability and social equity within coastal economic sectors and the blue economy.	Coastal and Great Lakes communities have access to and share knowledge, tools, services and technologies to adapt and grow resilient economies.	Support and educate communities in their efforts to improve coastal resilience through floodplain management.
		Leaders in coastal and Great Lakes economic sectors understand how they can become more resilient through diversification including expanded renewable, regenerative, and clean practices.	Diverse members of the community are aware of changing climatic, environmental, and socio-economic conditions and use this information to improve coastal resilience and sustainability.
Water resources are enhanced, sustained, and protected to meet existing and emerging needs of the communities and economies that depend on them.	Use engagement and information exchange to advance the understanding of how actions impact water quality, quantity, and availability.	Community members understand watershed and coastal functions and the ecosystem services they provide, understand how their actions will impact water resources, and are able to make informed decisions.	Identify, generate, and communicate strategies and tools for management and protection of water resources.

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