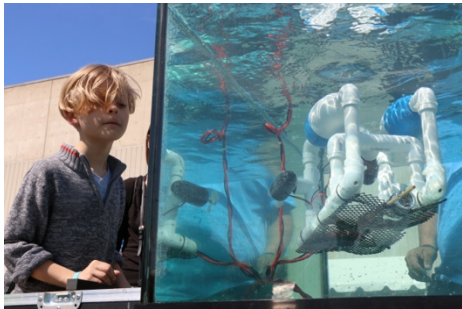


MIT SEA GRANT STRATEGIC PLAN FY 2018 – 2023



INTRODUCTION

The MIT Sea Grant College Program (MITSG) strategic plan is inspired by our vision, focused on our goals and objectives, and enhanced by the unique educational, scientific and technological resources of our home institution, local community, and statewide institutions and resources.

Vision

The MITSG is positioned to bring the substantial intellectual abilities of the Massachusetts Institute of Technology and our institutional collaborators to bear on a number of ocean-related challenges. In meeting these challenges with extraordinary technical contributions and strong commitment to scientific research, we will expand our knowledge of oceans, coasts, and watersheds, and establish the collaborative infrastructure to support the initiatives needed to address challenges to our fragile coastal and marine resources and the people who depend on them. Our vision was reviewed during our strategic planning constituent meetings and by our advisory committee, all of whom agreed that this vision statement accurately represents the program's strengths and ability to make meaningful contributions to ocean sciences and best serve our coastal communities in the Commonwealth of Massachusetts.

Mission

Our mission is to conduct and support research and develop technology to enable scientific investigation into problems surrounding the ecosystem health and human use of coastal and marine environments. Our education and outreach efforts disseminate the results of our MITSG-funded research as well as research conducted by our Design Lab, Autonomous Underwater Vehicle (AUV) Lab, and Advisory staff in collaboration with industry, state and federal partners. These stakeholder engagement, education, and outreach efforts are meant to encourage stewardship and implementation of sustainable and useful technologies that help answer management questions in support of public policy and industry through the use of relevant, evidence-based and scientifically sound information. Efforts in research, education, and outreach are designed to address critical marine and coastal issues at the state, regional, national and global levels that have been identified by Massachusetts constituents and are within the areas of focus for the National Sea Grant College Program (NSGCP). The goals of the focus areas shape priorities for our annual solicitation to fund new proposals, and they guide us in both the short- and long-term toward projects whose success can best serve our constituents. Our advisory committee reviewed and is in agreement with our mission and goals, and although there are no major changes from the previous period, MITSG's specific areas of emphasis may be different. For example, our current emphasis on ocean acidification, sensor and platform development, modeling and analytics, forecasting, fisheries research and engineering, and stakeholder engagement differ slightly from the last or earlier version of the MITSG strategic plan, but continue to support our mission and goals.

Core Values

The NSGCP core values focus on the strength and importance of university-based research and community engagement as an effective means to better understand and address issues facing our ocean and coastal ecosystems, resource management, industry, and coastal communities. For over 40 years, MITSG has brought the expertise of the Massachusetts Institute of Technology (MIT) to bear on ocean-related problems. Our rigorous research programs, dedicated outreach programs, and integrated education programs support industry and the wise use and conservation of marine resources along the Massachusetts coastline, and are helping to create the coastal stewards of tomorrow.

Cross Cutting Principles

The NSGCP Strategic Plan 2018-2021 defines cross cutting principles as broad measures of progress toward goals for all focus areas. MIT Sea Grant will work toward advancing the NSGCP cross cutting principles:

1. Cultivate Partnerships by integrating the expertise and capabilities of partners from the international, federal, tribal, and state communities and from academia, nongovernmental organizations, and industry.
2. Enhance Diversity and Inclusion (DEI) by seeking and welcoming diverse perspectives in order to enhance cultural understanding and enable the network to pursue its vision and mission effectively and efficiently.

The MITSG DEI statement can be found in Appendix 1.

MIT SEA GRANT STRATEGIC PLAN

Broadly speaking, the MITSG Focus Areas and Goals are aligned with those of the NSGCP 2018-2021 strategic plan, while our Objectives and Outcomes are dictated by stakeholder input. Within the framework of the four focus areas, the following sections include a brief discussion of the top priorities identified for Massachusetts as well as MITSG's recent and present research and outreach activities. Within each focus area, MITSG's outcomes are listed under the NSGCP's goals. Several outcomes are cross-cutting and therefore are affiliated with more than one focus area.

MIT Sea Grant College Program is committed to scientific and technical leadership to address priority issues for the Commonwealth of Massachusetts. MIT Sea Grant has and will continue to develop innovating technologies and systems to address environmental issues of greatest concern and to achieve goals of sustaining resources, communities, industry, and economies in the future. Impacts and adaptation for fisheries, coastal communities, shorelines, and ecosystems will continue to be of concern to our stakeholders and constituents. Four focus areas address the core of the NSGCP mission and vision, and these frame our goals and outcomes: Healthy Coastal Ecosystems; Sustainable Fisheries and Aquaculture; Resilient Communities and Economies; and Environmental Literacy and Workforce Development. MIT Sea Grant

solicited input from our advisory committee, networking partners and liaisons with local, state, federal, and regional agencies and organizations, industry, and the general public (with an internet-based survey), in creating our 2018-2023 strategic plan.

Through the 2016 MIT Sea Grant Stakeholder Meetings, we found that high among constituents' concerns are (1) preserving and restoring coastal resources, (2) promoting environmental stewardship, (3) coastal resilience, (4) wise use and management of coastal resources, (5) fisheries and aquaculture, and (6) water quality. Specific concerns highlight the need for research, data services, tools and models, and new technologies to predict impacts, support industry, and monitor effectively and efficiently in support of policy decisions to better manage ecosystem resources. MIT Sea Grant will continue its commitment to develop technology, vehicles, platforms, sensors, computational tools, data services and tools, oceanographic models, engineering solutions, and biological research in support of industry and critical public processes. Information and technology is transferred to our stakeholders through seminars, practitioner working groups, forums, workshops, and conference presentations. Our commitment to education involving K-12 students and teachers, undergraduate and graduate students, adult learning groups and all ages in underserved communities will further disperse our research in marine and coastal science and engineering.

MIT Sea Grant College Program is committed to providing the best science and innovating new technologies to address local, state, regional and national oceanic and environmental issues. Through collaboration and engagement with faculty across MIT and local universities and alliances with partners including Sea Grant programs in the region, MIT Sea Grant taps intellectual and financial resources to tackle major environmental issues. Our marine advisory staff conducts research and develops programs and materials that transfer technology and scientific information to industry and decision makers to encourage stewardship as leaders strive to balance human population growth and sustainability of resources. MIT Sea Grant's funded research projects in marine sciences, ocean engineering, and technology will continue to support the priorities of the Commonwealth of Massachusetts.

FOCUS AREA: HEALTHY COASTAL ECOSYSTEMS (HCE)

Under the rubric of the HCE focus area, coastal ecosystems are expected to be both healthy and aesthetically pleasing, providing diverse commercial and recreational opportunities for residents and visitors. However, various stressors may affect the health of these ecosystems including; degradation of water quality from nutrients, impacts to coastal resources and habitats, acidification of ocean and coastal waters, sea level rise, coastal erosion, and alteration of habitats. MIT Sea Grant addresses issues that impact coastal and marine waters through developing tools, platforms, technologies, and engineering solutions as well as conducting innovative research to increase the efficiency and capabilities of industry. This is all done to assist resource managers with decisions that will ensure long-term viability of coastal ecosystems.

HCE Continuing Priority Activities

MIT Sea Grant has a long history in supporting improvements to coastal ecosystems and ecosystem services that benefit coastal communities, focusing more recently on the following: coastal resilience processes involving carbon storage in eelgrass beds and coastal habitats; climate impacts to carbon cycling in coastal wetlands (Blue Carbon); ecosystem connectivity through diadromous fish migrations, associated food webs and resource requirements; and benefits from habitat restoration and hydrologic connectivity improvements. These are all HCE priority areas identified by our industry, management, and conservation stakeholders, and we will continue to address these priority areas.

MIT Sea Grant will continue its efforts to improve our understanding of ocean acidification in coastal and offshore waters through development of sensors for sampling, monitoring, and modeling physical, chemical, and biological variables, and sensor platforms and vehicles that can withstand forces associated with ocean and coastal environments. Developing inexpensive new technologies through machine learning for improved fisheries management in partnership with NOAA Fisheries and the MA Division of Marine Resources, and local watershed monitoring groups is an important area we have addressed in response to stakeholder needs and we will continue our efforts in this area. Developing sensors, platforms, and vehicles in our AUV Lab, translating biological adaptations (e.g., the role seal whiskers or fish lateral lines as sensors) for surface and underwater vehicles through biomimicry, and improving communications, energy storage, and recharge capabilities of autonomous vehicles are examples of currently funded research projects and additional areas we plan to continue to focus. In addition, MITSG currently maintains an array of databases that provide for 3D, web-based, mobile-friendly geospatial visualization in support of stakeholders and the public, and we will continue to build on this effort.

HCE Continuing Priority Areas

- Coastal Resilience in Support of HCE:
 - (a) Climate Impact assessment, adaptation, and planning
 - (b) Carbon Cycling and Climate Impact Mitigation in coastal habitats (Blue Carbon)
- HCE Resilience through Habitat Restoration and Ecosystem Connectivity enhancements
- HCE Resilience through Fish Passage and Habitat Improvements
- Ocean Acidification (OA) impacts on HCE:
 - (a) Monitoring and Modeling
 - (b) Sensor development
 - (c) Assessing OA impacts on coastal resources

HCE Future Directions

During 2018-2023 MIT Sea Grant will continue to build on this legacy of improving HCE in MA through additional contributions in the areas of: Microplastics and their impact to coastal and marine ecosystems and resources; Biological Research that reduces the impacts of ocean acidification on coastal and marine resources and contributes to the development of protective infrastructures; and Coastal Resilience engineering, modeling, and living shoreline improvements. The effects of microplastics, microbiomes, and ocean acidification on the health of oceanic and coastal ecosystems are poorly understood and represent priority topics identified by our industry, and management stakeholder groups.

We will apply sound science to improve the health and understanding of our coastal ecosystems and provide resilience for coastal resources and communities. We will identify opportunities in biology by asking key questions relevant to stakeholder challenges; by looking at recent technological developments in biology and biomedical fields (e.g., sequencing and imaging); and exploring powerful emerging technology that can open new avenues to address important questions in marine biology and applications for HCE. Work on decarbonization of marine craft and introducing electric propulsion has beneficial impact on coastal resources and provides opportunities for new company development and creation of high technology jobs.

Developing protective infrastructure that is biological in nature, the use of traditional coastal habitat restoration and natural processes, and addressing site selection challenges and the biological aspects of Living Shorelines and Resilience are priorities identified as priorities by our stakeholder groups (MA Division of Marine Fisheries; MA Office of Coastal Zone Management; and WHOI).

HCE Outreach and Education

Our outreach and education efforts seek to create opportunities for exchange of information among researchers, MITSG Advisory staff, and our stakeholders to support ecosystem-based management and HCE. We accomplish this through convening workshops with other Sea Grant Programs and organizations on topics of interest to industry, managers, and the public. We develop community science programs that increase awareness and stewardship of ecosystem based management of fisheries resources, coastal habitats, watersheds, diadromous species, climate impacts and coastal resilience, and ocean acidification effects on coastal and ocean resources. Development of data services for partners and stakeholders is an effort that we are currently undertaking, which includes database development and customized user

HCE Future Directions

- Microplastics impact to coastal and marine ecosystems and resources
- Biological Research to Improve the health of coastal and marine resources and protect against OA effects
- Coastal Resilience engineering, modeling, and living shoreline improvements
- Decarbonization and electrification of marine craft

interface tools that facilitate user queries, analyses, visualizations, and modeling. These data services are cross-cutting in support of all MITSG focus areas, designed to address current and future challenges among stakeholders for geospatial data storage, modeling, analysis, visualizations, resource management, and reporting through outreach, education, and training. Developing ocean engineering and coastal ecology education and training programs, teaching coastal ecology courses for K-12 students, teachers, and undergraduate and graduate students are all components of our HCE education program. Conducting informal public events, supporting undergraduate and graduate interns and postdocs, and providing community science programs that increase awareness and stewardship for HCE are additional MITSG outreach components. Transferring information, tools and technologies developed by MITSG and its funded researchers address and inform the needs of our stakeholders.

HCE COVID-19 Pandemic Response

MITSG has enacted several measures in response to the extraordinary circumstances resulting from the COVID-19 pandemic, and will continue its efforts especially as the emergency may be prolonged and/or it's after effects may be long lasting. For example, MITSG is engaging stakeholders, local communities, and state and federal resource managers to identify and map existing shellfish restoration projects along the Massachusetts coast. As part of this initiative, the MITSG Advisory Group has been working with MA shellfish farmers to help them understand how they can become involved with these restoration and replenishment projects through the sale of their unmarketable oversized shellfish products. These activities identify alternative markets for local shellfish farmers to help offset economic impacts of the COVID-19 pandemic, and provide shellfish resources that aid and contribute to restoration and enhancement projects along the MA coast. A map of oyster restoration projects in Massachusetts has been developed and is available here: <https://seagrant.mit.edu/shellfish-restoration/>.

HCE Goal 1: Habitat, ecosystems, and the services they provide are protected, enhanced, and/or restored

MIT Sea Grant Outcome: Scientific understanding and technological solutions inform and improve conservation and the management of natural resources.

MIT Sea Grant Outcome: Greater awareness and understanding of ecosystem functions and services they provide improves stewardship efforts for fisheries, aquaculture, and coastal and ocean resource managers, industry, and local communities.

HCE Goal 2: Land, water, and living resources are managed by applying sound science, tools, and services to sustain ecosystems.

MIT Sea Grant Outcome: Collaborations with partners and stakeholders support planning, research and technological solutions to address resource management needs.

MIT Sea Grant Outcome: Community Science initiatives are engaged and contribute to improving current knowledge with respect to coastal communities and ecosystems.

MIT Sea Grant Outcome: Communities have access to sound science, data, tools, and the training to be effective contributors in planning and decision-making processes.

FOCUS AREA: SUSTAINABLE FISHERIES AND AQUACULTURE (SFA)

Massachusetts and the Northeast region have long been associated with thriving commercial and recreational fisheries that land a diverse number of species including finfish, lobsters and shellfish. The decline of some of the favored fish stocks, including cod, has led to efforts to reduce waste and support sustainable fisheries. Although the public's desire is simple, namely sustain a safe supply of seafood, achieving this goal is complicated.

SFA Continuing Priority Activities

MITSG's SFA efforts have over the years focused on the following:

- Fisheries and Offshore Aquaculture Engineering
- By-catch reduction and sustainable fisheries management
- Working waterfronts
- Social science aspects of New England fisheries and community support
- Alternative markets development and opportunities for underutilized species
- Monitoring and analysis of coast-wide populations for fisheries management and stock assessments
- Community science, education, outreach, and engagement programs focusing on our stakeholder-driven SFA focus areas

Currently, MIT Sea Grant SFA outreach focuses on supporting the development of community supported fisheries and aquaculture, working with state fisheries managers and industry to develop products and markets for unused byproducts and underutilized species. MIT Sea Grant is working with the NOAA Northeast Fisheries Science Center and local fisheries wardens on the use of machine learning technology to improve video monitoring for fisheries assessments. Additional efforts will include the development of engineering and technology solutions, and computational tools in our AUV and Design Labs, and fisheries research in our new Bio Lab, in support of fish and aquaculture industries and management.

SFA Future Directions

We will continue our ongoing efforts, as well as address stakeholder-driven needs by developing advanced engineering, technology, and biological applications for sustainable fisheries and aquaculture production, monitoring, and operations.

SFA Continuing High Priority Activities

- Support development of fisheries and aquaculture especially offshore
- Develop with state fisheries managers and industry products and markets for underused products
- Use Machine Learning technology for video monitoring of fisheries
- Develop technology solutions for fisheries research

During 2018-2023, MIT Sea Grant will work with stakeholders to develop engineering and robotics technologies in service to aquaculture farming and sustainable fisheries industries. Our stakeholders have expressed opportunities and support for development of automation and sensor technologies for farm operations, hatcheries, ocean, and land-based applications. Every step in the aquaculture process has many pieces that would benefit from automation from seed to market, creating the need and opportunity for advancement in this area. MIT Sea Grant will work with Woods Hole Sea Grant (WHSG) to build partnerships with existing growers that can support, pilot, and demonstrate this work. Robotics, automation, and propulsion address production and farming needs, and integrating robotics improves safety and reduces operations costs, enabling the industry to compete and advance their capabilities. Our industry stakeholders expressed strong support for development and transfer of these technologies.

SFA Outreach and Education

MIT Sea Grant Sustainable Fisheries and Aquaculture outreach efforts focus on promoting the benefits of vibrant working waterfronts, fisheries engineering, fisheries management and assessment, and aquaculture practices. Our outreach includes transferring information, tools and technologies developed by our staff, researchers, engineers and modelers in support of fisheries, aquaculture, resource management, and industry, as well as assisting with monitoring and assessment of fisheries resources. Our outreach activities will continue to support these efforts. In addition, MITSG has added a Marine Extension Specialist (MES-A) to the MITSG Advisory Group, who will focus specifically on aquaculture outreach, extension, and training. The MITSG-A will work with WHSG to address the needs of our MA aquaculture stakeholders.

SFA Future Directions

- Engineering and robotics for fisheries and aquaculture operations
- Biomimetics research and engineering in support of fisheries and aquaculture monitoring and production
- Machine learning for fisheries and aquaculture management
- Alternative markets development
- Assisting with fisheries monitoring and stock assessments
- Monitoring and assessing climate impacts to fisheries and aquaculture resources
- Community science, education, outreach, engagement, and training programs focusing on our stakeholder-driven SFA focus areas

SFA COVID-19 Pandemic Response

MIT Sea Grant's SFA response to the COVID-19 pandemic focused on creating alternative markets that provide financial assistance for the local fishing industry through a Fishing Vessel-to-Food Banks Alternative Markets Development Program, "Saving a Community Fishery, Feeding People in Need". The program partners local fishermen with the Massachusetts food bank system and the Massachusetts Department of Agriculture by purchasing excess fish and making a chowder that is then given to the food banks. The program provides immediate financial relief for the local fishing industry to offset impacts from the COVID-19 pandemic and fresh locally caught seafood products for families that rely on the food banks. The program establishes alternative markets and revenue streams in the short-term during the COVID-19 pandemic period that will continue as a long-term alternative market for the Massachusetts fishing industry as part of the state emergency food assistance program. The second part of the SFA COVID-19 pandemic response is conducting MIT Institutional Review Board (IRB) compliant surveys of the Massachusetts Aquaculture and Fishing industry, seeking input from industry stakeholders regarding current and expected financial and practical impacts on short (i.e., 3-6 months) medium (6-12 months) and long (1-5 years) term time horizons. We have engaged with representatives of the following organizations who have provided feedback on different aspects of the project: NOAA National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, Northeast Aquaculture Office; Massachusetts Division of Marine Fisheries, Shellfish Program; and shellfish constables from Massachusetts coastal towns. This effort to characterize stakeholder needs and distribution of information to inform stakeholders will continue.

SFA Goal 1: Fisheries, aquaculture, and other coastal and freshwater natural resources supply food, jobs, and economic and cultural benefits

MIT Sea Grant Outcome: Increased understanding and technological solutions aid fisheries and aquaculture management and production.

MIT Sea Grant Outcome: Partnerships enable the wild caught fisheries and aquaculture industries to adapt and acquire innovative technologies.

MIT Sea Grant Outcome: Develop technologies that will be transferred to the coastal resource industries, so they can employ technologies and reinforce strategies to ensure safe and sustainable seafood and products.

FOCUS AREA: RESILIENT COMMUNITIES AND ECONOMIES (RCE)

Over the last thirty years or more, coastal areas have seen increased growth in development and tourism. The development along the coast has brought increased runoff, sedimentation, nutrients, contaminants, and habitat degradation. Stakeholders are concerned about sea level rise, more intense and frequent storms, and increased coastal erosion that could cause damage to coastal infrastructure. Constituents want data and analysis on inundation, changes to communities and natural resources, and ways to adapt and mitigate impacts. Impacts to fishing communities and the state seafood industry provided additional challenges for our stakeholders.

RCE Past and Continuing Activities and Accomplishments

To address these issues, MITSG has focused its RCE efforts on the following:

- Bluefin, MITSG AUV Lab multimillion-dollar ocean engineering robotics spinoff company
- Modeling storm surge inundation and flooding in coastal communities
- Supporting fishing communities through establishing cultural heritage centers, and emergency response guidance manuals
- Contributing to the NOAA North Atlantic Region Regional Collaboration Network's monthly climate assessments and forecasts for coastal community impacts

RCE Continuing Priority Activities

- Support fishing communities through working waterfronts
- Assist underserved communities with development of adaptation planning to protect critical infrastructure from coastal flooding and damage
- Assist regional planning groups such as the Northeast Coastal Acidification Network (NECAN) with monitoring, analysis, outreach, education, and training regarding impacts of ocean acidification on coastal resources, industries, and economies
- Contribute to multi-partner regional planning groups that focus on coastal impacts with secondary effects on communities and economies
- Contribute to fisheries and aquaculture monitoring and stock assessments
- Participation in regional working groups
- Collaborate with local fishing and aquaculture groups to develop alternative markets

RCE Future Directions

MIT Sea Grant will continue to focus on pioneering technology partnerships for 2018-2023. Future efforts will involve assessing community vulnerabilities and working to meet stakeholder needs by providing tools and technology to help coastal communities manage their monitoring efforts, overcome hurdles to increased fisheries and aquaculture productivity, and inform local/state/federal decision processes. MIT Sea Grant will work with our partners in research, design, engineering, and technology to develop solutions for improving living shorelines and resilience of our coastal resources and communities. Developing protective infrastructure that is biological in nature, the use of traditional coastal habitat restoration and natural processes, and addressing site selection challenges and the biological aspects of Living Shorelines and Resilience are priorities identified by our stakeholder groups (MA Division of marine Fisheries; MA Office of Coastal Zone Management; and WHOI). Applying our efforts in the areas of ocean wind and renewable ocean energy, with a focus on tidal and wave energy, and decarbonization of maritime fleets will further enable MIT Sea Grant to develop regional partnerships and collaborations that meet the needs of our stakeholders and address the Sea Grant priority focus for supporting Resilient Communities and Economies.

RCE Future Directions

- Autonomous vessel navigation for use in maritime commerce
- Coastal and ocean sensing advancements monitor and forecast environmental impacts on communities and economies
- Fisheries and aquaculture engineering and robotics to improve operations and reduce economic impacts
- Collaborations with partners and stakeholders to improve resilience of coastal communities through monitoring, forecasting, and engineering
- RCE outreach, education, and engagement with a focus on underserved communities

RCE COVID-19 Pandemic Response

The MITSG COVID-19 Pandemic response presented in the SFA section above also encompasses RCE components of supporting local communities and economies.

RCE Goal 1: Coastal communities use their knowledge of changing conditions and risks to become resilient to extreme events, economic disruptions, and other threats to community well-being.

MIT Sea Grant Outcome: Communities employ adaptive management strategies and apply tools to engage diverse members of the community to improve resilience and community sustainability.

MIT Sea Grant Outcome: Communities have access to tools, services, and technologies to adapt and grow resilient economies.

RCE Goal 2: Water resources are sustained and protected to meet existing and emerging needs of the communities, economies, and ecosystems that depend on them.

MIT Sea Grant Outcome: Communities have access to sound science, data, tools, and services to understand and anticipate changes in water quality and quantity.

MIT Sea Grant Outcome: Communities have access to science, tools, and technologies to protect and sustain water resources and make informed decisions.

FOCUS AREA: ENVIRONMENTAL LITERACY AND WORKFORCE DEVELOPMENT (ELWD)

The effort by many states to focus on science and engineering standards for K-12 education underscores the need to provide students and teachers with information, tools, experiences, and creative activities to achieve these goals. STEM education, community science programs, public outreach and engagement, and training for practitioners and the next generation of coastal and ocean scientists and engineers has been and will continue to be the focus of MITSG ELWD activities.

In 2018-2023, MITSG will continue with the programs listed above. Our Advisory staff will continue to offer K-12 education components resulting from their fisheries, watershed, coastal, and marine science research collaborations. MIT Sea Grant has a strong commitment to supporting students and interns, and we will continue to work with volunteer monitoring groups, and develop community science programs that increase environmental literacy and promote workforce development. MIT Sea Grant staff will continue to provide undergraduate and graduate level courses for students at MIT in engineering, natural resources, and marine science. Through our monthly lecture series, MIT Sea Grant-funded researchers present their work to staff, state and federal managers, and others to foster technical transfer of information; all constituents are welcome to attend and participate in discussions. We will continue to reach out to museums, aquariums, and the public. We will continue to host the Blue Lobster Bowl and to develop programs for minority students and underserved communities, which incorporate biology, ecology, chemistry, engineering, physics and public policy and resource management.

ELWD Continuing Priority Activities

- Undergraduate and K-12 courses in coastal and marine ecology
- Community science programs on fisheries, Blue Carbon, OA impacts
- MIT undergraduate courses in ocean engineering
- MIT Undergraduate Research Opportunities (UROP) at MITSG
- MIT Minority Introduction to Engineering and Technology programs at MITSG

ELWD Future Directions

In 2018-2023, MITSG will add increased education, outreach, extension, and training for aquaculture related topics. Our recent added MES-A will work with WHSG on aquaculture ELWD programs for MA stakeholders. In 2016, the Massachusetts Governor's office specifically identified workforce development in technology industries as a high priority¹; our future efforts will address this challenge. MIT Sea Grant educators are committed to expanding on our informal K-12 engineering program for teachers and students (SeaPerch) to introduce engineering design principles, and provide teachers with background information on physics and biological science relevant to engineering in the ocean environment. We will develop the tools and technology, spatial models, and research results that inform and enable our partners and constituents.

ELWD Future Directions

- Increased education, outreach, extension, and training for aquaculture related topics
- Contribute to workforce development in ocean technology industries
- Expand our informal K-12 engineering program for teachers and students (SeaPerch)
- Develop tools and technology for spatial models that inform and enable our partners and constituents
- Develop classes on novel technologies for the ocean

MIT Sea Grant staff will continue to provide undergraduate and graduate level courses for students at MIT in engineering, natural resources, and marine science and will introduce special curriculum for novel technologies in ocean and coastal engineering, including autonomy of surface and underwater vehicles, biomimetic physical, chemical and biological sensors, and robotics for underwater intervention, targeting offshore aquaculture farming.

ELWD Outreach and Education

The two subsections above provide detailed information relating to this subheading.

ELWD COVID-19 Pandemic Response

ELWD components of MITSG's COVID-19 pandemic response included the following:

The MIT Sea Grant Seafood Resources website was established in response to industry and stakeholder needs for accurate and timely COVID-19 information (<https://seagrants.mit.edu/seafood-resources/>). The website provides access to state, federal, and general resources for the seafood industry during the COVID-19 pandemic that are critical for navigating through the abundance of information on COVID-19 impacts and relief resources. The MIT Sea Grant Education at Home website was also created in response to stakeholder needs for engaging students and life-long learners in

¹ The Commonwealth of Massachusetts in the 189th General Court (2015-2016): An Act Relative to Job Creation and Workforce Development (H. 4569)

remote educational activities during the pandemic (<https://seagrant.mit.edu/education-at-home/>). These MIT Sea Grant websites link to the National Sea Grant Seafood Resources Information page and National Sea Grant Education at Home Resources for additional information. MITSG will continue to update these websites to provide the most current information in support of our stakeholders.

ELWD Goal 1: An environmentally literate public that is informed by lifelong formal and informal opportunities that reflect the range of diversity of our communities.

MIT Sea Grant Outcome: Communities are knowledgeable and equipped with the best available science and technology in order to contribute to adaptive management planning processes and stewardship.

MIT Sea Grant Outcome: Teachers and students are better informed in science, technology, engineering, and mathematics fields and can employ their knowledge to support sustainable practices within their communities.

MIT Sea Grant Outcome: Stakeholders develop a sense of awareness, understanding and stewardship in order to sustain watershed, coastal, and marine ecosystems and resources.

ELWD Goal 2: A diverse and skilled workforce is engaged and enabled to address critical local, regional, and national needs.

MIT Sea Grant Outcome: College level courses and internships provide increased literacy, experience, and preparedness in areas of engineering, watershed, coastal, and marine ecosystems for all students particularly those from underrepresented groups.

MIT Sea Grant Outcome: Undergraduate and graduate students particularly those from underrepresented groups, are supported and have access to formal and experiential learning, training, and research experiences.

APPENDIX 1

MIT Sea Grant Diversity, Equity, and Inclusion (DEI) Statement

The mission of MIT Sea Grant is to promote the sustainable development of coastal and marine resources, connect communities with science, and rise to meet ocean-related challenges. In meeting these challenges through innovative technical contributions and a commitment to scientific research, we continue to gain understanding about our oceans and coasts, as well as our communities.

As expressed through the Community of Practice on Inclusion and Diversity, Sea Grant empowers coastal communities to be resilient in the face of change. MIT Sea Grant's success in providing valued research, education, and outreach is dependent on adapting to the needs of an evolving coastal population and changing social climate.

Both MIT's Department of Mechanical Engineering and the NSGCP have developed diversity and equity working groups to ensure the advancement of these values. Diversity and inclusion are highlighted as "cross-cutting principles" in the 2018-2021 National Sea Grant Strategic Plan. These principles – to seek and welcome diverse perspectives in order to enhance cultural understanding and better serve communities – are echoed in the MIT Sea Grant Strategic Plan as we strive to proactively engage, reflect, and serve diverse populations of communities, researchers, students, and stakeholders.

From leading ocean engineering programs with MIT's Office of Minority Education, to recruiting students through the National Sea Grant Community Engaged Internships initiative, MIT Sea Grant has a strong history of supporting students and educators from minority and underserved communities. We also work to establish a diverse and skilled workforce and collaborative infrastructure needed to protect our resources and the people who depend on them.

MIT Sea Grant is committed to maintaining an unbiased, equal opportunity environment in which all voices in our community are valued and respected in an ever-changing and increasingly diverse world.

"We celebrate these differences as enhancing features of MIT's creative, energetic, and welcoming fabric."

- MIT Mechanical Engineering Statement on Diversity

"We encourage those working with MIT Sea Grant but also beyond, to take time to educate ourselves on what injustice and systemic racism look like today."

- A Message from the Director

National Sea Grant Community of Practice on Inclusion and Diversity

The National Sea Grant Community of Practice on Inclusion and Diversity defines diversity, equity, and inclusion in the following way:

Diversity - Sea Grant embraces individuals of all ages, races, ethnicities, national origins, gender identities, sexual orientations, disabilities, cultures, religions, citizenship types, marital statuses, education levels, job classifications, veteran status types, and income, and socioeconomic status types. Sea Grant is committed to increasing the diversity of the Sea Grant workforce and of the communities we serve.

Equity - Sea Grant provides individuals and communities a voice and opportunity in decision making. Sea Grant is committed to a policy of equal opportunity for all persons and does not discriminate. Sea Grant works to challenge and respond to bias, harassment and discrimination.

Inclusion - Sea Grant is committed to building inclusive research, extension, communication and education programs that serve people with unique backgrounds, circumstances, needs, perspectives and ways of thinking. Sea Grant cultivates a sense of belonging among staff, partners, and communities served.