

NEW HAMPSHIRE SEA GRANT STRATEGIC PLAN 2018–2021





The New Hampshire Sea Grant College Program provides support, leadership and expertise for university-based marine research, extension and education. Based at the University of New Hampshire, it is one of 33 members of the National Oceanic and Atmospheric Administration's National Sea Grant College Program, which is devoted to promoting the understanding, wise use and stewardship of our coastal resources.

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NEW HAMPSHIRE SEA GRANT

STRATEGIC PLAN 2018–2021

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COASTAL SCIENCE FOR THE GRANITE STATE

A Note from Our Director



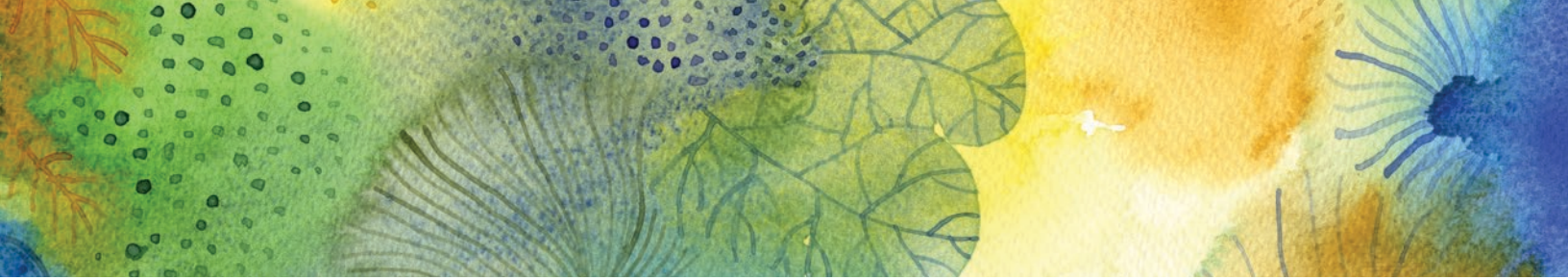
As we head into the next four years, New Hampshire and the Northeast coastal communities will face a familiar set of challenges and opportunities. Warming temperatures, the effects of ocean acidification, a changing frequency and intensity of storms, lingering water quality issues, invasive species, marine debris and emerging toxins are just some of the challenges we face in our search for sustainable wild fisheries, a thriving and growing 'green' aquaculture industry, resilient communities and local economies and healthy ecosystems.

This strategic plan, developed by the New Hampshire Sea Grant staff and Policy Advisory Committee, will motivate and guide our actions to address these challenges based on the Sea Grant approach: Long-term investment in research integrated with extension, education and communications efforts that are continuously engaged with stakeholders.

We will combine this approach with our dedication to partnership and collaboration, our role as facilitators and connectors, our unbiased source of science-based information, and our responsibility to work on behalf of the people of New Hampshire and our region. We look forward to working with you as we develop programs that reflect and support this strategic plan so that, together, we can make the most of our coast.

A handwritten signature in black ink that reads "Erik Chapman". The signature is written in a cursive, flowing style.

Dr. Erik Chapman
Director of New Hampshire Sea Grant



Outline of Strategic Planning Process

The New Hampshire Sea Grant (NHSG) strategic planning process began during the summer of 2016 with an assessment of the membership of our Policy Advisory Council (PAC). We added several new positions to the PAC in order to fill gaps in their collective expertise, experience and perspectives with respect to the Sea Grant Network Focus Areas. In September 2016, we sent an online survey to each PAC member as well as recently funded researchers and NHSG staff to get their feedback on whether the situation statements and goals from our current strategic plan remain relevant today and moving forward to 2018-2021. We then reviewed the survey results and discussed changes to our Strategic Plan during an all-staff meeting (September 30) and a PAC meeting (October 5). The information and feedback from the survey and in-person meetings were then integrated into the draft strategic plan submitted on November 7, 2016. The final draft of the NHSG Strategic Plan was submitted on February 8, 2017.



This draft was developed by our staff based on 1) feedback from the National Sea Grant Office on our draft plan, 2) modifications to align with a final Sea Grant Network Strategic Plan, and 3) input from the PAC on our draft plan.

Vision

New Hampshire Sea Grant envisions a future where people live, work and play along our coast and estuaries in a manner that supports healthy ecosystems while allowing for wise use of natural resources.

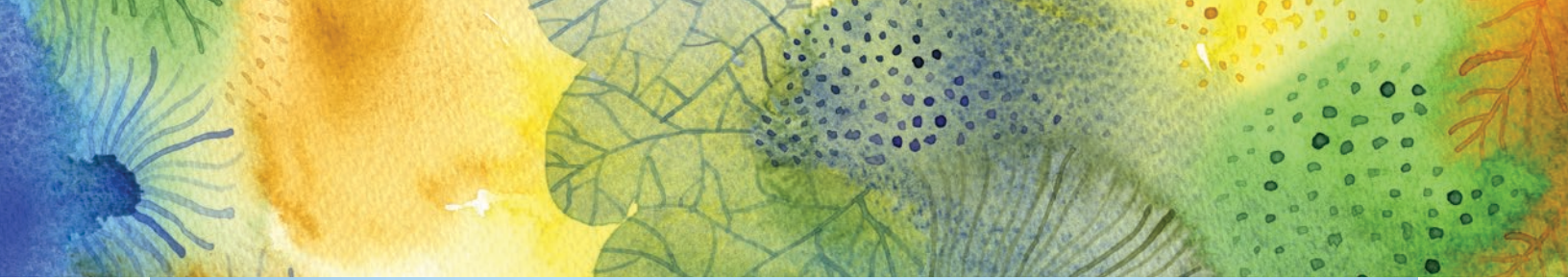
Mission

To promote responsible stewardship of New Hampshire's ocean, coastal, and estuarine resources that supports coastal communities, economies and ecosystems through integrated research, education, extension, and communication efforts.

Core Values

The New Hampshire Sea Grant core values that guide our behaviors and actions are:

- **Innovation** NHSG staff and programs support creative solutions to emerging challenges in science and stewardship.
- **Engagement** NHSG staff and programs are responsive and accessible and allow for the flow of information both from and to stakeholders in order to support decision making that is mutually beneficial to a range of constituents.
- **Collaboration** NHSG staff coordinate, build partnerships and seek out relationships that leverage our and our partners' strengths and promote efficiency.



- **Accountability** NHSG staff take responsibility for their behavior and actions while creating an environment where others feel supported in doing the same.
- **Sustainability** NHSG staff and programs communicate the importance of effective stewardship of ocean, coastal and estuarine ecosystems to quality of life for people in the state and region, both along the coast and inland.
- **Objectivity** NHSG staff and programs should be neutral and serve as honest brokers of science-based information.

Cross-Cutting Principles

New Hampshire Sea Grant will strive to implement its Strategic Plan by applying the following three cross-cutting principles in order to enhance the network's capabilities to meet future needs:

- **Partnership** NHSG assembles the expertise and capabilities of our partners from the international, federal, tribal, and state

communities and from academia and nongovernmental organizations.

- **Organizational Excellence** NHSG establishes a framework of standards and processes that engage and motivate our network of partners to deliver products and services that fulfill our mission and vision in a manner that is respectful of all those involved.
- **Diversity and Inclusion** NHSG seeks and welcomes diverse perspectives and viewpoints in order to strengthen and renew Sea Grant's mission and vision.

New Hampshire Sea Grant 2018-2021 Programming Overview

New Hampshire Sea Grant focuses its research, extension, education and communications efforts within the four focus areas outlined in the Sea Grant Network Strategic Plan. The following outlines the situations, approach, vision and targeted outcomes of this work within each of the focus areas.



Focus Area: Healthy Coastal Ecosystems

Situation

New Hampshire's coastal watershed is a highly desirable place to live, work and recreate due to the diverse ecological, aesthetic and economic benefits the region has to offer. Tourism, recreational and commercial activities — including fishing, aquaculture and shellfishing — and the quality of life in the Seacoast all depend on balancing healthy ecosystems with ongoing and increasing human demands. The N.H. coastline has long endured a legacy of human impacts beginning in

There is an overarching need to harmonize and integrate human needs with ecosystem health considerations.

the early 1600s when European settlers first arrived and began extracting resources, transforming diverse terrestrial, coastal and estuarine habitats, and introducing pollutants

into the ecosystem. Human population growth and development, along with increasingly significant impacts from climate change, continued this widespread degradation and loss of coastal and estuarine habitats, resources and biodiversity in N.H.

While pollution abatement efforts, fisheries management, habitat restoration and dam removal activities have helped the Seacoast to partially recover from historic impacts, the health of N.H.'s coastal ecosystems continues to be challenged by ongoing and emerging human- and climate-derived stressors both on the Seacoast and further inland. Land-use changes have resulted in habitat loss and increased pollution associated with septic, wastewater and stormwater discharges. The proliferation of pathogens, marine debris and

contaminants of emerging concern (CECs) threaten the health of humans and aquatic life. Climate change impacts including increased rainfall and drought, rising sea levels and a rapidly warming Gulf of Maine serve to amplify existing problems like flooding and shoreline erosion, the spread of invasive species and the effects of ocean acidification.

There is an increasing awareness among scientists and resource managers that biodiversity, bio-complexity, and healthy ecosystem structure and function are essential attributes of natural systems that underlie their resilience and their long-term capacity to provide ecosystem services. In addition, the myriad challenges to ecosystem health are complex, interrelated and require a forward-thinking, collaborative local-to-global approach to ensure a sustainably managed Seacoast for the future.

Approach

NHSG recognizes the linkage of ecosystem issues in N.H. with regional and global factors and management efforts; there is an overarching need to harmonize and integrate human needs with ecosystem health considerations. NHSG is connecting research, education, extension and communications efforts to mitigate human impacts on N.H.'s coastal resources and plan for future issues and changes. Specifically, our focus is on enhancing and restoring ecosystem functions critical to human and ecosystem health by ensuring safe and clean waters and seafood, identifying information gaps and emerging issues, and supporting scientific study by both university and citizen scientists through the Coastal Research



Volunteer (CRV) Program. Working in partnership with our coastal watershed stakeholders, NHSG will provide tools and knowledge to communities and resource managers that will inform decision making on how best to manage coastal ecosystems to maintain and improve overall integrated ecosystem health and to address new challenges as they emerge.

Vision

New Hampshire's stakeholders work together to share knowledge, contribute to research and monitoring, and implement management practices to ensure that coastal ecosystems are high functioning, safe for human use and resilient to future changes.

Goal 1

Critical coastal ecosystem functions and services are preserved, maintained and/or restored.

Learning outcomes:

- 1.1 New Hampshire resource managers and scientists develop, optimize and evaluate

methods for improving and restoring ecosystem services of coastal habitats.

- 1.2 Volunteers increase their knowledge of the functions and values of coastal ecosystems, the threats to these systems and options for addressing these threats.
- 1.3 NHSG supports the development of methods for quantifying and predicting changes in critical ecosystem processes, biological responses and conditions within coastal habitats that are adopted by N.H. resource managers.

Action outcomes:

- 1.4 By working with NHSG's CRV Program, researchers and natural resource managers increase their capacity to collect data and implement management strategies.
- 1.5 Volunteers participate in coastal research and stewardship projects.
- 1.6 Agencies and organizations make decisions regarding coastal ecosystem management based on the best available science.



Focus Area: Healthy Coastal Ecosystems

Consequence outcomes:

- 1.7 New Hampshire's coastal ecosystems provide abundant ecosystem services.
- 1.8 Public involvement via the CRV Program leads to informed decision making about N.H.'s coastal resources.

Goal 2

Coastal waters are safe and clean for recreation and locally harvested seafood is safe for consumers.

Learning outcomes:

- 2.1 New Hampshire oyster farmers, fishermen, distributors, seafood consumers and resource managers are better informed about seafood safety issues.
- 2.2 New Hampshire recreational coastal water users, beachgoers, resource managers and other stakeholders are better informed about the full breadth of water quality issues in the state.
- 2.3 Volunteers increase their knowledge of issues related to safe seafood and water.
- 2.4 Fishermen and the public understand the effects and impacts of marine debris and plastics on coastal ecosystems.
- 2.5 Local, state and regional agencies and organizations recognize pollution management options, associated costs and benefits, and likely public and ecosystem outcomes from different approaches.

Action outcomes:

- 2.6 Researchers develop tools to identify

sources of – and strategies to reduce – pollutants in coastal waters and seafood.

- 2.7 Models and new monitoring technologies are developed to predict and assess public health and ecosystem health risk conditions associated with naturally occurring pathogens, invasive species and toxin-producing algae.
- 2.8 Tools are developed that determine the incidence of – and strategies to reduce – marine debris, plastic and CECs in N.H. coastal waters.
- 2.9 Volunteers participate in research projects related to ecosystem and public health.





Consequence outcomes:

- 2.10 Tools and information developed through research and volunteer efforts are used by municipalities and management agencies to reduce all types of pollution and protect coastal waters.
- 2.11 The seafood industry and recreational harvesters use new information and best management tools to reduce consumer safety concerns.

Goal 3

Coastal communities effectively plan for the future and mitigate existing problems associated with human impacts to healthy and resilient coastal ecosystems.

Learning outcomes:

- 3.1 Managers and municipalities in the coastal watershed know about technical tools and assistance that can be used to enhance habitat restoration and ecosystem-based management.
- 3.2 Managers and municipalities gain knowledge about the effects of current and projected

climate conditions and acidification processes on coastal ecosystems.

Action outcomes:

- 3.3 Methods for quantifying and predicting ecosystem impacts of climate change, sea-level rise and coastal acidification are developed.
- 3.4 Local, regional and state agencies working in the coastal watershed incorporate the best available knowledge about current and projected climate conditions into ecosystem planning and management activities.
- 3.5 Coastal communities use best management approaches to treat and reduce impacts of stormwater and wastewater on coastal ecosystems.

Consequence outcomes:

- 3.6 New Hampshire's coastal ecosystems are managed using an ecosystem-based approach.
- 3.7 Coastal communities are resilient and prepared for current and projected changes in climate conditions and sea levels.



Focus Area: Resilient Communities and Economies

Situation

New Hampshire's coastal watershed features 42 rural towns, including beach towns near the Hampton-Seabrook Estuary, a few small cities with historic mills around Great Bay and Portsmouth and an additional 10 municipalities within the state of Maine. The Great Bay Estuary drains into the Gulf of Maine via the Piscataqua River, which serves as an important waterway for most of N.H.'s water-dependent commerce and industry. The Seacoast is rich in Pre-Columbian and early settlement and maritime history, arts and culture, recreational opportunities and tourist attractions, and ecological and aesthetic treasures.

Local opportunities to make a real difference are growing.

The coastal watershed is home to 25 percent of N.H.'s population. As in many coastal areas, development pressure and nonpoint source pollution potential are high

for the Seacoast. Effluent from 20 wastewater treatment facilities and hundreds of stormwater pipes release into the coastal waters, bay and tributary rivers. About one-quarter of the coastal subwatersheds contain greater than 10 percent impervious cover, indicating the potential for water quality degradation. In addition, significant nutrient contributions are made to N.H.'s coastal estuaries from septic systems that serve an estimated 175,000 residents as well as from lawn and agriculture fertilizers introduced in coastal watersheds. As a result, The Great Bay Estuary, N.H.'s dominant estuarine system, was designated nitrogen impaired by the U.S. EPA in 2010.

Changing climate conditions are compounding threats to water and community resources. Annual precipitation is expected to increase by as much as 20 percent before the end of the century compared with the late 20th century, and sea level is projected to rise between 1.6 and 6.6 feet by 2100. Impacts from coastal storms are expected to increase because of rising sea levels and additional coastal development. The threat of nonpoint source pollutants in the form of sediment, pathogens, toxic contaminants and nutrients are exacerbated by increasing precipitation rates and storm intensity. At the same time, communities are expressing concern about the vulnerability of transportation routes and municipal infrastructure including roads, bridges, culverts and all types of wastewater treatment due to these changing climate conditions.

Climate-related threats are not limited to municipal infrastructure and assets. Groundwater supplies that serve as drinking water are threatened by the increasing likelihood of saltwater intrusions in response to rising sea level. Concerns about the region's cultural and historical resources, as well as its natural resources in the face of a changing climate, have increased. A recent survey of community leaders also identified concern about vulnerable populations, especially with regard to flooding along coastal watershed rivers.

Responses to these threats must recognize that the people of N.H. pride themselves on principles of local control. Community decisions, including those regarding land use, are primarily made by municipal officials, many of whom are volunteer board members; this results in communities feeling



under-resourced and operating reactively rather than proactively. However, local opportunities to make a real difference are growing thanks to strengthened partnerships, the availability of new and local science data, state-level recognition of the need to address coastal hazards, and traction with outreach and education for community leaders.

These emerging partnerships have been very productive in recent years, producing a number of regional assessments, including a climate assessment, two vulnerability assessments, a planning, policy and regulation assessment, an online viewer for GIS-based information, and a water quality indicator report. The information contained in these documents helps provide a background for decision making and community action.

In addition, the N.H. Coastal Risks and Hazards Commission released its final report with recommendations in November 2016. The Commission's Science and Technical Advisory Panel created a report that offers communities planning guidance based on different planning timeframes and projected climate conditions. An outreach project to share the Commission's recommendations with the state's 42 coastal watershed communities is about to begin.

Approach

The importance of NHSG's partnerships in its approach to these challenges, particularly in terms of its work with coastal watershed communities cannot be overstated. NHSG's work to address nonpoint source pollution is often done in coordination with N.H.'s Natural Resource Outreach Coalition. The members collaborate to build the capacity of municipal officials and community leaders to reduce nonpoint source pollution, primarily through better land-use planning and practices. NHSG's work to advance climate adaptation is often done in coordination with N.H.'s Coastal Adaptation Workgroup, a coalition created to deliver education, facilitation and technical assistance in the Seacoast. NHSG is also collaborating with UNH Cooperative Extension to support a Community Climate Adaptation Program Coordinator position that will bridge water, forestry and agriculture in coastal and inland communities.

With its partners, NHSG Extension is able to actively participate in and lead efforts related to building resilient communities and economies. NHSG's work with communities is grounded in providing communities with the best available



Focus Area: Resilient Communities and Economies

data and helping community leaders apply the information to their own priorities with as much comfort and confidence as possible. NHSG's approach includes community engagement over a period of time that has resulted in successes in the past and plays a critical role in promoting resilience. Staff members from NHSG and Maine Sea Grant lead an annual exchange between their climate adaptation networks and inform each other of professional development opportunities as they arise. This exchange presents an opportunity to identify shared issues that could benefit from regional attention and resources.

Vision

Coastal community leaders in N.H. are able to prepare and plan for, mitigate, recover from or more successfully adapt to actual or potential adverse events, especially those related to severe weather and a changing climate.

Goal 4

Coastal watershed communities in N.H. protect marine and coastal natural resources through better land-use planning and practices that reduce nonpoint source pollution.

Learning outcomes:

- 4.1 Community leaders (such as municipal employees or volunteer board members) and conservation organizations will be familiar with the basic principles of water resources protection.
- 4.2 Land care and design professionals working in communities will be familiar with, value

and have the ability to implement best management practices related to land care and development practices.

- 4.3 Community leaders will have the ability to engage appropriate technical experts, facilitators and communities of interest in coastal resource decision making.
- 4.4 Community leaders will know about impacts of different land uses and development techniques on coastal resources and consider them in developing plans, policies, regulations and practices in ways that protect environmental, economic and social benefits of coastal resources.

Action outcomes:

- 4.5 Community leaders (such as municipal employees or volunteer board members) and conservation organizations will seek and apply relevant data, technical tools and technical assistance to improve land use decision making and land development practices.
- 4.6 Land care and design professionals working in communities will incorporate better land development practices into protocols and designs.
- 4.7 Community leaders will engage appropriate technical experts, facilitators and communities of interest in coastal resource decision making.
- 4.8 Community leaders will promote, request or require land use patterns and development techniques that protect environmental,



economic and social benefits of coastal resources through planning documents, policies, regulations and practices.

Consequence outcome:

- 4.9 Coastal communities in N.H. will have high-quality marine and coastal natural resources that provide social, economic and environmental benefits.

Goal 5

Coastal watershed communities in N.H. are better prepared for current and projected climate conditions and are able to reduce risks to life, health, property, built and natural infrastructure from severe weather, sea-level rise, flooding and other climate effects.

Learning outcomes:

- 5.1 Municipal, business and organizational community leaders will increase their knowledge about climate conditions, impacts and associated vulnerabilities and assets.
- 5.2 Municipal, business and organizational community leaders will increase their knowledge about tools, techniques and strategies that can be used to reduce climate-related risks to life, health, property and infrastructure.
- 5.3 Municipal, business and organizational community leaders will recognize how climate-related risks affect their own communities.
- 5.4 Municipal, business and organizational community leaders will be motivated to incorporate climate adaptation into plans, policies and practices.
- 5.5 Community leaders will increase their access to sources of technical, human and financial assistance for climate adaptation.



Action outcomes:

- 5.6 Community leaders will participate in opportunities for capacity building to increase technical, financial and human resources that can be applied to climate preparedness.
- 5.7 Community leaders will incorporate current and projected climate trends into planning processes and documents.
- 5.8 Community leaders will adapt regulations and policies to account for current and projected climate trends and promote adaptation through protection, accommodation and retreat as befitting community priorities.

Consequence outcome:

- 5.9 Coastal communities in N.H. will reduce risks to health, life, property and infrastructure from climate effects.



Focus Area: Environmental Literacy and Workforce Development

Situation

In December 2015, the Every Student Succeeds Act (ESSA) was passed by the U.S. Congress and signed into law by President Obama. The act reauthorizes the 50-year-old Elementary and Secondary Education Act (ESEA), the nation's law that acts as the foundation for national educational policy and funding. The law replaces the controversial No Child Left Behind Act and includes a number of provisions that have important implications for the Environmental Literacy and Workforce Development focus area. The ESSA

There remains a critical need for a public with an understanding of ocean and coastal science, climate science and the need to plan for increased community resilience.

on increasing the number of marine-career-ready graduates and encourages development of this capacity beginning at younger ages.

The ESSA also supports the adoption of the Next Generation Science Standards (NGSS) – a set of standards for science education that is based upon, among other things, the philosophy that students need to do science to learn science, and that environmental literacy is a critical component of a literate citizenry. Ocean and climate science in particular are included in this set of national standards for the first time, and the support for

“requires...that all students in America be taught to high academic standards that will prepare them to succeed in college and careers.” This emphasis on career readiness in the act supports Sea Grant’s emphasis

the standards in the ESSA improves the likelihood that states and school districts will add these content areas to their curricula. Based on a recommendation from the N.H. Department of Education (NHDoE), N.H. school districts have adopted NGSS as N.H. Science Standards. NHDoE also supports the state’s Environmental Literacy Plan (NHELP) which aligns with the NGSS and recommends a significant increase in field-based science instruction. The implication for this focus area is that programming to support professional development for N.H. teachers in ocean, climate and environmental science will be a significant need, and both formal and informal education programs that support the standards will be valued.

There remains a critical need for a public with an understanding of ocean and coastal science, climate science and the need to plan for increased community resilience. A general lack of understanding of coastal conservation and management decision making by people who are, and will be, our country’s voters, workforce, and political and community leaders persists. The national reports that reiterated the need for an informed public and well-trained workforce in ocean, coastal and Great Lakes issues (Pew Oceans Commission [2003]; U.S. Commission on Ocean Policy [2004]) are still pertinent. Coordinated Sea Grant Extension and education programming to address the conceptual and technical needs of this area remains a high priority.

Beyond the need for an informed and environmentally literate citizenry is the recent challenge at the national and local levels to increase the number of students graduating from two- and four-year institutions of higher learning



who are trained in science, technology, engineering and mathematics (STEM). Recently, the U.S. business and industry sectors have reported a severe shortage in the number of STEM-trained graduates in the workforce. This shortage has led to sourcing jobs overseas, thus resulting in a significant negative impact on the economy.

Approach

Delivery of marine science education programs in the region will continue to rely heavily on the more than 180 Sea Grant-trained volunteers, the UNH Marine Docents. The Docents support NGSS, the Ocean Literacy and Climate Literacy standards, and N.H. Environmental Education Plan through in-school and field-based science activities for students pre-K through college, and with adult audiences at events and public meetings. Sea Grant education staff also support increased literacy through the provision of teacher professional development programs and leadership in regional and national marine and environmental education initiatives.

NHSG will continue to address the need for

supporting workforce development in ocean-related industries by investing in undergraduate internships in marine science, providing support for Sea Grant's John A. Knauss Marine Policy Fellowship, and providing support for an undergraduate course at the University of New Hampshire that specifically targets ocean engineering (Tech 797 Ocean Projects Course). In addition, NHSG will continue to support workforce development by providing training and other hands-on learning opportunities for individuals interested in pursuing employment and careers in the region's emerging aquaculture industry.

Vision

New Hampshire youth and adults are environmentally literate and make informed decisions about ocean and coastal issues.

Goal 6

An environmentally literate and engaged public supported by informal education and outreach opportunities in ocean, coastal and climate sciences.



Focus Area: Environmental Literacy and Workforce Development

Learning outcome:

- 6.1 New Hampshire residents increase their environmental literacy and stewardship activity through NHSG informal ocean, coastal and climate education programs that utilize the latest scientific research and educational best practices.

Action outcome:

- 6.2 Participants in informal programs increase their ocean, coastal and climate literacy and make informed decisions regarding society's impact on the ocean and the Earth's climate.

Consequence outcome:

- 6.3 Decisions regarding society's impact on the ocean and Earth's climate are developed and supported by engaged citizens who are literate in ocean, coastal and climate science utilizing the latest scientific research.

Goal 7

Environmentally literate pre-K – 12 students supported by formal education and outreach opportunities in ocean, coastal and climate sciences, aligned with the Next Generation Science Standards (NGSS) and N.H. Environmental Literacy Plan (NHELP).

Learning outcome:

- 7.1 New Hampshire pre-K – 12 students increase their environmental literacy through UNH Marine Docent formal and informal ocean, coastal and climate education programs that utilize the latest scientific research and educational best practices and are aligned with the NGSS and the NHELP.

Action outcome:

- 7.2 Students in formal and informal programs increase their ocean, coastal and climate literacy.

Consequence outcome:

- 7.3 Increased student environmental literacy results in increased participation in related undergraduate and graduate opportunities and increased involvement in environmental stewardship activities.

Goal 8

Formal and informal educators utilize ocean, coastal and climate curricula and programming grounded in NGSS and NHELP.

Learning outcome:

- 8.1 Formal and informal educators gain an increased understanding of ocean, coastal and climate literacy principles and standards.





Action outcome:

8.2 Formal and informal educators incorporate ocean, coastal and climate literacy principles and standards into their teaching.

Consequence outcome:

8.3 Analysis of assessment data from participating schools shows a measurable increase in student ocean, coastal and climate literacy.

Goal 9

A workforce skilled in science technology, engineering and other disciplines critical to the resolution of ocean, coastal and climate issues.

Learning outcome:

9.1 NHSG program participants gain skills and knowledge qualifying them for ocean-, coastal- and climate-related career opportunities.

Action outcome:

9.2 NHSG program participants qualify and apply for ocean-, coastal- and climate-related career opportunities.

Consequence outcome:

9.3 Ocean-, coastal- and climate-related career opportunities are filled with qualified applicants.





Focus Area: Sustainable Fisheries and Aquaculture

Situation

Today's commercial and recreational fishing industries continue to be affected by the combined impacts of fishing and warming Gulf of Maine waters. These effects appear to be reducing the size and distribution of commercially valuable stocks, particularly those at the southern edge of their range (e.g. Atlantic cod and northern shrimp). As a result, fishermen have experienced severe cuts in their allowable catch for valuable stocks.

Finfish and shellfish aquaculture offers a business alternative for the small vessel owner.

The management response has been to provide strong incentive for fishermen to develop fishing methods and gear

that can select for abundant species while avoiding rare ones. Meanwhile, cultural and knowledge gaps among fishermen, scientists and managers continue to present challenges to efforts to develop successful management solutions in wild fisheries.

These combined challenges have led to a decrease in N.H.'s commercial groundfishing fleet from around 60 vessels in 2008 to approximately 10 vessels today. This reduction in fishing activity threatens the continued existence of dockside infrastructure in Portsmouth and at the Yankee Fisherman's Cooperative in Seabrook while dimming prospects of development of greater processing capacity in N.H. that might allow fishermen greater access to alternative, higher-value markets.

In the future, prospects may improve if some stocks recover in response to management, or if fishermen are able to take advantage of emerging fisheries as

southern species such as squid, summer flounder, butterfish, and black sea bass expand their range into Gulf of Maine waters. In addition, a growing interest and need for local, sustainable seafood has created opportunities for fishermen to access improved markets for lesser-known, more abundant species (e.g. spiny dogfish and whiting). Local seafood businesses, including community-supported fisheries, restaurants and some processors that offer seafood to local consumers and institutional buyers while directing higher profits to fishermen than to traditional markets continue to grow in the Seacoast. This continuing trend offers some hope for market changes that can provide meaningful support for local fishermen and associated fishing businesses.

New Hampshire's recreational fishery has also been affected by struggling stocks as bag limits for cod and haddock, the two primary target species for a thriving for-hire recreational fishing sector, have recently experienced dramatic swings from year to year. Improved science and management that stabilizes bag limits and methods for increased species selectivity and reduces release mortality could improve the sustainability of N.H.'s recreational fishing industry.

The N.H. lobster industry faces high fuel and bait prices, as well as the potential for negative population effects in response to a warming Gulf of Maine. This, combined with increasingly high landings creates some concern for future prospects in this fishery despite a general indication of healthy stock status at present. Continued monitoring and assessment of factors affecting lobstering businesses are critical despite relatively stable recent trends in landings and value.



Unlike wild fisheries, seafood aquaculture has been identified as a U.S. economic sector with great potential for growth. The United Nations Food and Agriculture Organization predicts a 40 mmt shortfall in seafood availability by 2030, and it is widely believed that ocean aquaculture has the best potential to meet future protein demands. At present, the U.S. imports 90 percent of its seafood, half of which are aquaculture products. Seafood produced overseas does not always adhere to strict oversight on farm practices or environmental standards. As consumers demand safe and sustainable seafood, the U.S. needs to develop responsibly managed, environmentally safe and sustainable aquaculture.

Given the challenges facing N.H. fishermen and lobstermen, finfish and shellfish aquaculture offers a business alternative for the small vessel owner to either transition from wild harvest fisheries to farming or to subsidize loss of income. Recently, the state permitting process was streamlined through the N.H. Department of Fish and Game to encourage shellfish production in state waters. Since then, oyster production has grown to include 15 oyster farming permits in the Great Bay Estuary. Over six million oysters are in bottom culture with a crop value worth approximately \$3.4 million. Aided by ongoing research and collaboration with NHSG-funded research projects, oyster farmers are continuing to refine and develop their approaches to reduce product grow-out time, human health consequences and mortality. The potential for further development of oyster farming in N.H. is

uncertain due to area closures related to water quality, available space, potential conflicts with other uses of the Great Bay Estuary and technological challenges. In addition to the existing shellfish industry in Great Bay, opportunities for blue mussel, seaweed and finfish aquaculture exist in N.H. coastal and offshore waters. Regionally, the emerging sustainable aquaculture industry is limited by technical support, permitting requirements and a lack of training and expertise in growth and husbandry of shellfish, seaweeds and finfish.

Approach

NHSG works through partnerships with fishermen, NOAA Fisheries, the New England Fisheries Management Council, N.H. Department of Fish and Game and nongovernmental organizations that are invested in fisheries to track and respond to emerging needs in fisheries and aquaculture. By facilitating workshops, meetings and collaboration among stakeholders, NHSG works to improve the efficiency and effective development of fisheries and aquaculture science, management and policy. NHSG will continue to work with dockside businesses to explore ways that they can take advantage of improved business management practices and emerging market opportunities. NHSG continues to facilitate the development and transfer of technologies and methods that reduce the environmental impact of fishing and aquaculture practices, and will support improved knowledge about the effects of climate change



Focus Area: Sustainable Fisheries and Aquaculture

on fisheries and aquaculture and the relevant adaptation methods available to fishermen. In addition, NHSG pursues the development and demonstration of multi-trophic aquaculture systems that combine macroalgae, shellfish and finfish culture to create an environmentally friendly, nutrient-neutral system, while providing technical assistance to fishermen and other entrepreneurs interested in this and other aquaculture ventures.

Vision

New Hampshire supports aquaculture and fishing industries that sustain our coastal economy and our fishing heritage while providing recreational opportunities and conserving coastal and marine resources.

Goal 10

The N.H. recreational and commercial fishing industries build economic resiliency while preserving marine ecosystems.

Learning outcomes:

- 10.1 Commercial and recreational fishermen have an improved knowledge and understanding of technologies that reduce environmental impacts of fishing operations.
- 10.2 Commercial fishermen are more aware of opportunities to diversify their portfolio of activities in order to maintain profitable businesses on the water.
- 10.3 There is improved awareness and availability of innovative dockside processing, handling and marketing methods available to commercial fishermen and associated dockside businesses.
- 10.4 Seafood consumers and the interested public

improve their awareness of opportunities for purchasing local seafood and recreational fishing.

Action outcomes:

- 10.5 Innovative methods to reduce environmental impacts are adopted by commercial and recreational fishermen.
- 10.6 Innovative processing, handling and marketing methods are used by local businesses.
- 10.7 Fishermen diversify and supplement their fishing businesses by moving into additional fisheries or aquaculture businesses.
- 10.8 Local and regional consumers purchase more local seafood and participate in recreational fishing.

Consequence outcome:

- 10.9 New Hampshire commercial and recreational fishermen increase local production and revenues and have more profitable, resilient businesses that support and are supported by other local associated businesses.

Goal 11

The N.H. aquaculture industry increases its employment level and economic value.

Learning outcomes:

- 11.1 There is an improved knowledge of effective engineering and husbandry practices used in aquaculture production of shellfish, finfish and/or sea vegetables in N.H.'s estuarine, coastal and offshore waters.
- 11.2 There is an improved understanding of processes and requirements to establish



and maintain permits for N.H. aquaculture production.

- 11.3 There is an improved understanding of the economic opportunities and risks associated with different forms of aquaculture production in N.H.
- 11.4 Seafood consumers and the general public understand local aquaculture production methods, availability and the health and other benefits of consumption of N.H. aquaculture products.
- 11.5 There is greater access to training through credit and non-credit programs in N.H. for those interested in gaining employment in the aquaculture industry.

Action outcomes:

- 11.6 New Hampshire oyster farmers modify their practices to improve safe and sustainable production while improving ecosystem impacts of their operations.
- 11.7 New Hampshire aquaculture entrepreneurs use proven engineering and husbandry methods to improve and establish businesses farming shellfish, finfish and/or sea vegetables.
- 11.8 New Hampshire seafood consumers increase consumption of locally sourced aquaculture products.

Consequence outcomes:

- 11.9 There is improved efficiency and profitability of existing oyster farms.
- 11.10 New aquaculture businesses are established for cultivating shellfish, finfish and/or sea vegetable species.

Goal 12

Fisheries and aquaculture industries and marine ecosystems are supported by an effective and

trusted system of integrated fishing, science, permitting, management structures, and industry practices.

Learning outcomes:

- 12.1 The knowledge, experience and expertise among fishermen, scientists and managers are shared to improve ecological knowledge, stock status and management options that effectively support conservation and fishing goals.
- 12.2 Fishermen and aquaculturists are more aware of ways to participate in science and management processes.
- 12.3 Fishermen and aquaculturists are more aware of each other's activities and space requirements.

Action outcomes:

- 12.4 Fisherman, aquaculturists, scientists and managers are better informed about marine ecosystems, fishing and aquaculture practices and implications of management options that meet both ecosystem and industry goals.
- 12.5 Fishermen and aquaculturists are more engaged in science and regulation activity and decisions.
- 12.6 Fishermen and aquaculturists allow for the marine spatial requirements for each other's activities.

Consequence outcome:

- 12.7 Greater trust and engagement among fishermen, aquaculturists, scientists, permitting agencies and managers leads to improved success in management of fisheries and aquaculture practices to support ecological and business goals.



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