



**A New Vision
for the
Lobster Institute**



LOBSTER INSTITUTE

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The lobster wharf - a way of life in coastal New England and Atlantic Canada

I. EXECUTIVE SUMMARY

Since 1987 the Lobster Institute has been a center of scholarship and outreach at the University of Maine. Its mission is to promote, conduct and communicate research focused on the sustainability of the American lobster fishery in the US and Canada. The Institute also provides technical and educational outreach, disseminates research findings in understandable and accessible ways, and convenes conferences and workshops to engage stakeholders in solving challenges faced by this iconic fishery.

Over the past three decades the American lobster has emerged as one of the few fisheries in the world that is more productive now than it has been over the past century. It has long been an economic driver and cultural icon for the State of Maine and Atlantic Canada. As of 2015 the lobster represented the most valuable fishery in both nations. Maine harvests about 80% of the US share, and lobster is the state's most valuable export commodity. Apart from its unparalleled commercial value, the lobster has also long stood as a model organism in biological research. Still, a changing environment and global economy make for an uncertain future for this fishery.

With the lobster at this precarious height of its economic value, the Lobster Institute now enters its fourth decade with the opportunity to enhance its impact as never before. Over the past year, feedback gathered from UMaine faculty, fishing industry members, and government resource managers, both in the US and Canada, have provided a clear message that the Institute can and should do more to facilitate and promote research to address the needs of industry and policy makers. This document describes a vision for a path forward, one that builds upon the Institute's previous successes and aspires to create greater opportunities for UMaine faculty and students to engage with the diverse groups of industry members, resource managers, and scientists that have a stake in the sustainability and management of this important fishery.

A Lobster Institute working group has identified three strategic goals: *(1) To be UMaine's center for information and opportunities in lobster research; (2) To enhance faculty and student incentives to engage with stakeholders; and (3) To increase outreach and visibility to stakeholders through traditional and new media.*

The sea change the new vision brings is its intent to capitalize on the significant research and outreach capacity of UMaine faculty and students so as to engage their full potential in the spectrum of opportunities and partnerships with external stakeholders in the lobster industry and fishery management. The vision not only includes UMaine programs that have already established a track record of lobster research, such as Animal Health, Fishery Science and Ecology, Policy and Economics, and Food Sciences, but it also seeks to develop new potential in areas such as Engineering and New Media. This vision statement identifies specific outcomes and impacts anticipated from activity toward these goals. Feedback from reviewers of this evolving document will help further refine UMaine's aim to better support the lobster industry and resource managers in the Maine and the wider region through an invigorated Lobster Institute.

This visioning document is meant to serve as a springboard for a fully developed strategic plan, in which more specific programming and strategies to meet and implement this vision's goals and objectives will be outlined. A wider net will be cast to acquire additional input as the plan is developed.

II. INTRODUCTION

The Lobster - A Maine Icon

The American lobster (*Homarus americanus*) is an economic driver and cultural icon for the State of Maine. The lobster fishery holds the distinction of being one of the few fisheries in the world that can boast being more productive now than at any time in its history. Indeed, in the last decade both US and Canadian lobster fisheries have broken all previous harvest records. Since 2015 the American lobster has comprised the most valuable fishery in the nation. Maine harvests about 80% of the US share, and lobster is also the state's most valuable export commodity. The state's lobsters are traded worldwide, supplying major markets across North America, Europe, and Asia. In addition, Maine's lobster fishery forms the foundation of the state's coastal economy that supports many related economic sectors, from tourism to trap makers. In the wake of a severely depleted groundfish fishery, once at the heart of the region's marine economy, Maine's coastal communities are now exceedingly reliant on this single fishery, presenting fishing communities with a precarious future.

The University of Maine has rightly become a leading center of scholarship in every aspect of lobster science. Apart from its commercial fishery value, the lobster has a long history as a model organism in biological research. It is also a key component of the Northwest Atlantic coastal marine ecosystem, and the coupled natural-human system, which has stood as a subject of intense socio-economic study. As a conspicuous member of the coastal food web, and because of its sensitivity to a changing environment, it has become a poster child for the impacts of climate change in marine ecosystems. Indeed, the importance of the American lobster extends well beyond the boundaries of our region.

The Lobster Institute

The Lobster Institute is a center of scholarship and outreach in the College of Natural Sciences and Agriculture at the University of Maine. Since 1987 it has conducted and facilitated research related to lobsters, primarily the American lobster and its fishery. The Institute quickly grew from a Maine-focused entity to serve the entire domain of the American lobster fishery from New York to Newfoundland. The Institute has also served as a central clearing-house for lobster-related information. Institute staff engage with the lobster industry, scientists, fishery managers, health regulators, and legislators to address industry priorities through collaborative research, educational workshops and conferences. As the lobster industry continues to grow in size and importance to the State of Maine and the region, so too must the University's Lobster Institute. With new challenges facing the lobster industry and fishery managers in the 21st century, the Lobster Institute is uniquely positioned to find novel and effective ways to enhance research and promote education, innovation, and communication among stakeholders, while promoting the sustainability of the lobster resource and the communities that rely on it.

Mission: *The Lobster Institute, with guidance and involvement from fishermen¹ and all constituents within the lobster industry, and with both a community and global perspective, conducts and provides for research and educational outreach focused on protecting, conserving, and enhancing the lobster resource and lobstering as an industry...and as a way of life.*

For the Lobster Institute to deliver on its mission it must have a clear vision and a realistic plan that capitalizes on the significant research and outreach capacity at the University of Maine. The ensuing vision, developed by the Lobster Institute working group (Appendix 1), first identifies the Institute’s current strengths, assets, and challenges. Next, it outlines the Institute’s vision for the future with realistic goals; and finally, it lays out a basic business plan to acquire the resources it needs to deliver on its mission over the coming decade.

Today the Lobster Institute is well positioned to build on its past successes and confront new challenges and opportunities that are on the horizon. In 2017 the Institute, in coordination with the College of Natural Sciences Forestry and Agriculture, initiated a series of meetings with groups of key stakeholders – harvesters, dealers, processors, fishery managers and UMaine faculty – to understand how it could better address existing and emerging priorities. One message was clear from these meetings: all stakeholders acknowledged the important role the Lobster Institute could take on with a new vision, and the need to expand on its success and become even more responsive to industry needs.

As it looks ahead, the Lobster Institute has the opportunity to create a new vision that builds upon its 30-year history and is grounded by core values embodied by its vision and mission statements. In particular, the Institute aspires to create greater opportunities for UMaine faculty and students to engage more deeply with the diverse groups of industry members, resource managers, and scientists that have a stake in the sustainability and management of lobsters.

III. WHERE WE STAND NOW: STRENGTHS, ASSETS AND OPPORTUNITIES

Strengths

Key strengths of the Lobster Institute that emerged from stakeholder meetings include:

- The Lobster Institute comprises a unique international membership of US-Canadian lobster interests;
- Its Board of Advisors (Appendix 2) has deep and broad stakeholder representation, comprising industry members, resource managers, and scientists from all regions of the fishery from the U.S. and the Canadian Maritimes;
- It benefits from University of Maine’s leadership, reputation and connection with its qualified faculty and their students;

¹ It is conventional in the Maine lobster industry for women to call themselves “lobstermen” or “fishermen.” In keeping with that culture we will use that terminology throughout this document, with all due respect to those who prefer “lobster fisher” or “fisher.”

- It has a solid reputation as a facilitator of communication and convener of stakeholder groups;
- It is a central clearinghouse for information on the lobster and the industry;
- It has strong outreach capability – linking qualified consultants with businesses and policy makers;
- It is involved in several research areas, especially related to lobster health and pathology as well as value-added product development;
- It is a facilitator of research – connecting industry needs with qualified researchers and helping to find funding for needed studies;
- Its long-standing staff has experience and credibility guided by core values (Appendix 2);
- It has well-established working relationships with harvesters as well as key players within the industry.

University of Maine Assets

The Lobster Institute's principle asset is the faculty, staff and students at the University of Maine, which provide access to scholarship in a diversity of lobster-related topics. Faculty with expressed interest and track record in lobster research are listed in Appendix 1. Additionally, its long history of building relationships with external researchers and industry members has produced substantial programmatic and financial support.

Over the past 5 years alone (2013 - 2017) the Lobster Institute assisted UMaine faculty and outside companies in preparing successful grants totaling \$987,462. In addition, Institute staff collaborated in the writing of the successful proposal submitted by UMaine for funding of the Alliance for Maine's Marine Economy, which resulted in \$7 million in state bond funding and at least equal matching funds from Alliance members.

In that time period, the Lobster Institute also raised \$227,440 in annual gifts and sponsorships, and \$57,580 in merchandise and events income (key donors listed in Appendix 3). Currently, the Institute has six endowed funds that support its work, held at the University of Maine Foundation (UMF), with a combined fair-market value of \$714,151 (UMF Annual Report 2017).

Importantly, over the past 5 years UMaine's Office of Research Administration reported more than \$2.8 million in grant support secured by UMaine faculty on research related to lobster biology and fisheries (Appendix 4). These projects supported numerous graduate and undergraduate students, resulting in over 13 graduate theses (Appendix 5) and 25 peer-reviewed publications (Appendix 6). Research topics, ranging from stock assessment to shell disease to socio-economics, often represent close collaborations with industry members and policy makers, and in some cases were interdisciplinary.

The following bullets briefly describe some of the key focal themes of existing UMaine expertise that provided opportunities for interdisciplinary collaboration and can be further tapped as the Institute addresses future challenges to the lobster fishery and related industry:

- ***Health and Environmental Stressors*** – Lobster health is a key driver of population abundance and sustainability. Our rapidly changing ocean environment has led to increased concern for the stability of lobster populations, and researchers at UMaine are actively coordinating their efforts to understand the potential consequences. UMaine's grant-funded Rapid Response Program provides lobster health advice and services throughout the region, enabling the industry to diagnose, prevent and respond to emerging lobster diseases.

Other research includes alternative bait and assessment of associated environmental health risks, as well as concerted efforts to understand the effects of ocean acidification and rising ocean temperatures on lobster health and disease susceptibility. It is important to identify conditions that are likely to impact lobster abundance; this information is critical for fisheries managers to enact timely management solutions. It will provide needed data for future ecosystem modeling, and will increase stakeholder resilience.

- ***Fishery Science and Ecology*** – UMaine has an eminent international reputation and track record in this area. A key contribution has been to open a window of understanding on the consequences of the interaction between ecological processes and harvesting on the distribution and productivity of the fishery. The UMaine lobster stock assessment model has been the gold-standard by which the US lobster stock has been assessed and managed. Faculty have also been instrumental in increasing the engagement of the fishing industry in research, and have played a key role in bringing down barriers between harvesters, managers and scientists. The American Lobster Settlement Index is an unprecedented 30-year US-Canadian monitoring partnership that is has proven to be a key indicator of the stability of the resource.
- ***Policy, Business and Economics*** – Since the 1988 publication of Dr. Jim Acheson’s landmark book *The Lobster Gangs of Maine*, the lobster fishery has been recognized worldwide as a model of effective co-management. The social-ecological conditions that have made the fishery sustainable have and continue to be a major focus. Socioeconomic research is an emerging area of emphasis. Researchers are also studying the aging of the lobster fleet and resilience of the industry in the face of socioeconomic and environmental change, implications of international trade, and bycatch of non-target species. New focus is being brought to the areas of business modeling and planning as well as cost-benefit analysis for technological and other changes in the harvesting, distribution and processing sectors.
- ***Food Sciences*** – For the lobster industry to reach its full economic potential it is essential for the resource to be fully utilized. Adding value to the current catch through product development as well as using by-catch and waste from processing will increase the value of the lobster, translating to enhanced income at all points in the supply and commercialization chain. UMaine’s School of Food and Agriculture’s Food Science program has a great deal of experience in this area. The lobster processing capabilities at the Dr. Matthew Highlands Food Pilot Plant provide modern facilities and opportunities for industry collaboration in food research. The sensory evaluation lab used for new product evaluation is world class. The Institute has strong ties with processors and specialty food producers in the U.S. and Canada that work with our faculty and students.
- ***Cooperative Extension*** – It is also critical to realize goals in safety and efficiency by developing proper handling protocols from boat to plate. UMaine faculty provide connections to Hazard Analysis and Critical Control Point (HACCP) planning, facility design, sanitation, food safety training, handling and holding systems manuals, and other outreach services.
- ***Engineering*** – The Lobster Institute working group envisions opportunity for growth in this discipline. UMaine’s School of Engineering’s Advanced Manufacturing Center has collaborated with Food Sciences on seafood processing innovations. New tools and technological support for harvesting, processing and shipping lobsters, as well as health monitoring, and enforcement of conservation laws, will continue to be needed and

improved. Systems for proper holding and shipping continue to evolve. Hatchery technology could become important if stocks decline, and present hatchery methods are not cost effective. Historically, the Institute has worked with chemical, biological, electrical, mechanical, civil and environmental engineering in this evolution. Engineering opportunities include: boat or trap designs, engine efficiency, quality evaluation, automation, and environmental modeling. Conservation management involves engineering with the detection of illegally scrubbed egged lobsters. Innovation Engineering may also have a function in an evolving Lobster Institute.

- ***New Media*** – UMaine’s New Media Department has been involved in producing lobster podcasts and videos, but the Institute has only scratched the surface in this area. It could play a larger role in translating our research results to stakeholders in industry and to policy makers. The Institute has helped relay the history and culture of the lobster industry through compiling oral histories, presenting lectures to community groups, bringing tourists to the state through its Lobster Colleges, and helping to coordinate the Downeast Fisheries Trail as a public attraction. There is great potential to expand our reach to stakeholders through social media and other internet outlets.

Priority Issues and Opportunities

Stakeholder meetings conducted by the Institute’s working group identified a number of areas where UMaine’s Lobster Institute could more effectively support the lobster industry and resource managers in Maine and the wider region. Both industry members and resource managers interviewed saw the need for the Institute to place a stronger emphasis on industry-identified research priorities. While there has been a long-standing core of UMaine faculty engaged in lobster research, many meeting attendees from within UMaine commented that the Lobster Institute could do more to promote UMaine lobster research. The Institute aspires to be recognized as a hub of opportunity, and could play a greater role to facilitate research and develop incentives for faculty and students to collaborate with resource managers and lobster industry stakeholders. The Institute aims to seek new resources to catalyze in-service training partnerships and interdisciplinary research. It will attract a full spectrum of potential users to engage in research on the industry’s most pressing problems, thereby enhancing UMaine’s positive impact on the industry and coastal communities.

Stakeholders identified the following unprioritized list of specific areas in which the Lobster Institute could have a positive impact over the short and long term. Some are issues of the moment; others are long-standing. New ones will surely emerge with time.

- ***Enhancing Survival in Lobster Holding Facilities:*** Lobster dealers and processors are eager to find ways to enhance survival and health of lobsters in their holding facilities. Improving survival by even a few percent could mean a substantial increase in profitability. Identifying the cause of death can be challenging because the lobster may have moved several steps down the supply chain over a few days before it dies. The Lobster Institute has a solid history of consulting with pound owners and dealers regarding health issues, and could play an even greater role in assembling appropriate UMaine expertise to advise and improve industry standards in health monitoring along the supply chain. UMaine’s Rapid-Response Program identified above is a useful model. Discussions with the Maine Lobster Dealers Association and individual dealers regarding next steps are already under way.

- ***Adding Value:*** Lobster dealers and processors are keenly interested in finding ways to enhance the value of their product. Overseas demand for live hard-shell lobster is as high as ever, especially in Asia. Live, hard-shell, lobster command the highest price. Maine lobster fishermen, however, largely take part in a summer fishery that lands mostly softshell lobster that do not ship well and are destined for a local market or processor. Through a Maine Technology Institute grant, UMaine faculty and students are already partnering with Ready Seafood Company, Portland, to find a profitable strategy to hold lobsters for several days to upgrade shell hardness and value. Product not entering the live market goes to processors. Most of the lobster processing capacity is in Canada. New high-tech methods of processing and extending the shelf life of fresh lobster meat are available and in demand.
- ***Implications of Whale Protections for Lobstering:*** In the wake of recent die-offs of the endangered North Atlantic right whale, the lobster industry is especially concerned about the implications of renewed public pressure on NOAA to enforce whale protection laws. In compliance with the Marine Mammal Protection Act and the Endangered Species Act, harvesters in US waters already use whale-safe gear designed to minimize whale entanglements, and it is illegal for US dealers to buy lobster from countries that do not have similarly stringent regulations. UMaine faculty in the School of Marine Sciences and the School of Engineering have been approached by the whale-watching industry to explore ways to help the lobster industry address this problem. Newly proposed rope-less traps with remote triggering devices to bring them to the surface, while technically feasible, are understandably being met with much skepticism in the fishing industry. The Lobster Institute can help facilitate research efforts and partnerships to help the fishing industry thrive while protecting marine mammals.
- ***Wind Energy Development:*** Wind energy development on lobster grounds is controversial. Locating wind turbine arrays and cable routes has the potential to interfere with lobstering activity. Efforts to site wind energy projects on the coast have met with substantial resistance from the harvesting sector of the lobster industry. Nonetheless, several windfarms are already in place in southern New England waters, and plans are being made for sites in Maine. The Lobster Institute's impartial involvement early and often to convey research and identify gaps in understanding impacts could help thwart misunderstandings.
- ***Stock Assessment and Forecasting:*** Every five years the Atlantic States Marine Fisheries Commission (ASMFC) convenes resource managers from all lobster-producing states and the NMFS for periodic stock assessments of the American lobster fishery, to evaluate the sustainability of current fishing pressure. UMaine faculty and graduate students have been intimately involved with the development and improvement of the ASMFC lobster stock assessment model as well as lobster fishery-independent and -dependent sampling protocols throughout the region. The Lobster Institute has an opportunity to play a greater role working with resource managers and industry members in the US and Canada to both facilitate fishery data collection and research priorities, and to translate often complex stock assessment analyses and conclusions to stakeholders.
- ***Understanding and Adapting to Climate Change:*** Climate change is a multi-faceted issue for the lobster industry. Its impacts are ecological, social and economic. Recent research suggests that existing conservation measures enabled the Gulf of Maine lobster fishery to capitalize on favorable environmental conditions arriving with a warming climate, but that

southern New England may have forestalled its collapse had it adopted similar regulations sooner. Meanwhile, lobster fisheries are expanding in the Gulf of St. Lawrence. Understanding and adapting to future environment change is a major challenge to the American lobster fishery and the coastal economies that depend on it. Many UMaine faculty and students are conducting research, often in collaboration with fishermen, on the ecological and socio-economic impacts of a changing environment that will help the fishing industry understand and adapt to a changing environment. The Lobster Institute can play an important role in providing research opportunities for faculty and students, and in outreach to disseminate and translate new findings.

- ***Barriers to Women in the Harvesting Sector:*** While women have traditionally played a long-standing role on shore, running lobster businesses or as industry advocates at fishery management meetings and the legislature, an increasing number are becoming or want to become harvesters in their own right. Social and financial barriers exist, however, that prevent women from entering the harvesting sector. The Lobster Institute sees an opportunity to work with UMaine's Rising Tide Center and women and men in the fishing industry to advance gender equity in the fishing work force.
- ***An Aging Fishing Fleet and Next Generation Leadership:*** The new generation of commercial fishermen entering the lobster sector today confront challenges not faced by the generation before them. The younger generation fishermen have only known a growing lobster fishery and made substantial financial investments in boats and gear. In real dollars the cost of fishing continues to rise just as the price of lobster runs near 50-year lows. These challenges include, but are not limited to business profitability, over-capitalization, limited bait supply, complex regulations, climate change, and global trade. The Lobster Institute sees an opportunity to facilitate networking and skill-building among young fishermen, recognizing that they are the future leaders of the industry.



The American lobster, *Homarus americanus*

IV. LOOKING AHEAD: A VISION FOR THE FUTURE

Where is the Lobster Institute headed? The working group has crafted an ambitious re-envisioning of the Lobster Institute’s direction for the future that builds upon current strengths and assets to address the emerging areas of concern identified above.

Vision: *The Lobster Institute’s vision is to be a leader in ensuring a sustainable and profitable American lobster industry by fostering transparency in communication among stakeholders; and championing credible scientific research supporting lobster and ecosystem health, conservation management and industry sustainability. We aspire to a University of Maine community engaged to its full potential to work collaboratively with lobster industry members, resource managers and policymakers, along with the international marine research community.*

The Lobster Institute can realize this vision with a collaborative approach linking industry expertise, resource managers and other external stakeholders with academic resources to solve and anticipate challenges (Figure 1). It will require the necessary resources for an effective Lobster Institute to creatively fulfill its goals and objectives. The Institute will be a proactive, inclusive, and trustworthy liaison between the scientific needs of the lobster industry and the talent pool of researchers within and outside UMaine. The Lobster Institute aspires to energize and expand the existing connections of distinguished researchers and communicators to the people of Maine’s lobster industry, with the overarching goal of fostering future growth and opportunity for all elements of the industry and for Maine and the wider region.

Understanding existing and evolving challenges to the lobster fishery and industry is the key to relevant research and programming. The Institute will regularly review industry priorities; including such areas as ocean acidification, rising water temperatures, whale interactions, socio-economic factors, workforce development, offshore energy, emerging technologies as well as ongoing issues related to lobster health (i.e. shell disease) and population dynamics.

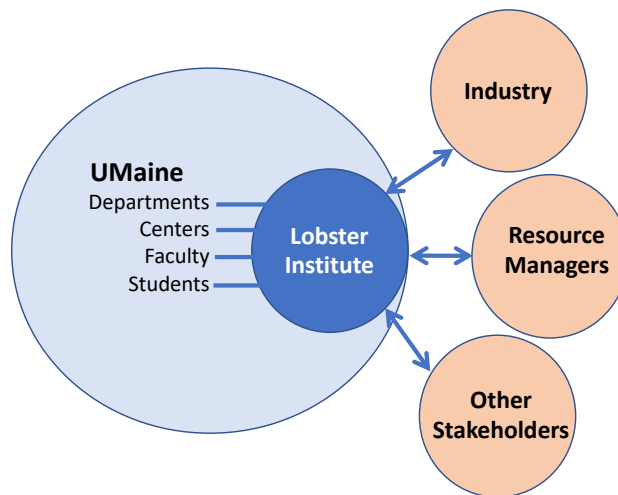


Figure 1. The University of Maine’s Lobster Institute aspires to engage UMaine faculty and students with external stakeholders, mostly representing the fishing industry and resource managers, in the US and Canada.

Strategic Goals & Initiatives

The Lobster Institute acts on behalf of the University of Maine and the University of Maine System to enhance the engagement and impact of its faculty and students at the state, national and international level. Given the importance of the American lobster to the state and region, there is an expressed need from our stakeholders to expand and enhance the impact of UMaine's Lobster Institute in several areas. Specific goals have been identified for the Institute to address these needs over the coming years. These goals align with UMaine's three-part mission of research, teaching and service, placing an even stronger emphasis on UMaine's unparalleled talent pool of diverse faculty and students as our ambassadors for greater engagement with industry and policy makers on lobster-related projects. The objective and outputs derived from these goals are to remain fluid and ever-evolving, and the impacts to be meaningful.

- **Goal 1 – Be UMaine's center for information and opportunities in lobster research:** The Lobster Institute currently houses a diversity of lobster-related resources, such as published research, announcements of meetings and funding opportunities, as well as links to key industry members, associations, marine resource agencies and academic researchers in the US and Canada. There is great potential for the Institute to be not only a purveyor of information, but to play a more prominent role in defining the research agenda by working with external groups to identify research priorities and to set the stage to link UMaine faculty and students to external partnerships identified under Goal 2.

Objective: Maximize UMaine's effectiveness in addressing research priorities identified by stakeholders in industry and management.

Outputs: Research proposals, funded projects, match dollars leveraged, peer-reviewed publications, graduate theses, undergraduate capstone and honors projects.

Outcomes: Proactive coalition of UMaine researchers engaged with external stakeholders. Greater understanding by stakeholders of the topics addressed by the research.

Impacts: Industry and management decisions informed by research outcomes. UMaine is recognized as a center for lobster research. A healthy, sustainable lobster resource.

- **Goal 2 – Enhance faculty and student engagement with stakeholders and policy makers:** Although many UMaine faculty and students are already engaged in lobster-related collaborative activities such as research, technology transfer, or outreach, there is potential for even greater engagement through an inclusive membership of associate researchers connected to the Lobster Institute. The Institute will capitalize on existing potential within the UMaine faculty to build new research and outreach synergies to address critical needs identified by the lobster industry and leverage funding opportunities.

Objectives: Create incentives for faculty and student engagement. Serve as a liaison to potential collaborations with industry and managers. Build a diverse Board of Advisors.

Outputs: Negotiate/facilitate faculty access to research funding. Assist in proposal preparation. More lobster-related proposals submitted. More student assistantships, internships in support of faculty research.

Outcomes: An affiliated UMaine faculty membership and external partners with accompanying membership criteria and benefits (yet to be identified). UMaine researchers and students incentivized to make lobster research a priority. More diverse industry input. More grants for lobster-related research funded.

Impacts: UMaine faculty and student researchers engaged to their fullest potential. UMaine and Lobster Institute having a state, regional, and global reputation for a robust core group of lobster researchers. More industry voices heard, from all sectors, enhancing the value and relevance of the Lobster Institute.

- **Goal 3 - Enhance outreach and visibility:** The presence of UMaine’s activities in lobster research, outreach, and education across all subject areas and academic units will be bolstered on the web and in the media. The Lobster Institute’s presence will increase in traditional and new media to emphasize and serve partnerships with outside stakeholders including industry, managers, and policy makers.

Objectives: Play a key role in convening and presenting at workshops and forums. An enhanced website. Provide timely information to policy makers and the press.

Outputs: Number and type of workshops convened, attendance, number of presentations. Number of invited external presentations. Number of website hits, downloads, resultant collaborations. Number and type of contacts with decision makers and press releases.

Outcomes: Research and other relevant information is shared with all sectors of the industry in a timely manner. Greater participation in Institute-sponsored events. A vibrant and changing website featuring participating faculty, industry and government partners; current projects; news; upcoming events and funding opportunities. Decision makers knowledgeable about lobster and industry related challenges before making policy.

Impacts: The lobster industry is informed and engaged in science and collaborative research and outreach. Enhanced ability to bring Institute knowledge and services to a wide audience. Well informed policy and legislation. Elevated recognition of the Lobster Institute as the go-to center for lobster-related information.

Evaluation & Measures of Success

Lobster Institute programs, services and financial status will be reviewed periodically to ensure the Institute’s programs continue to serve its mission and are justified through measurable positive impact from the perspective of its stakeholders. Periodic reviews will be undertaken by subcommittees of the Institute in coordination with the College of Natural Sciences, Forestry, and Agriculture and external advisors as deemed necessary. The Institute director will produce an annual report consisting of a financial statement, and a full disclosure of outputs and impacts as outlined under our strategic goals in section V above. Every five years a programmatic review will be conducted by the College of Natural Sciences, Forestry, and Agriculture or the University of Maine and updates to the Institute’s Strategic Plan will be made as needed.

Financials: An annual financial review by a Budget Committee will ensure that Institute revenue and subsidies can continue to support the costs of Institute staff, students and programs. The budget committee would be comprised of the Executive Director, a representative of the College of Natural Sciences, Forestry, and Agriculture and two members of the Board of Advisors. A method will be devised to periodically review the financial status of the Lobster Institute, which

is consistent with UMaine fiscal policies and protocols. The aim is to ensure that Institute revenues and subsidies are being efficiently used to support the costs of Institute staff and priority programs.

Programs and services: An outcomes and impacts monitoring process will be devised and implemented to enable the Institute to track its progress in achieving its mission and vision with regard to research, outreach and education. Evaluation tools will consist of needs assessments, comparison to scientific best-practices and standard operating procedures, qualitative stakeholder surveys, utilization surveys, before and after comparisons, tracking trends and others. In keeping with NSFA-USDA project evaluation criteria, evaluation might consider the following questions: What was accomplished under the Institute's three strategic goals? Who are the affiliated UMaine faculty and how are they involved? What opportunities for research, training and professional development has the program or project provided to UMaine students? What is the economic impact? How have the results been disseminated to stakeholders in industry and management? Who is the target audience? How have the products been used by the target audience? Conference attendance? Media coverage?

A process to develop new programs and services: Prior to the development or modification of programs or research projects, an appraisal will be conducted to determine compatibility with the Institute mission. A research and programs committee representing the appropriate parties will be formed to review such proposals, and assess their success.

A cost analysis, and when possible a cost-benefit analysis, will be conducted prior to implementation of proposed programs and services, or expenditures to evaluate whether resources are being employed effectively, and whether new investments are consistent with the mission of the Institute.

With this new vision in hand, the Lobster Institute will embark upon a strategic planning exercise. Many specific programmatic additions were suggested during our preliminary stakeholder interviews and will be considered as the strategic plan develops.

V. BUSINESS PLAN AND BUDGET

The Lobster Institute is currently led by a part-time Executive Director, a full-time Associate Director, and part-time administrative support, and advised by a Board of Advisors (Appendix 2). Reporting line for the Institute will shift from the director of the Maine Agricultural & Forest Experiment Station to the dean of the College of Natural Resources, Forestry and Agriculture. Position responsibilities and budget considerations are outlined below.

Director

Responsibility: Leadership for the center and strategic planning. Catalyzing collaborative activities with stakeholders and faculty with support of the Associate Director. Provides scientific expertise, management, leadership and is the science and agency interface.

Cost Description: Part time responsibility with salary based on summer salary and/or release time from teaching or research workload of faculty member serving as director.

Notes and assumptions: Director will be a University of Maine faculty member. Three year renewable appointment.

Associate Director

Responsibility: Facilitates activities of the Lobster Institute. Active in development, outreach and management. Assists in catalyzing collaborative activities with stakeholders and faculty. Supervises/manages activities of the Administrative Specialist.

Cost Description: Currently a full time position supported by the Maine Economic Improvement Fund (MEIF).

Notes and assumptions: Vice President for Research (VPR) will continue to provide full MEIF support.

Administrative Specialist

Responsibility: Supports activities in development, outreach, and budget and finance.

Cost Description: Currently part-time; entirely supported by private fund raising.

Notes and assumptions: Assumes private funding can continue to provide partial support.

Graduate Research Assistant 1

Responsibility: Dedicated to lobster research. Grant leverage basis.

Cost Description: College of Natural Sciences, Forestry and Agriculture will commit to funding toward a new research assistantship annually with sources of funding for elements (stipend, tuition, and health insurance) of the commitment to be determined.

Notes and assumptions: In keeping with marine sciences being designated as a Signature Area of Excellence at the University, this research assistantship will be allocated to faculty in UMaine's School of Marine Sciences on a competitive basis (process to be determined). The faculty member will serve as the student's advisor. The intent of the college sponsorship is to provide assistantship resources to leverage external funding support.

Graduate Research Assistant 2

Responsibility: Dedicated to lobster research. Grant leverage basis.

Cost Description: No dedicated source at this time. See notes.

Notes and assumptions: This research assistantship will be allocated to faculty in UMaine academic units on a competitive basis. The faculty member will serve as the student's advisor. Funding options are in discussion.

Undergraduate Research Support

Responsibility: Facilitate faculty research.

Cost Description: Planning discussions with the director of the Center for Undergraduate Research (CUGR) on options to redirect and dedicate some current College of Natural Sciences, Forestry, and Agriculture support to CUGR for projects on lobsters.

Notes and assumptions: The college supports a significant number of CUGR projects annually and could dedicate some of that support annually to lobster research.

VI. CONCLUSIONS

As a result of nearly a year of sounding sessions and interviews with all sectors of the lobster community, from lobster processor to professor, the University of Maine’s Lobster Institute working group has come to the conclusion that the Institute can more effectively serve this community by strengthening UMaine partnerships with external stakeholders in the US and Canada. The working group has identified three primary goals: for the new Lobster Institute: (1) *To be UMaine’s center for information and opportunities in lobster research;* (2) *To enhance faculty and student engagement with stakeholders;* and (3) *To enhance outreach and visibility to stakeholders and the general public through traditional and new media.*

Informed by internal and external review of this evolving document, the Lobster Institute, in consultation with the College of Natural Sciences Forestry and Agriculture, will refine and implement this vision over the coming year. The Lobster Institute’s primary concern will be the sustainability of the fishery and the vitality of the industry. It will embrace its role as a collaborator and facilitator working with UMaine researchers, industry members and policy makers to advance relevant priorities. It will establish a membership-based assembly of UMaine faculty and student lobster researchers to extend its impact and reach. The Lobster Institute will also be recognized as a major disseminator of information on new developments in research. While the main focus will be on the American lobster, the Institute recognizes the global nature of the lobster industry and will continue to foster broader international linkages.



New beginnings – the three larval and single postlarval stage of the American lobster

APPENDIX 1

Lobster Institute Working Group:

Richard Wahle (Research Professor, School of Marine Sciences – Marine Biology; Lobster Institute Board of Advisors)
Robert Bayer (Director, Lobster Institute, Professor, School of Food & Agriculture – Animal Science)
Cathy Billings (Associate Director, Lobster Institute)
Heather Hamlin (Associate Professor, School of Marine Sciences - Aquaculture; Aquaculture Research Institute)
Joshua Stoll (Assistant Research Professor, SMS – Marine Policy; Maine Center for Coastal Fisheries)
Fred Servello (Dean, Natural Sciences, Forestry and Agriculture)

Stakeholder Groups Interviewed:

Downeast Lobstermen’s Association
East Coast Seafood
Luke’s Lobster / Cape Seafood
Maine Department of Marine Resources
Maine Lobstermen’s Association
Ready Seafood Company
UMaine faculty in School of Marine Sciences, School of Food & Agriculture, School of Economics, and UMaine Cooperative Extension

Faculty with Expressed Interests in Lobster Research and Outreach

James Acheson <Acheson@maine.edu> (Emeritus), Dept. Anthropology; School of Marine Sciences
Robert Bayer <rbayer@maine.edu>. School of Food & Agriculture
Christine Beitzl <christine.beitzl@maine.edu>, Dept. Anthropology; School of Marine Sciences
Jason Bolton <jason.bolton@maine.edu>, Cooperative Extension
Debbie Bouchard <deborah.bouchard@maine.edu>, Cooperative Extension; Director, Aquaculture Research Institute
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Richard Wahle <richard.wahle@maine.edu>, School of Marine Sciences
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APPENDIX 2



2017- 2018 BOARD of ADVISORS

Chairman

William Adler, Massachusetts Lobstermen's Association

Vice Chairman

Herbert Hodgkins, Maine Lobster Pound Association (ret)

Secretary/Clerk

Kathy Heanssler, Conary Cove Lobster (ME)

Executive Director

Robert Bayer, Ph.D., University of Maine

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William Anderson, Maine Lobstermen's Association (ME)
Dave Borden, Atlantic Offshore Lobstermen's Association
Sheila Dassatt, Downeast Lobstermen's Association (ME)
Lanny Dellinger, Rhode Island Lobstermen's Association (RI)
Jim Dow, Maine Lobstermen's Association (ME)
Kenneth Drake, PEI Lobstermen's Association (PEI)
Melanie Giffin, Director, PEI Fishermen's Association
Luke Holden, Lobster Processor/Restaurant Owner (ME)
Geoff Irvine, Lobster Council of Canada (NS)
Matt Jacobson, Maine Lobster Marketing Collaborative (ME)
Jason Joyce, Maine Lobstermen's Association (ME)
John Levy, LFA 33 (NS)
Bart Mansi, Connecticut Lobsterman & Restaurant Owner (CT)
Jack Merrill, III, Vice President Maine Lobstermen's Association (ME)
Eugene O'Leary, LFA 31A (NS)
Kathleen Reardon, Maine Department of Marine Resources (ME)
Dana Rice, D.B. Rice Fisheries, Downeast Lobstermen's Assoc. (ME)
Michel Richard, Maritime Fishermen's Union (NB)
Michael Sirois, V.P.-Fisheries Products International (MA)
Melanie Sonnenberg, Eastern Fishermen's Federation, (NB)
Norbert Stamps, Rhode Island Lobstermen's Association (RI)
Michael Tourkistas, Lobster Processor (ME, NB)
Annie Tselikis, Maine Lobster Dealers' Association (ME)
Richard Wahle, University of Maine School of Marine Sciences (UM)

Lobster Institute Core Values (from LI Strategic planning document 2012)

The following values represent the core priorities upon which the mission and vision of the Lobster Institute are based:

- The Lobster Institute values *cooperation* among and between scientists, harvesters, marine resource managers, lobstering communities and all constituents within the lobster industry... all working together toward a common goal of a sustainable, thriving fishery and related businesses.
- The Lobster Institute values *conservation* of the lobster resource and a respect for the overall environment that sustains all of our natural resources.
- The Lobster Institute values open *communication* – a sharing of concerns, knowledge of conditions, accomplishments and research findings within the industry, as well as educational outreach to a broader public.
- The Lobster Institute values the *way of life* associated with lobstering and lobstering communities that has evolved over the generations... a unique blend of independence, family pride, and community spirit.
- The Lobster Institute values the time-honored tradition of *shared access* between those who live by and those who make their living from the sea.
- The Lobster Institute values its *standing in the lobstering community* as a non-political, research/educational organization that balances the need to sustain the lobster resource with the need to maintain a vital fishery.

APPENDIX 3

Lobster Institute key donors.

University of Maine Foundation

Banks

Bangor Savings Bank
Bar Harbor Bank & Trust
Camden National Bank
Farm Credit of Maine
Gorham Savings Bank
Machias Savings Bank
University Credit Union

Corporations and businesses

Canadian Consul General in Boston - Canada
Chicken of the Sea - California
Conary Cove Lobster (Heanssler Family) - Maine
Connecticut Commercial Fishermen's Association
Craig's All Natural - New Hampshire
Darden Restaurants - Florida
Downeast Lobstermen's Association
East Coast Seafood - Massachusetts
 Subsidiaries: Paturrel - Canada & Maine Fair Trade Lobster - Maine
Grand Manan Fishermen's Association - Canada
Long Island Sound Lobstermen's Association
Luke's Lobster/Cape Seafood - Maine
Maine Lobster Dealer's Association
Maine Lobstermen's Association
Maine Salt - Maine
Maritime Fishermen's Union - Canada
Massachusetts Lobstermen's Association
New Brunswick Department of Agriculture, Aquaculture & Fisheries
Orion Seafood - Canada
PEI Fishermen's Association - Canada
Riverdale Mills - Massachusetts

APPENDIX 4
 UMaine grants supporting lobster-related research 2013-2017
 as recorded by the Office of Research Administration

FY	College	Unit	UM Investigators	Title	Sponsor	Award Amt
2013	NSFA	Mar Sci	Johnson	Aquaculture in shared waters	NOAA	\$56,601
	NSFA	Mar Sci	Wahle	Evaluating the American Lobster Settlement Index in Fishery Forecasting	ALSF	\$12,000
	NSFA	Mar Sci	Wahle	A new era in stock assessment of the American lobster (2013-2018)	ME DMR	\$250,000
	NSFA	Mar Sci	Wahle	American Lobster Settlement Index Oversight +\$ (2013-2017)	ME DMR	\$25,000
2014	Sea Grant		Anderson	Collaborative Research: Strengthening the scientific basis for decision-making: Advancing knowledge-action capacities in a coupled coastal-inland	NSF	\$120,000
	NSFA	Mar Sci	Chen, Thomas, Wahle	Coastal SEES (Track 2), Collaborative Research: Resilience and Adaptation of a Coastal Ecological-Economic System in Response to Increasing Temperature	NSF	\$139,713
	NSFA	Mar Sci	Hamlin, Bricknell, Bayer	The effects of regional temperature cycles on the development and disease susceptibility of the American lobster (<i>Homarus americanus</i>)	NOAA	\$249,516
2015	Sea Grant		Anderson (Brady, Bricknell, Hamlin)	Maine EPSCoR: The Nexus of Coastal Marine Social-Environmental Systems and Sustainable Ecological Aquaculture	NSF	\$600,000
	NSFA	Mar Sci	Chen	Improving survivability of cusk and Atlantic cod bycatch discarded in the Gulf of Maine lobster trap fishery	NOAA	\$229,243
	NSFA	Mar Sci	Hamlin, Bricknell, Bayer	The effects of regional temperature cycles on the development and disease susceptibility of the American lobster (<i>Homarus americanus</i>)	NOAA	\$199,613
	NSFA	Mar Sci	Wahle	CINAR: Using the American Lobster Settlement Index and Environmental Indicators in Fishery Forecasting and Stock Assessment	NOAA	\$134,827
	NSFA	Mar Sci	Wahle	Supplementary support for Maine DMR lobster growth and age determination project	NOAA	\$46,550
2016	NSFA	Co-op Ext	Bouchard, Hamlin, MacRae, Bayer	Understanding the effects of changing ocean ecosystems on lobster health and susceptible to disease in the context of rising water temperatures	ME DMR	\$127,482
	NSFA	Mar Sci	Chen	Evaluate Lobster Sea and Port Sampling Programs and effectiveness of Conservation measures	ME DMR	\$25,000
2017	NSFA	Mar Sci	Wahle	Assessing the Impact of Environmental Change on the Recruitment of Lobsters off Southeastern New England	NOAA	\$48,356
	NSFA	Mar Sci	Leslie, Stoll, Anderson, Wilson	Assessing the potential for sustainability of fishing-dependent communities in coastal Maine in the face of environmental and socioeconomic change	NOAA	\$275,308
	NSFA	Mar Sci	Wahle	Genetic and phenotypic response of larval American lobster to ocean warming and acidification across New England's steep thermal gradient	NOAA	\$153,099
	NSFA	Mar Sci	Wahle	Revealing Deepwater Lobster Settlement Across Thermal Gradients in the Gulf of Maine	NOAA	\$82,337
	NSFA	Mar Sci	Wahle	Supporting decision-making under climate variability and change: multi-scale forecasts and analyses for the Maine lobster fishery	NOAA	\$58,053
Total						\$2,832,698

APPENDIX 5
Graduate theses on lobster related research 2013-2017.

Year	Author	Degree	Title
2013	Anna M. Henry	MS	Assessing Social Resilience of Maine Fishing Communities and Developing a Longline Groundfish Survey
	Dominic Fitzpatrick	MS	Dynamical, Bioeconomic Modeling of Fishery Interactions in the Gulf of Maine
2014	Jennifer McHenry	MS	Abiotic Proxies of Benthic Megafaunal Assemblages in the Coastal Gulf of Maine: A Template for Ocean Planning?
	Hillary Scannell	MS	Frequency of Ocean Heat Waves in the North Atlantic and North Pacific Oceans
2015	Jie Cao	PhD	Evaluation and Improvement of Fisheries Stock Assessment, from Data Collection to Modeling
	Jui-Han Chang	PhD	Population Dynamics of American Lobster: Environmental, Ecological, and Economic Perspectives
2016	Jesica Waller	MS	Linking Rising pCO ₂ and Temperature to the Larval Development, Physiology and Gene Expression of the American Lobster (<i>Homarus americanus</i>)
	Joshua Stoll	PhD	The Human Ecology of Commercial Fishing in Maine: Hidden Connections, Tangled Institutions, Uncertain Resilience
	Lisha Guan	PhD	Development of Modeling Frameworks for Assessing Impacts of Habitat and Stock Structure on Fish Population Dynamics
	Meghan Capps	MS	The Effects of Regional Temperature Cycles on Larval American Lobsters, <i>Homarus americanus</i>
	Noah Oppenheim	MS	Recruitment Forecasting and Scientific Knowledge Production in the Gulf of Maine and Southern New England American Lobster Fishery
2017	Jocelyn M. Runnebaum	PhD	Improving Management and Conservation of Cusk (<i>Brosme brosme</i>): Habitat Distribution, Bycatch Interactions, and Conservation Practices
	Kevin Stapes	MS	Lobster in a Changing Gulf of Maine: Investigating the Temporal Impact on Molting and the Fishing Fleet

APPENDIX 6

Peer Reviewed Publications 2013-2017 listed in UMaine faculty annual reports available to the College of Natural Sciences Agriculture and Forestry (UM authors in bold; * students).

Year	Citation
2013	Mills, K.E., A.J. Pershing, C.J. Brown, Y. Chen , F.-S. Chiang, D.S. Holland, S. Lehuta, J.A. Nye, J.C. Sun, A.C. Thomas , and R.A. Wahle . 2013. Fisheries management in a changing climate: Lessons from the 2012 ocean heat wave in the Northwest Atlantic. <i>Oceanography</i> 26: 191-195. http://dx.doi.org/10.5670/oceanog.2013.27
	Oppenheim, N.* , R.A. Wahle . 2013. Cannibals by night? In situ video monitoring reveals diel shifts in inter- and intraspecific predation on tethered American lobsters. <i>Canadian Journal of Fisheries and Aquatic Sciences</i> 70: 1635–1640.
	Steneck, R.S. & R.A. Wahle . 2013. Lobster dynamics in a brave new ocean. <i>Canadian Journal of Fisheries and Aquatic Sciences</i> 70: 1571-1575
	Wahle, R.A. , A. Battison, L. Bernatchez, S. Boudreau, K. Castro, J.H. Grabowski, S.J. Greenwood, C. Guenther, R. Rochette, J. Wilson. 2013. The American lobster in a changing ecosystem: A US-Canada science symposium, 27-30 November, Portland, Maine. Introduction. <i>Can. J. Fish. Aquat. Sci.</i> 70: 1571-1575.
	Wahle, R.A. , C. Bergeron*, J. Tremblay, C. Wilson, V. Burdett- Coutts*, M. Comeau, R. Rochette, P. Lawton, R. Glenn, M. Gibson. 2013. The geography and bathymetry of American lobster benthic recruitment as measured by diver-based suction sampling and passive collectors. <i>Marine Biology Research</i> . 9: 42-58
	Wahle, R.A. , C. Brown*, K. Hovel. 2013. The geography and body size dependence of top-down forcing in New England's lobster-groundfish interaction. <i>Bulletin of Marine Science</i> . 89(1):189–212
2014	Bolton, J.C. , R. Bayer , R. Bushway, S.Collins and B. Perkins. 2014. Analytical and semi preparative HPLC analysis and isolation of hemocyanin from the American lobster. <i>Journal of Shellfish Research</i> . 33:11-17
	Burdett-Coutts, V.* , R.A. Wahle , R. Rochette, P. Snelgrove. 2014. Spatial linkages between settling young-of-year and older juvenile lobsters. <i>Mar. Ecol. Prog. Ser.</i> 499: 143–155. doi: 10.3354/meps10625
	Grieve, C., Brady, D.C. , & Polet, H. 2014. Best practices for managing, measuring, and mitigating the benthic impacts of fishing – Part 1. Marine Stewardship Council Science Series 2: 18-88
	Teisl, M.F. , McCoy, S., Marrinan, S., Noblet, C.L., Johnson, T. , Wibberly, M., Roper, R., & Klein, S. 2014. Will offshore energy face ‘fair winds and following seas’?: Understanding the factors influencing marine energy acceptance. <i>Estuaries and Coasts</i> . DOI 10.1007/s12237-014-9777-6
	Travis, J., Coleman, F. C., Auster, P. J., Cury, P.M., Estes, J. A., Orensanz, J., Peterson, C. H., Power, M. E., Steneck, R. S. , Wootton, J. T. 2014. The invisible fabric of nature: species interactions and fisheries management. <i>Proceedings of the National Academy of Sciences</i> . (doi/10.1073/pnas.1305853111).

Year	Citation
2015	Gledhill, D.K., M.M. White, J. Salisbury, H. Thomas, I. Mlsna, M. Liebman, B. Mook, J. Grear, A.C. Candelmo, R.C. Chambers, C.J. Gobler, C.W. Hunt, A.L. King, N.N. Price, S. Signorini, E. Stancioff , C. Stymiest, R.A. Wahle , J.D. Waller* , N.D. Rebuck, Z.A. Wang, T.L. Capson, J. R. Morrison, S. Cooley, S. Doney. 2015. Ocean acidification off New England and Nova Scotia. <i>Oceanography</i> . 28(2):182–197, http://dx.doi.org/10.5670/oceanog.2015.41
	Henry, A.M.* , & T.R. Johnson . 2015. Understanding social resilience in the Maine lobster industry. <i>Marine and Coastal Fisheries</i> . 7(1):33-43. http://www.tandfonline.com/doi/pdf/10.1080/19425120.2014.984086
	Petit, I.J., C.F. Gaymer, Á.T. Palma, R.A. Wahle . 2015. Predation of juvenile <i>Jasus frontalis</i> : An endemic spiny lobster of the Juan Fernández Archipelago, Chile. <i>Journal of Shellfish Research</i> 34:1085-1089. http://dx.doi.org/10.2983/035.034.0335
	Wahle, R.A. , L. Dellinger, S. Olszewski, P. Jekielek. 2015. Lobster nurseries of southern New England recede in the face of climate change. <i>ICES Journal of Marine Science</i> 72 (Suppl. 1): i69-i78, doi:10.1093/icesjms/fsv093
	Wahle, R.A. , L. Dellinger, S. Olszewski, P. Jekielek. 2015. Lobster nurseries of southern New England recede in the face of climate change. <i>ICES Journal of Marine Science</i> . doi:10.1093/icesjms/fsv093
2016	McHenry, J.* , R. Steneck ; D. Brady . 2016. Abiotic proxies for predictive mapping of near-shore benthic assemblages: Implications for marine spatial planning." <i>Ecological Applications</i> . Doi: 10.1002/eap.1469.
	McMahan, M.D.* , D. F. Cowan, Y. Chen , G. D. Sherwood, and J. H. Grabowski. 2016. Growth of juvenile lobster, <i>Homarus americanus</i> , in a changing environment. <i>Marine Ecology Progress Series</i> 557: 177–187 doi: 10.3354/meps11854
	Stoll, J. S., C.M. Beitzl , & J.A. Wilson. 2016. How access to Maine’s fisheries has changed over a quarter century: The cumulative effects of licensing on resilience. <i>Global Environmental Change</i> , 37, 79-91.
	Waller, J.* , D. Fields, R. Wahle , H. McVeigh*. 2016. Linking ocean acidification and warming to the larval development of the American lobster (<i>Homarus americanus</i>). <i>ICES J. Mar. Sci.</i> doi:10.1093/icesjms/fsw154
2017	Hunt, H., R.A. Wahle , J. Tremblay, M. Comeau, A. Silva, R. Rochette. 2017. Spatial patterns of richness and abundance of benthic decapod crustaceans and fishes in the Northwest Atlantic as measured by passive cobble-filled collectors. <i>Marine Biology Research</i> http://dx.doi.org/10.1080/17451000.2017.1296161
	Steneck, R. S., A. Parma , B. Ernst, J. Wilson . Two lobster tales: lessons from the convergent evolution of TURFs in Maine (USA) and the Juan Fernandez Islands (Chile)". <i>Bulletin of Marine Sciences</i> . 93: 13 – 33.
	Stoll, J. S. , E. Fuller, B.I. Crona. 2017. Uneven adaptive capacity among fishers in a sea of change. <i>PLoS One</i> , 12(6), e0178266.
	Tanaka, KR.* , S.L. Belknap, J.J. Homola and Y. Chen . 2017. A statistical model for monitoring shell disease in inshore lobster fisheries: A case study in Long Island Sound. <i>PLoS ONE</i> 12(2): e0172123.doi:10.1371/journal.pone.0172123

Note: We welcome information on additional journal articles and research. Email to cbillings@maine.edu