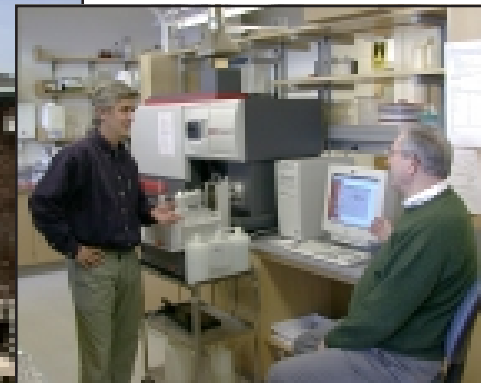
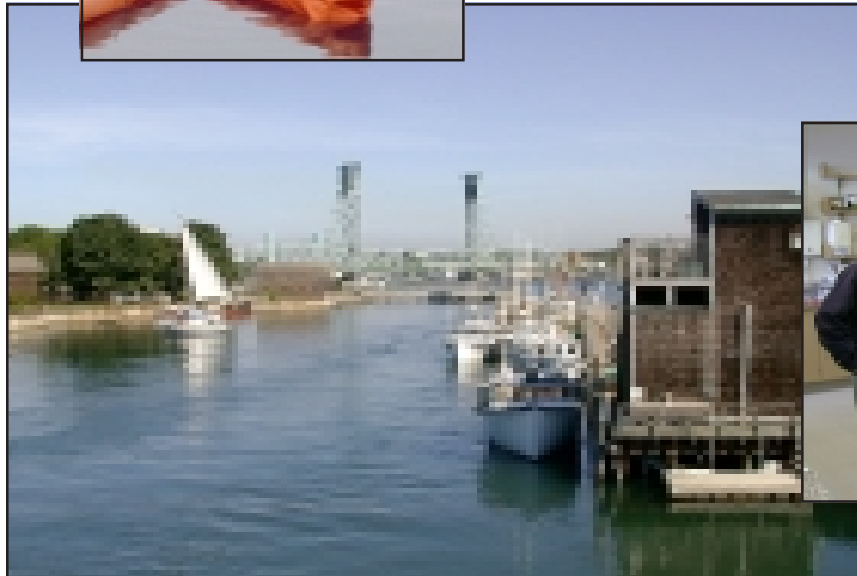


New Hampshire Sea Grant

Strategic Plan

2001-2006





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New Hampshire Sea Grant Staff

Ann Bucklin, Professor and Director
(acb@cisunix.unh.edu) Morse Hall 142, UNH,
Durham, NH 03824, 603.862.0122, fax 862.0243

Brian Doyle, Associate Director/Program Leader
(brian.doyle@unh.edu)

Sharon Meeker, Extension Specialist/Marine Education
(sharon.meeker@unh.edu)

Steve Adams, Communications Coordinator
(steve.adams@unh.edu)

Marie Polk, Editor/Information Specialist
(marie.polk@unh.edu)

Ann Reid, Program Assistant (ann.reid@unh.edu)

Julia Peterson, Extension Specialist/Water Resources
(julia.peterson@unh.edu)

Lori Lavac, Program Assistant (lori.lavac@unh.edu)

Barbara Pinto-Maurer, Education Assistant
(barbara.pinto@unh.edu)

all: Kingman Farm/UNH, Durham, NH 03824,
603.749.1565, fax 743.3997

Rollie Barnaby, Extension Educator
(rollie.barnaby@unh.edu) — Cooperative Extension,
113 North Rd., Brentwood, NH 03833, 603.679.5616,
fax 679.8070

Pingguo He, Extension Specialist/Commercial Fishing
Gear (pingguo.he@unh.edu) — Morse Hall 142, UNH,
Durham, NH 03824, 603.862.3154, fax 862.0243

Jane Audet, Business Manager (jane.audet@unh.edu)
Marine Program, Chase Hall, UNH, Durham, NH 03824,
603.862.0268, fax 862.0241

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Overview and History

The New Hampshire Sea Grant Program is one member in a national network of 30 Sea Grant programs, which together have a primary mission to promote the wise use, conservation, and development of marine and coastal resources. A partnership with universities and research institutions, the National Sea Grant College Program is a federal program of the National Oceanic and Atmospheric Administration (NOAA). Federal funding is provided by NOAA through a competitive grant process; federal funds must be matched 2:1 by non-federal funds. The core elements of all Sea Grant programs are marine research, formal education (undergraduate and graduate), extension (outreach), and communications.

New Hampshire Sea Grant, located at the University of New Hampshire, was established in 1968, just two years after Congress passed the National Sea Grant College Program Act. Eight years later, the universities of New Hampshire and Maine merged their independent Sea Grant programs to become the joint Maine/NH Sea Grant Institutional Program. At the time of the merger, the universities had complementary strengths in marine science and engineering fields, but were perceived to have insufficient research capacity on an individual basis to meet user needs. The joint program flourished, culminating in its designation as the Maine/NH Sea Grant College Program in 1980.

Over the next 20 years, Maine/NH Sea Grant accumulated a strong record of accomplishment and became one of

the larger (in terms of federal funding) Sea Grant programs. Research capacity, as measured by the number of marine faculty and their extramural funding, grew steadily at UNH until 1990. In the past decade, external research and extension support increased dramatically with the addition of new academic programs in marine science and new marine facilities (i.e., vessels, research labs, and demonstration projects). Matching funds have been provided by UNH and other institutions in New Hampshire receiving federal Sea Grant funds, private businesses, and volunteers.

In light of the marked growth in the University's marine research and outreach community; private marine, biotech, and engineering industries; and state and local programs with marine resource management and policy responsibilities, UNH joined the University of Maine in requesting the

separation of the joint program in 2000. On Oct. 1, 2000, the NH Sea Grant Program became fully distinct in all administrative and budgetary functions.

NH Sea Grant



remains committed to programmatic integration. We see our leadership role as encouraging, facilitating, and promoting regional and national collaborations for NH marine researchers and NH Sea Grant staff. Our independent status has the advantage of allowing us to focus on the issues and needs associated with marine resource use within our state's borders and to capitalize upon the ever-expanding marine capabilities within New Hampshire.

Sea Grant at the University of New Hampshire

Throughout the 1970s and much of the 1980s, Maine/NH Sea Grant was the principal source of support for marine-related research and extension activities in the region. This is no longer the case, especially in New Hampshire. Over the past decade, there has been considerable expansion in marine-related research, extension, and education initiatives, activities, and organizations. At the University, these include:

- The UNH/NOAA **Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET)** was established in 1998 to support development of innovative technologies for understanding and ameliorating the impacts of coastal and estuarine contamination and degradation. Several CICEET outreach programs are currently delivered by NH Sea Grant Extension staff.
- The UNH/NOAA **Center for Coastal and Ocean Mapping (C-COM)/Joint Hydrographic Center (JHC)**, created in 1999, is a national center with expertise in ocean mapping and hydrographic sciences. NH Sea Grant has played a facilitative role in assisting the Seacoast Science Center, a public science education facility, to become the public outreach arm for C-COM.
- The UNH/NOAA **Cooperative Institute for New England Mariculture and Fisheries (CINEMar)**, established in 2000, includes the UNH Open Ocean Aquaculture (OOA) Demonstration Project. In addition to providing a facility for research, development, and demonstration of open ocean finfish and shellfish aquaculture, CINEMar serves as a regional and national center where scientists, stakeholders, and regulators can work together on issues in fisheries management, mariculture, and marine policy. CINEMar evolved out of the successful three-year Maine/NH Sea Grant offshore finfish aquaculture enhancement project carried out from 1995-1998. Sea Grant provided leadership for the first two years of the OOA project; the outreach functions of CINEMar continue to be provided by Sea Grant Extension.
- The **Northeast Consortium**, a regional initiative led by UNH, was created in 1999 to encourage and support effective, co-equal partnerships among commercial fishermen, researchers, and other stakeholders to become active participants in cooperative research and development of selective fishing gear technology. NH Sea Grant staff provide direct leadership and most outreach functions for this program.
- The **Institute for the Study of Earth, Oceans, and Space (EOS)** has continued incremental growth with core funding from the National Aeronautics and Space Administration, the National Science Foundation, and NOAA. Oceanographers associated with EOS typically

share an interdisciplinary “systems approach” to understanding the marine environment. NH Sea Grant has several staff with appointments within EOS and partners with the NH Space Grant Consortium, housed within EOS, on GIS technology extension programs.

- The growth of the UNH **Coastal Marine Laboratory** and the construction of the **Jere Chase Ocean Engineering Building** provided significant new resources for researchers studying living marine organisms, coastal ecosystems, and the design performance of coastal engineering devices and structures. Sea Grant researchers have utilized these facilities to enhance greatly their efforts in finfish and sea urchin aquaculture.
- UNH received initial funding in 2001 to design a **new marine science center**. The center will be located on the coast in New Castle, NH, and will provide state-of-the-art marine culture and laboratory facilities for NH Sea Grant researchers and a showcase for Sea Grant Extension activities.

NH Sea Grant is fully integrated into the diverse array of marine institutes and initiatives at UNH. The distinct NOAA/UNH partnerships are a direct result of perceived needs and opportunities for the university community and the state’s citizens. In some cases, for example CINEMar and the Northeast Consortium, NH Sea

Grant has helped incubate the new organization by providing a research basis, vision and planning, and critical administrative and budgetary oversight. In other cases, such as CICEET, C-COM, and EOS, NH Sea Grant has successfully sought partnership opportunities to further our mission areas. NH Sea Grant remains unique in the broad definition of our mission and in the seamless integration of research, extension, education, and communications elements.

Sea Grant Within the State

Marine initiatives at the state and regional level have also shown substantial growth in recent years, mirroring and enhancing the growth within UNH. Marine-related programs have created new opportunities for NH Sea Grant to build partnerships and capitalize on expanded research and outreach capabilities. Programs in this group include:

- The formation and development of the **Regional Association for Research on the Gulf of Maine (RARGOM)** to foster cooperative and coordinated research on this important marine ecosystem. NH



Sea Grant has partnered with RARGOM to sponsor workshops on key issues affecting the Gulf of Maine.

- The three-state, two-province **Gulf of Maine Council on the Marine Environment** is developing and implementing long-term, regionally planned educational and monitoring activities designed to maintain the health of the Gulf of Maine ecosystem and its resources. NH Sea Grant is actively involved in the Council's volunteer water quality monitoring networks around the region and has provided training to many organizations within this network.
- The **Northeast Regional Aquaculture Center (NRAC)** was established to support regionally important and well-coordinated research and extension in areas important to aquaculture. It is administered through the University of Massachusetts at Dartmouth and funded by the US Department of Agriculture (USDA). NH Sea Grant staff have served on NRAC leadership and proposal review committees, and have successfully competed for USDA funding for regional outreach projects.
- The **Saltonstall Kennedy (S/K) Program** has expanded to include aquaculture research and development, in part to encourage these activities as an alternative to groundfishing. Close collaboration is maintained with S/K through the NH Sea Grant Policy Advisory Committee, which includes National Marine Fisheries Service (NMFS) managers associated with the S/K Program. NH Sea Grant staff also serve as reviewers of S/K proposals.
- The construction of the **Seacoast Science Center (SSC)** at Odiorne Point State Park in Rye, NH, was made possible through a combination of state, private, and corporate support. SSC, managed by the NH Audubon Society, provides year-round marine science education programs for school children, teachers, and adults. NH Sea Grant-trained marine docents frequently participate in and lead SSC marine education programs. In addition, NH Sea Grant is represented on the SSC Advisory Committee, ensuring close collaboration on outreach efforts.
- The creation of the **Great Bay National Estuarine Research Reserve (GBNERR)** has provided additional opportunities for research and outreach education. NH Sea Grant is represented on GBNERR's Policy Advisory Committee. In addition, several volunteer water quality monitoring and marine education programs are carried out jointly.
- The **New Hampshire Estuaries Program (NHEP)** has developed a management plan for the Great Bay and Hampton Harbor estuaries, which serves to identify opportunities and guide funding decisions for research and extension projects. NH Sea Grant is a member of NHEP Management Committee and has received funding for an assortment of Sea Grant Extension water quality programs.

While NH Sea Grant's mission has not changed over the years, the context within which we work most certainly has. Our continuing challenge is to clearly define NH Sea Grant's leadership role both within the university community and the state, and to develop effective partnerships

with other programs and initiatives with related missions. A fundamental role of NH Sea Grant is to produce new information and understanding by funding excellent, needs-based research. NH Sea Grant's further role is to coordinate the dissemination of this information among academic institutions; federal, state, or local agencies with stewardship responsibilities; private entrepreneurs and marine industries; and New Hampshire's citizens.



targeting or prioritization of issues and topics, which may result in the exclusion of innovative and high-risk projects.

The *NH Sea Grant Strategic Plan* is a long-term vision with a five-year horizon. Short-term priorities are better articulated in the annual/biennial program RFP's and the ensuing Implementation Plans, which guide NH Sea Grant towards its

Strategic Goals

The *NH Sea Grant Strategic Plan (2001-2006)* builds upon and is consistent with the *National Sea Grant Strategic Plan (1995-2005)* in its overall focus on the economy, the environment, and education. However, NH Sea Grant's specific goals and opportunities have been developed locally. Consistent with our dual role as an independent program and as a member of a national network of programs, NH Sea Grant identifies, encourages, facilitates, and leads research, extension, education, and communications efforts that address both local needs and national priorities.

The *NH Sea Grant Strategic Plan* is intentionally broad. Also intentionally, it does not identify particular topics of highest priority. We present a wide range of issues, needs, and opportunities that together define our mission and direct our efforts, but we do not seek to direct individual researchers or extension personnel to particular topics. This approach to strategic planning was selected with the clear guidance of our Policy Advisory Committee, which has consistently urged NH Sea Grant to refrain from specific

strategic goals. Our success in the implementation of our strategic planning process is reflected in case studies of successful projects, compilation of data (including traditional measures of research productivity as well as the real-world impacts of the results), and annual reports and other program documents.

Finally, the strategic goals presented here should be viewed in the context of a rapidly changing society. The marine enterprise in which NH Sea Grant is embedded includes academic, private, and governmental organizations, institutes, and programs. NH Sea Grant must serve a diverse constituency that itself changes with state and national socioeconomic conditions. The breadth of NH Sea Grant's mission and the complexity of its relationships with its partners and clientele argue strongly for strategic and implementation plans that provide a general framework to define our mission, describe our vision for the future, and ensure flexibility for NH Sea Grant to respond, adapt, and grow.

Advanced Technology for Commercial Products and Processes

National Perspective

Recent developments in advanced technologies have rapidly and profoundly altered the numerous fields comprising ocean engineering. These revolutions — in medical, molecular, electronic, and computer fields — have created new challenges and opportunities for the marine and environmental research communities. The demand for real-time observation and analysis and the need for accurate prediction of ocean and weather events have been met by global coverage by satellites and remote detection by moored and autonomous instrumentation. The proliferation of earth-, ocean-, and space-based platforms has accelerated the development of new sensing technologies. Increasingly, it will be possible (without leaving the laboratory) to analyze environmental quality, ecosystem health, living and non-living resources, and other complex entities in the coastal and open ocean. This vision for the future will be made possible with the development of new sensors, new energy sources, and new



propulsion systems — to name a few useful technological developments.

There is a continuing debate about the need for man to visit distant and dangerous worlds — whether they are far out in space or deep under the ocean. In addition to new remote

technologies, we must continue to explore new technologies for sustainable commercial development in ocean habitats and new approaches to human exploration and habitation in and on the sea.

Recent biomedical research has created a new field, biotechnology, that has revolutionized modern medicine and has already had huge impacts on research and development in many other fields, including marine biology and

oceanography. Sea Grant programs should facilitate and encourage the use of these new tools of biotechnology in all of our research, development, outreach, education, and communications efforts.

New Hampshire Perspective

The universities, colleges, and commercial enterprises of New Hampshire offer exceptional academic, intellectual, and technical capacity in ocean engineering, environmental technology, and biotechnology. These capacities are important resources for NH Sea Grant and offer nearly unlimited opportunities for partnerships and collaboration. In particular, UNH has a long history of pioneering in ocean engineering, including “firsts” in the design and production of a manned undersea habitat and a successful autonomous vehicle. The ocean engineering presence at UNH remains strong, with research and testing facilities in the new Jere Chase Ocean Engineering Building.

More recently, UNH has added capacity in environmental technology and ocean engineering with the creation of three new NOAA/UNH partnerships: the Cooperative Institute for Estuarine and Environmental Technology (CICEET), the Joint Hydrographic Center (JHC) with the associated Center for Coastal and Ocean Mapping (CCOM), and the Cooperative Institute for New England Mariculture and Fisheries (CINEMar). Dartmouth College brings established strength in the Thayer School of Engineering. Environmental and engineering consulting companies have multiplied in the seacoast region over the past decade. The ocean engineering capacity in our state



presents both opportunity and challenge for NH Sea Grant. We aspire to draw existing expertise and talent toward issues and problems within our mission area and to build new and enhanced capacity in the highest priority areas. A short summary of some of these opportunities is included here.

New Hampshire’s commercial and light industrial presence in biotechnology has grown rapidly in recent years, offering opportunities for partnerships with the state’s educational and research institutions. Private-public partnerships are facilitated by the NH Biotechnology Council, whose mission is to promote and grow the biotechnology (including life sciences, biosciences, and medical sciences) industry in New Hampshire. Educational opportunities include ground-breaking research at UNH and the state’s colleges and federally funded training programs associated with the NH Technical College system.

NH Sea Grant seeks to enhance the growing commercial and academic research potential in biotechnology and to draw this expertise toward our high-priority mission areas, including aquaculture and fisheries, healthy marine ecosystems, and new marine molecular technologies, materials, and products. NH Sea Grant must both encourage and grow our state-of-the-art research capacity and also ensure real-world benefits and impacts from these efforts.

Strategic Goals and Opportunities

A. Commercial biotechnology

Goal 1. To develop new disease diagnostics for mariculture and fisheries.

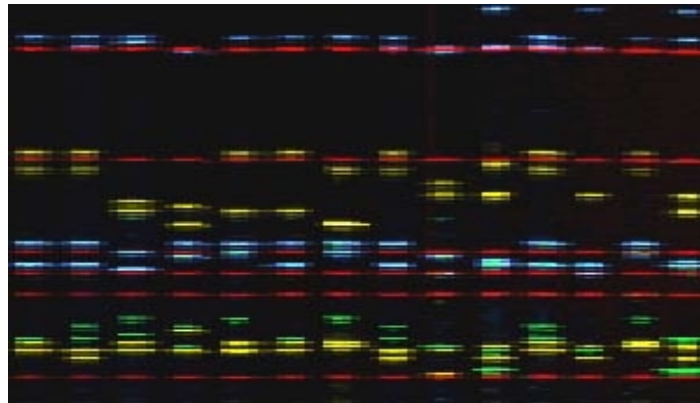
Actions and Opportunities:

- Understand the workings of natural microbial communities in order to develop probiotic approaches to disease control in closed-system aquaculture facilities.
- Develop detection, diagnosis, and amelioration protocols for human pathogens and fish and shellfish diseases that reduce commercial viability of mariculture operations.

Goal 2. To use new tools and techniques in the development of species for culture.

Actions and Opportunities:

- Design molecular markers for finfish and shellfish broodstock selection (e.g., for growth potential and survivorship) and improvement (e.g., for disease resistance).
- Assess the molecular genetic consequences of domestication (e.g., inbreeding).
- Identify and quantify interbreeding between cultured and wild stocks of finfish.



Goal 3. To develop molecular indices and analyses of environmental health.

Actions and Opportunities:

- Analyze, understand, and predict the physiological and human health consequences of environmental estrogens.
- Develop model systems to study the molecular and biochemical mechanisms of endocrine receptors.
- Detect and assess sub-lethal effects of pollutants in the coastal ocean on marine organisms and human populations.

B. Environmental Technology

Goal 1. To establish and grow effective public-private partnerships for the extension and marketing of new marine technologies.

Actions and Opportunities:

- Identify needs and issues for new marine environmental technologies in coastal ecosystem health and habitat restoration.
- Facilitate partnerships

among private industries, environmental and non-governmental organizations, and local, state, and federal programs (including NH Sea Grant) to transfer useful technologies to the end users.

C. Ocean Engineering

Goal 1. To enhance ocean observing programs by the development and use of new sensors.

Actions and Opportunities:

- Develop new remote and autonomous sensors and sensing capabilities.
- Design detectors for new or complex entities, including bio-molecular sensors, chemical detectors of pollution, and multiparameter sensors for environmental health.
- Apply optical technologies, including video and imaging, to marine resource issues.
- Design new acoustical sensors for detection and mapping of marine life and habitats.

Goal 2. To use the coastal and open ocean for human habitation and sustainable enterprises.

Actions and Opportunities:

- Use computer and scale models to design and test marine structures, including moorings and anchors.
- Design and test platforms for detection and surveying.
- Develop novel solutions for underwater habitats for humans.

Goal 3. To bring new technologies to high-resolution surveys of marine environments.

Actions and Opportunities:

- Design and conduct biological, environmental, historical, archaeological, and geological surveys in coastal waters.
- Implement geo-referenced information systems targeted on issues and areas of local and regional significance.
- Examine and improve survey methodologies for marine resources.
- Use innovative approaches to survey marine resources and habitats.
- Conduct geological surveys of coastlines.
- Map benthic and sub-bottom habitats and environments.

Goal 4. To implement new approaches to traditional problems in ocean engineering.

Actions and Opportunities:

- Design new propulsion systems based on biomechanical analyses.
- Identify new energy sources from the sea, including waves, currents, and thermal sources.
- Design and deploy new solutions for ecosystem health challenges, such as pollution containment devices.

Seafood Production — Commercial Fisheries

National and Regional Perspective

Many of the fish stocks that US commercial fishermen depend on are overutilized: of 160 stock groups currently being managed by the National Marine Fisheries Service (NMFS), 34% are overutilized and 47% fully utilized. The Northeast demersal fisheries (cod, haddock, pollack, flounder) lead the way, with 16 of 25 stocks overutilized and seven fully utilized (two are unknown). Nationally, additional marine fish stocks are added to the overutilized list every year.

In 2000, the Northeast had landings of 1.23 billion pounds of fish, worth nearly \$900 million. The single most economically important species was the American lobster, with landings of 67 million pounds valued at \$230 million. Sea scallops, at \$161 million, ranked second in value, followed by mixed groundfish (cod, haddock, cusk, pollack, and flounder) at \$135 million. The most important recreational species were cod, winter flounder, mackerel, striped bass, bluefish, and bluefin tuna.

The mainstays of Northeast commercial fisheries — cod, haddock, and yellowtail flounder — reached record

low levels in spawning-stock biomass during 1993-1994. Under restricted fishing effort for these species, many inshore fishermen switched to dogfish, skates, and monkfish. The consequent decline in these species necessitated new regulations, restricting fishing on these species as well.

Other important issues facing the commercial fishing industry are by-catch and regulatory discards. These issues can be addressed through regulation and through conservation engineering, the science of designing habitat-friendly, low-bycatch fishing gear. Recent improvements in fishing gear design have raised hope for sustainable fishing on targeted species with reduced impact on other fisheries.

Commercial fishing in the US is now facing one of its most complicated and serious challenges: interactions with threatened and endangered species. West coast and Alaskan fishing grounds have



been closed and quotas reduced because of declining populations of Steller Sea Lions. In the southeast US, endangered sea turtles have been a critical problem for many years. Gillnetters in New England have had to reduce harbor porpoise mortalities — and have been successful using acoustic pingers on their nets. In one of the most serious threats to New England's commercial fishing in recent years, right whale entanglements have forced modifications in the design of fixed gear, including lobster traps and gillnets, to make them “whale friendly.” Concern over right whale mortalities remains a critical issue for commercial fishing throughout the region.

In addition to overfishing, commercial fisheries are threatened by habitat loss and damage, environmental contaminants, decline of wild stocks, and disease. At the same time, many fisheries management practices and strategies are not working. The crisis in fisheries management — clearly evidenced



by more than 140 active lawsuits against NMFS — continues to worsen and the commercial fishing community continues to suffer, as more fishermen experience severe economic losses and leave the industry. New approaches to fisheries management must be explored in commercial and recreational fishing industries, regulatory agencies and councils, quasi-governmental commissions,

conservation organizations, coastal resource management programs, and the academic community.

Many individuals, institutions, organizations, and agencies are looking at alternative fisheries management systems and considering approaches involving both old and new management tools. Much-debated approaches include the use of individual transferable quotas (ITQ's) and other systems that give ownership of a public resource to an individual or corporation. Alternatively, community-based management may offer hope for innovative strategies to protect shared resources. Of interest is a federal initiative to establish Marine Protected Areas (MPA's), with one goal being the use of MPA's as fisheries management tools. Clearly, additional research and long-term monitoring will be required to determine the effectiveness and suitable roles of MPA's in managing marine fisheries.

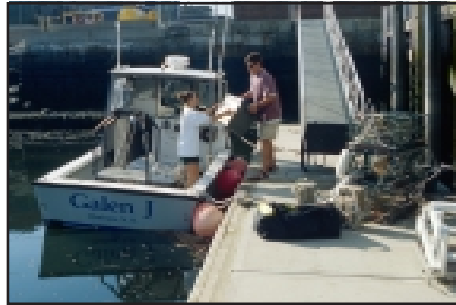
Of highest priority in the search for new approaches to fisheries management is the need for effective communication and genuine partnership among the diverse stakeholders. It is absolutely essential that we work toward closing the wide communications gap between fishermen, researchers, environmentalists, managers, and the concerned public. The current enthusiasm for “cooperative research” (i.e., partnerships between researchers and commercial fishermen to conduct research) can provide opportunities to involve both commercial and recreational fishing groups in partnerships with academic and government scientists. Topics suitable to cooperative research efforts include stock assessment, fish habitat and behavior, impacts of closed areas, environmental assessment, and coastal monitoring. In order for cooperative research efforts to significantly impact fisheries management practices, fishermen must be involved in all aspects of the research — discussion of research needs, design of testable hypotheses, collection

and analysis of data, and interpretation and presentation of results. Only if fishermen are full partners in cooperative research efforts will we get the full benefit of their knowledge and ensure their ownership of the fisheries management practices.

Curiously, the severest test of fisheries management practices may come as wild stocks rebound and fisheries regulations relax. There is some indication that Georges Bank haddock stocks are close to being rebuilt, and some managers feel confident that Georges Bank cod are on the rebound. A critical challenge for fisheries management will be to ensure that these recovering stocks are harvested in a sustainable manner. A key element in this process will be creating an environment where fishermen take ownership in the decision-making process and feel a sense of stewardship in the resource.

New Hampshire Perspective

The commercial fishing industry in New Hampshire consists of nearly 150 commercial vessels — 100 lobster boats and 50 groundfish boats. In 2000, landings from mixed groundfish, shrimp, and scallops were valued at \$8.3 million, while 1.15 million pounds of lobster (valued at \$5 million) were landed. The groundfish boats are divided almost equally between gillnetters and draggers. With the exception of one large company targeting lobster, most New Hampshire fishermen represent small, family-owned operations that fish inshore. NH's commercial fishermen are entrepreneurial, opportunistic, and flexible, changing



fisheries seasonally and as conditions dictate. As examples, many groundfishermen spend part of the summer fishing for bluefin tuna, and a number of fishermen have fished for dogfish and monkfish during the winter in the mid-Atlantic for the past six or seven years.

Both the state and our coastal towns have been supportive of the commercial fishing industry. Several communities have public facilities dedicated to the industry and two fishing cooperatives handle most of the groundfish landed in NH. Each of our three major harbors has several lobster buyers. The Yankee Fishermen's Cooperative in Seabrook has a sizeable bluefin tuna operation, conducting a daily auction during the tuna season.

NH's inshore fishermen have been much impacted by recent fishing regulations, including daily trip limits, closed areas, days-at-sea restrictions, and seasonal quotas. Many of the regulations have impacted small inshore boats — like NH's fishing fleet — more than larger offshore boats, which have greater range and seaworthiness and more flexibility in where and when they fish. To compensate, NH's fishermen have worked longer hours, taken their boats farther offshore, changed fisheries, and fished out of different ports. In an encouraging sign, the New England Fisheries Management Council has recently recognized the importance of evaluating both the sociological and the economic impacts of fishing regulations.

Sea Grant's non-advocacy role as an "honest broker of information" is much-needed during the local, regional, and national crises in marine fisheries and fisheries management. NH Sea Grant remains dedicated to bringing all

the stakeholders together to engage in open discussion and consensus-based problem solving, with the dual goals of maintaining a traditional way of life and managing some of New England's most valuable living resources.

Strategic Goals and Opportunities

Goal 1. Develop predictive models and new management strategies that will aid in the management of complex, multi-species fisheries such as those found in the Gulf of Maine.

Actions and Opportunities:

- Assist with the development of multi-stakeholder, collaborative problem-solving strategies for fisheries issues.
- Assess the effectiveness of a consensus-based, multi-stakeholder fisheries alliances in dealing with local fisheries management issues.
- Create a strong sense of stewardship among fishermen by developing management strategies that include them in all phases of development and implementation.
- Evaluate whether the current, innovative management strategies (Northwest Atlantic Marine Alliance, Lobster Zone Councils) are effective.
- Investigate the feasibility of alternative fisheries management processes like ITQ's, community quota systems, community-based management, and area management.
- Devise alternative fisheries management strategies that will be responsive to fluctuations in fish stocks, including the pending recovery of Gulf of Maine groundfish stocks.

- Develop a quantitative understanding of the biological and physical processes that determine the population dynamics of important commercial species.
- Develop assessments and simulation capabilities that reliably predict fisheries production for key Gulf of Maine commercial species.
- Develop research-based data describing the anticipated economic and sociological impacts that various fisheries management decisions will have on coastal communities and their residents.



Goal 2. Develop technologies and techniques that will lead to reduced by-catch and regulatory discard of commercially important Gulf of Maine fish species.

Actions and Opportunities:

- Develop mobile gear that catches flat fish while releasing non-targeted species such as cod and other roundfish.
- Develop an applied research and outreach program in fisheries conservation involving commercial fishermen, managers, and scientists.
- In collaboration with fishermen and fisheries managers,

devise techniques or procedures for reducing or utilizing regulatory discard.

- Determine proper gillnet mesh sizes to reduce the capture of undersize fish.

Goal 3. Improve fisheries science and provide ancillary employment for fishermen by encouraging and facilitating cooperative research between fishermen and scientists.

Actions and Opportunities:

- In collaboration with the Northeast Consortium, NMFS, and the NE Fisheries Management Council, facilitate the identification of fisheries research projects and needs that could be addressed jointly by the research and fishing communities.
- Develop a mechanism to ensure that cooperative research results are routinely considered in the fisheries management system.
- Develop outreach tools and a network to distribute results of cooperative research to the fishing industry and the general public.

Goal 4. Reduce the incidental take of marine mammals during fishing operations in a way that has minimal economic impact on the commercial fishing industry.

Actions and Opportunities:

- Develop less expensive acoustic pingers to be used by gillnetters to reduce the incidental take of harbor porpoises.
- Develop “whale-safe” fixed gear (lobster traps and gillnets) that prevents or minimizes the incidental take

of whales migrating through the Gulf of Maine.

- In collaboration with NMFS, fishermen, and environmental organizations, conduct outreach programs on marine mammal issues, especially those related to right whales.
- Establish a framework for involving fishermen, environmentalists, scientists, and fisheries managers in addressing marine mammal issues.
- Identify current right whale sighting and disentanglement programs that fishermen could utilize to minimize the possibility of harming these mammals.

Goal 5. Provide scientifically based information on essential fish habitat (EFH) and marine protected areas (MPA) that allows regulators to implement policies that balance the harvesting of living marine resources with environmental protection.

Actions and Opportunities:

- Determine the effects of fishing practices, especially mobile gear, on various fisheries habitats.
- In collaboration with appropriate partners (NMFS), identify and define essential and critical fisheries habitats for economically important species.
- Develop and disseminate habitat-friendly fishing gear and practices that can be utilized by the fishing industry.
- In cooperation with all stakeholders, identify potential locations for Gulf of Maine MPA’s based on perceived benefits.
- Determine the potential socioeconomic and environmental costs/benefits of MPA’s related to the commercial fishing industry.

Seafood Production — Sustainable Aquaculture

National Perspective

In response to continued decline in capture fisheries and a \$7 billion annual seafood trade deficit, the US aquaculture industry is poised to grow dramatically over the next few decades. The current value of farm-raised aquaculture products in the US is about \$1 billion, with the Northeast accounting for \$130 million (13%) of that total. However, marine aquaculture production accounts for only 15% of the US total, lagging far behind its well-developed freshwater counterpart. The principal marine species are shellfish (clams, oysters, mussels), shrimp, and salmon.

The US Department of Commerce has developed a strategic initiative for the development of sustainable aquaculture — calling for a more than five-fold increase in US aquaculture production by 2025. In order to reach this goal, many technological, social, economic, and environmental challenges must be addressed. Expansion of commercial marine aquaculture in many US coastal areas is strictly constrained by user conflicts, environmental and ecological concerns, and a complex and forbidding regulatory environment. In response to such



constraints to the growth of aquaculture in coastal marine waters, interest has developed in establishing open ocean and land-based recirculating culture systems.

New Hampshire Perspective

During 2000, commercial aquaculture sales totaled about \$2 million in New Hampshire. The most important species were freshwater trout, Atlantic salmon, and summer flounder. Despite a relatively small industry, New Hampshire has been actively engaged in aquaculture research and development that has had local and regional impact.

NH Sea Grant has provided significant funding for basic and applied research in marine aquaculture, especially for systems engineering and new species development. NH Sea Grant has also addressed socioeconomic issues and engaged extension capacity to facilitate the expansion of commercial marine aquaculture, including a focus on alleviating user conflicts with the state's commercial fishing industry.

For more than a decade, UNH faculty have been intensively involved in aquaculture research and development of finfish, molluscan shellfish,

seaweeds, and sea urchins — frequently with the active partnership of local fishermen, fishermen’s cooperatives, and NH Sea Grant staff. NH Sea Grant-funded efforts have provided the basis for the UNH Open Ocean Aquaculture Demonstration Project (OOADP), established in partnership with the Portsmouth Fishermen’s Cooperative in 1999. OOADP has served as a test site to determine the biological, engineering, economic, and environmental feasibility of culturing finfish and shellfish in exposed oceanic environments. In 2000, the Cooperative Institute for New England Mariculture and Fisheries (CINEMar) was created around the successful demonstration project.

NH Sea Grant has encouraged and funded research leading to the culture of alternative species. With the steep decline in wild-harvested Gulf of Maine sea urchins over the past five years, development of efficient and profitable culture systems has been a focus of NH Sea Grant efforts. Researchers have also worked with a number of private-sector partners to test and refine commercial sea urchin culture technologies. Similarly, the development of a commercially viable seaweed aquaculture industry has also been a focus of NH Sea Grant efforts since the mid-1990s. Researchers have investigated the potential for both indigenous and non-indigenous seaweed species for both human consumption (i.e., nori) and the biotechnology industry.

As a result of strategically targeted research and extension activities, effective partnership-building, and a clear vision for the future of sustainable, commercially viable marine aquaculture, NH Sea Grant has led and leveraged the activities and resources of regional and national programs.



Strategic Goals and Opportunities

NH Sea Grant’s overall goal is to contribute to the further development of environmentally responsible marine aquaculture in the state and region. Specific goals and their associated actions and opportunities include:

Goal 1. To develop and improve production methods for cold-water marine species appropriate for the New England region.

Actions and Opportunities:

- Improve broodstock and hatchery methods for established cold-water marine species.
- Develop broodstock and hatchery methods for new cold-water marine species.

- Improve nursery and growout techniques for established cold-water aquaculture marine species.
- Develop nursery and growout techniques for new cold-water aquaculture marine species.
- Improve systems engineering for offshore structures and land-based hatchery, nursery, and growout facilities.
- Advance research in the use of aquaculture techniques for stock enhancement (finfish) and habitat restoration efforts (shellfish).

Goal 2. To ensure that commercial aquaculture is environmentally sustainable.

Actions and Opportunities:

- Develop easily measurable indicators of the environmental impacts of aquaculture on the marine environment.
- Develop environmental models to determine the carrying capacities of marine systems.
- Improve methods for waste management for land-based and coastal/offshore aquaculture.
- Develop methods to reduce escapement of fish and shellfish from containment structures.
- Develop methods to minimize or prevent the spread of disease from culture organisms to native populations.
- Develop ocean-based systems that minimize harmful interactions with endangered and threatened species.

Goal 3. To ensure that commercial aquaculture is economically and socially viable.

Actions and Opportunities:

- Develop business plans for different combinations of aquaculture species and systems.
- Identify economic opportunities in marine aquaculture that are appropriate for the region's commercial fishing industry.
- Conduct research to determine social impediments to marine aquaculture development.

Goal 4. To transfer information and technology to appropriate user communities.

Actions and Opportunities:

- Provide balanced, unbiased information on marine aquaculture opportunities to the commercial fishing community, aquaculture entrepreneurs, regulators, legislators, and the general public.
- Sponsor forums for discussion on environmental, regulatory, and policy aspects of aquaculture development.
- Facilitate conflict resolution between user groups.
- Provide technical information on aquaculture in written, electronic, and presentation formats.
- Provide training in aquaculture methods to appropriate audiences.

Coastal Economic Development

National Perspective

Research to reveal the biological and physical components of coastal and marine systems has received considerable attention and funding since the inception of the National Sea Grant College Program. A systematic program of research has led to better understanding of the geological, hydrological, biological, and ecological processes associated with these systems. However, the US lacks a comprehensive understanding of the social, cultural, and political components of coastal and estuarine systems, and their relationships to coastal processes, resources, and economic development policies. A well-planned program integrating both applied social science and natural science can assist decision-makers, managers, and



researchers in identifying and resolving many of the challenges facing the US coastal zone. What is needed is a comprehensive and mechanistic understanding of human actions and interactions within the context of a natural resource setting.

There are numerous issues associated with use of ocean, coastal, and estuarine resources for human consumption, habitation, commercial development, and recreation. The issues may fall within the boundaries of economics, sociology, anthropology, geography, psychology, human ecology, community development, recreation management, tourism, and fisheries management, among others. Innovative research, extension, and education programs in all of these areas are critically needed in order to understand, quantify, and predict the human dimension of natural and social systems — and in order to fulfill the Sea Grant mission of the wise use, development, and conservation of marine and coastal resources.

New Hampshire Perspective

Coastal waters, and the lands adjacent to them, include some of the state's

most valuable assets, including fish and wildlife habitats, tidal marshes, natural areas, urban waterfronts, historic sites, transportation rights-of-way, economic development projects, housing sites, tourist attractions, and recreation areas. Management of New Hampshire's valuable coastal resources takes place in an environment of continuous social and ecological change, which originates directly or indirectly from human activity.

The management and development of New Hampshire's marine resources require the consideration of a wide range of opinions, especially those related to coastal commercial development, public access to publicly owned and managed coastal regions, and user conflicts. Following public debate and appropriate planning, implementation and evaluation should proceed in an open and deliberate fashion. A key aspect for the success of any program is to communicate the major goals and objectives and to provide information about strategies for implementing these goals. Public awareness is needed to highlight and stimulate discussion about the issues. NH Sea Grant should have a role and a presence in these activities through its research, extension, and education functions.

There are more than 40 federal departments, agencies, or programs that have management or policy responsibilities for marine resources, as well as four regional and over 20 state departments and agencies and more than 20 non-profit organizations. This situation presents an opportunity (viewed in one way) for NH Sea Grant to identify a particular niche or role within marine resource management. The discussion here and the following examples are intended to



focus and guide researchers, outreach personnel, and others to the issues in coastal economic development that are of highest priority for NH Sea Grant.

NH Sea Grant can magnify its impact by proactively pursuing public-private partnerships at all levels. As an example, NH Fish and Game is faced with many education and outreach issues associated with public access and can work effectively with NH Sea Grant to engage the

public on a wide range of public access issues. Similarly, the management and regulation of recreational marine fisheries can be examined by NH Sea Grant researchers in partnership with the New England Fisheries Management Council, a quasi-governmental organization responsible for engaging public debate on these and many other issues.

Strategic Goals and Opportunities

A. Coastal Business Development

Goal 1. To provide the necessary data on recreational fishing to guide fishery management decisions and policy and to assist in the development of fishery management plans.

Actions and Opportunities:

- Measure the equity of management allocation decisions as perceived by groups and individuals.
- Identify angler perceptions of social and environmental conditions.

- Measure and map resource and activity substitutes for recreation fishing in response to fishery management limitations and closures.
- Understand how marine anglers make trade-offs in management and product preference decision making.
- Evaluate the effectiveness of public hearings and other public participation approaches in representing the diversity of opinions, behaviors, and management preferences.
- Evaluate deterrents to participation in recreational fishing, including the social environment and attitudes.
- Evaluate the effectiveness of alternative communication strategies for educating fishery managers and recreational anglers.

Goal 2. To enhance environmentally responsible tourism in NH's seacoast.

Actions and Opportunities:

- Develop and evaluate programs and approaches to strengthen and build the capacity of New Hampshire's coastal tourism industry.
- Evaluate the effectiveness of public-private cooperative programs in the region.
- Develop and evaluate comprehensive training and education programs for tourism businesses, focused on the development of sustainable tourism.
- Develop assessment tools and



- techniques to assist communities in the development and evaluation of revitalization plans that might include construction of marinas, docks, piers for commercial and recreational fishing, boat ramps, restaurants, condominium complexes, and public trails.
- Evaluate the effectiveness of state coastal management programs relative to urban waterfront development grants of financial and technical assistance.

Goal 3. To promote sustainable coastal communities.

Actions and Opportunities:

- Document infrastructure needs relative to changing fishing and developing aquaculture industries (e.g., to preserve, enhance, or develop suitable fishing infrastructure to support the industry).
 - Investigate the relationship between competing residential and tourism industries and the commercial fishing industry, focusing on identifying opportunities for cooperation.
 - Develop the tools and techniques necessary

to estimate infrastructure needs relative to a changing commercial fishing industry and a developing aquaculture industry, with particular focus on seafood processing.

- Examine the feasibility of a network for fishing-related service firms in the regions. Such a network could provide small businesses with information that will build their customer bases and assist with their strategic planning processes.
- Identify entrepreneurial opportunities and entrepreneurial talent that will allow the development of an adaptive infrastructure for an ever-changing fishing and rapidly developing aquaculture industry.
- Complete a comprehensive assessment of current building codes and programs focused on redeveloping and revamping existing fishing infrastructure.

B. Coastal access and resource use

Goal 1. To maintain safe and adequate coastal access for both recreational and commercial users.

Actions and Opportunities:

- Engage interest groups in decision making about public access.
- Promote and facilitate partnerships among NH state, regional, and federal programs and agencies for public access issues.
- Communicate and explain the results of environmental assessments prior to establishment of public access sites.
- In partnership with the NH Coastal Program, develop a formal access site monitoring program and communi-

cate monitoring strategies and criteria to interest groups and the public.

- Design and evaluate public information, education, and reference materials addressing a wide range of coastal access and resource use issues.

C. Conflicting uses

Goal 1. To encourage and implement programs and research that assist local and regional communities in managing growth, conflict, and incremental change.

Actions and Opportunities:

- Determine the present and future sources of competition for access to marine resources.
- Identify opportunities for cooperation between industries competing for resources.
- Define and implement planning and management activities to preserve access for traditional users and create opportunity for non-traditional users.
- Identify, implement, and evaluate acceptable and effective mitigation options for coastal zone developers.
- Assess the impacts of past economic development and planning activities.
- Evaluate technical, legal, and/or socioeconomic changes needed to control and broaden opportunities for, or remove barriers to, future coastal development.

Coastal Ecosystem Health and Public Safety

National Perspective

The growth in coastal populations and the subsequent competition for limited resources threaten the continued sustainability of coastal communities. Currently, more than half of the US population (141 million) resides within 50 miles of a marine or Great Lakes coast. As baby boomers begin to retire over the next 20 years, this influx to coastal areas, particularly in Florida, California, and Texas, is projected to continue at unsustainable rates.

While population growth has often brought economic prosperity to coastal regions (18 of the 20 leading counties in per capita income are coastal counties), improved schools and regional infrastructure, and created new jobs, it has not been without cost to the environment. As coastal populations swell, development has often caused major declines in our nation's coastal ecosystems. Increased solid waste production, higher volumes of runoff, losses of green space, decline in biodiversity, and increasing water quality problems are evident in varying degrees in nearly all of the areas where population growth is greatest.

In order for marine and coastal ecosystems to remain productive and sustainable, strategies must be found that balance growth and protect these unique environments. The relationships between coastal ecosystem impacts and the factors causing them are often unclear, resulting in the inability of decision-makers to predict outcomes or successfully manage valuable resources. Cumulative impacts are a particularly vexing problem as it is often necessary not only to measure these but also to determine when cumulative impacts fall within the range of natural variability.

With the growth in coastal populations comes increased

risk to life and property from recurring natural hazards such as winds, waves, and floods from storms, earthquakes and tsunamis, and shoreline changes. These hazards are compounded by other factors, including sea level rise, land



subsidies, new coastal residents unfamiliar with local hazards, and an increasingly valuable building stock along the nation's coastline. While it will be impossible to eliminate risk from natural hazards, selected programs are needed to assist states and localities in creating an aware and prepared citizenry capable of employing the most effective means to reduce loss of life and property and mitigate economic impacts.

New Hampshire Perspective

Although New Hampshire is not a particularly populous state (1.2 million residents) and does not have a long coastline when compared to its neighboring states of Maine and Massachusetts, it does have an incredibly rich and diverse coastal zone. It is a coastal zone where nearly 75% of the state's population lives within 50 miles of the coast. In keeping with the national trend, this area grew in population by nearly 10% over the last decade, while the rest of the state grew at only about half that rate.

The state borders on the 36,000-square-mile Gulf of Maine, which is among the world's most productive water bodies. A semi-enclosed sea, the Gulf is encircled by the outstretched arms of Cape Cod and Nova Scotia, and bounded to the south by Georges and Browns banks. It is a distinct body of water that differs from the Atlantic Ocean geologically, oceanographically, and biologically. Most importantly, the Gulf of Maine is a marine ecosystem, comprised of interrelated nutrient cycles, currents, tides, food chains, and energy flows.

The parts of the Gulf most familiar to its residents and visitors are the coast and adjacent waters. In particular, Gulf estuaries such as Great Bay are exceedingly productive habitats. The region's estuaries are believed to be vital



at some life stage to 70% of the commercially valuable fish species of the Gulf.

Recognizing the important role of estuaries and coastal processes in maintaining a

healthy ecosystem, Sea Grant has supported work to understand how physical processes acting over a broad range of space and time scales affect such things as the cycling of nutrients, pollutants, and other materials. Emphasis has also been placed on the continued development of credible predictive models of physical transport and in mitigating effects of oil spills and major storms.

Strategic Goals and Opportunities

A. Coastal Ecosystem Health

Goal 1. Develop capabilities to monitor and predict reliably the response of Gulf of Maine ecosystems to both natural and anthropogenic factors that may cause these perturbations.

Actions and Opportunities:

- Determine which parameters are most important for understanding ecosystem function.

- Describe how Gulf of Maine physical processes affect the transport, dispersion, and fate of contaminants in the coastal zone.
- Assess cumulative impacts and determine when they become significant enough to threaten the sustainability of marine ecosystems.
- Develop methods that distinguish between anthropogenic change to an ecosystem and change caused by natural variability.
- Support and promote volunteer water quality monitoring programs that provide critical and timely data to decision-makers about the status and trends of NH coastal waters.

Goal 2. Identify and link specific land use practices within the coastal watershed that are significantly degrading Gulf of Maine water quality through nutrient and toxic contaminant discharges.

Actions and Opportunities:

- Determine potential ecological and public health risks associated with areas of high-level toxic contaminants.
- Develop and determine remedial measures for reducing inputs of toxic chemicals from point and non-point sources (e.g., bioremediations).



- Determine the impacts that increasing impervious surfaces throughout the watershed have on water quality. Develop practical alternatives.
- Develop a better understanding of the relationships between nutrient over-enrichment and habitat alteration/loss.

Goal 3. Determine the environmental and ecological factors primarily responsible for harmful algal blooms (HAB) in the Gulf of Maine.

Actions and Opportunities:

- Identify the source, frequency, composition, and distribution of harmful blooms affecting Northern New England coastal areas.

- Develop reliable predictive capabilities for HAB outbreaks, utilizing selected environmental cues.
- Continue to support volunteer monitoring programs designed to identify the occurrence and distribution of potentially harmful blooms throughout the region.

Goal 4. Develop techniques and approaches to conserve, improve, restore, and create important Gulf of Maine coastal habitats, including seagrass beds, wetlands, mudflats, and beach systems.

Actions and Opportunities:

- In partnership with appropriate federal and state agencies, design novel habitat restoration technologies.
- Develop criteria to assess the long-term ecological and socioeconomic consequences of coastal habitat restoration.
- Evaluate the effectiveness of estuarine and marine reserves in conserving and protecting key coastal habitats.
- In collaboration with the NH Coastal Program and the NH Estuaries Program, develop outreach programs that transfer restoration technologies/results to appropriate public officials, businesses, and the general public.

Goal 5. Provide scientifically based information, allowing decision-makers to implement policies for sustainable development in coastal areas.

Actions and Opportunities:

- Develop innovative applications of remote sensing, Geographic Information Systems (GIS), and other novel technologies needed to build a comprehensive coastal watershed monitoring and impact prediction system.
- Support economic valuation studies that quantify both the use and non-use values derived from coastal



habitats and resources (i.e., fisheries, recreation, waste-assimilation, flood control).

- Build partnerships with coastal communities to help construct a means to measure

sustainability that realistically represents a community's economic, environmental, and social situation, and provides a framework for measuring successes.

B. Public Safety

Goal 1. Enhance preparedness and reduce loss of human life, property and environmental resources from coastal natural hazards affecting the state and the region.

Actions and Opportunities:

- Quantify impacts and help reduce vulnerability regarding sand dunes and beach nourishment projects.
- Develop methodologies and techniques for risk management and cost benefit analysis (social, physical, economic, and environmental).
- Develop new technologies for remediation and disaster prevention.
- Increase public and decision-makers awareness of threats from natural disasters through innovative outreach programs done collaboratively with appropriate state agencies.

Marine Education and Human Resources

National Perspective

For over 30 years, training the next generation of marine scientists, engineers, and technicians and seeking to provide the general public with marine-related information have been key elements of the Sea Grant mission. These two needs are even more important today as our growing population puts increasing pressure on all of our natural resources and particularly on those in our coastal zones. In addition, realizing that the ocean and the atmosphere are intimately connected and that their combined contribution to global climate change is significant, Sea Grant has sought to include these topics in its programs when appropriate.

In order to remain preeminent, the US needs to continue to attract a fair share of its best and brightest to work on the current and future significant marine science issues and to train them in the



use of the most advanced technology. The Sea Grant network has accomplished this mission by supporting graduate and undergraduate students and giving them opportunities to work alongside many of today's leading research scientists and educators, receiving hands-on experience and learning practical skills that they will use throughout their careers. In addition, Sea Grant has supported a wide range of fellowship programs and other such opportunities, giving promising students every assistance in launching productive careers.

Sea Grant also has a long tradition of getting information into the hands and the heads of the general public, thereby helping to create a nation of informed and interested stakeholders. With opportunities geared for every age group, Sea Grant has provided everything from boat-based programs for K-12 students, teachers, and families to hands-on volunteer opportunities for seniors. Although science testing over the past decade has consistently placed US students below their peers on the international scale, recent test results show that our students are gaining ground at the elementary level. To continue to raise science literacy in students, teachers, and the general

public, Sea Grant seeks to leverage its efforts to use the marine environment as both a motivator and a laboratory to increase science skills and understanding.

New Hampshire Perspective

In New Hampshire, Sea Grant has a 30-year tradition of developing and supporting innovative initiatives designed to achieve both of these national marine science goals: preparing a highly trained workforce and developing an informed citizenry. In addition, NH Sea Grant has the programs and personnel in place both to continue and to enhance this tradition.

On the informed citizenry side, Sea Grant has partnered with UNH Cooperative Extension to develop a model outreach program. Led by an extension educator and



powered by well over 100 volunteers, the UNH Marine Docent Program reaches 15,000-20,000 people each year and provides many hours of programming and instruction through the many initiatives of its SeaTrek Program. The docents provide a range of programming to school classes, youth groups, civic organizations, and families.

Through this effort and other collaborative endeavors, such as the Great Bay Coast Watch and the NOAA/UNH Cooperative Institute for Coastal and Estuarine Environmental Technology, Sea Grant seeks to engage a range of citizens and convince them that they hold a stake in the use, conservation, and development of our nation's marine resources. Quite often, a young participant in one of these marine education programs opts for a marine-related career and goes on to benefit from NH Sea Grant's undergraduate and graduate involvement.

Tech 797, the UNH Ocean Projects Course, is an innovative undergraduate course offered each year. Supported by NH Sea Grant for over 30 years, the course pits interdisciplinary teams of students against genuine marine science problems and introduces the undergraduates to the challenges, pitfalls, and rewards of hands-on marine science research.

Many of these students go on to seek advanced degrees in the marine science fields and to work on Sea Grant-supported research projects. A number of graduate students apply for one of the Sea Grant-supported fellowship programs each year, seeking to broaden their perspectives before beginning their careers.

Thus, Sea Grant offers a continuum that can attract a child to the marine sciences and then assist him or her for many years as he or she prepares for a marine-related career. One of the program's goals is to strengthen and enhance this comprehensive set of programs.

Strategic Goals and Opportunities

A. Fostering an Informed Citizenry

Goal 1. Develop, enhance, customize, and field test multidisciplinary K-12 curriculum materials and programs that support state and national science standards.

Actions and Opportunities:

- Compile and review existing curriculum materials and programs to assure that they support current standards.
- Develop new marine education programs that reflect emerging national scientific issues.
- Assist teachers in measuring the results of student participation in programs.
- Evaluate the possibility of instituting daylong or weeklong job shadowing opportunities for promising students.
- Develop additional programs focused on high school-level teachers and students.
- Continue to enlist researchers' participation (faculty and graduate students) in K-12 programs.
- Develop a system for the ongoing evaluation of all SeaTrek programs.
- Coordinate the expansion of K-16 programs with other UNH-based programs, 4-H, and scouting organizations.
- Continue to provide home-school opportunities within the Marine Docent Program and the Great Bay Coast Watch.
- Continue to develop and promote the Marine Education Resource Center.



- Encourage Sea Grant-supported researchers to include a K-12 education component or an outreach component in their research project whenever appropriate.

Goal 2. Increase opportunities for K-12 NH teachers to improve their knowledge and skills in the marine science fields by providing appropriate training for pre-service and practicing teachers.

Actions and Opportunities:

- Continue and enhance teacher training in conjunction with all boat-based and field programs.
- In partnership with schools and UNH, develop new programs that engage in-service and pre-service teachers directly with researchers, faculty, and graduate students.
- Participate in the planning and delivering of regional and national educator training programs, such as COAST: Pathfinder.
- In collaboration with the new UNH Mathematics, Science, and Engineering Education Center, develop a credit-bearing marine science internship program for middle and high school teachers.

Goal 3. Build a marine literate citizenry by increasing public understanding of critical NH marine and coastal issues through up-to-date and relevant marine education programs focusing on the Gulf of Maine.

Actions and Opportunities:

- Undertake regular needs assessments to determine marine issues likely to impact NH's coastal zone.
- Incorporate information on environmentally safe practices into current programming and develop new programs focusing on this issue.
- Work in collaboration with excursion vessel owners to devise public information programs on the marine environment aboard their boats.
- Partner with the NH Coastal Program to expand the National Marine Debris Monitoring Program.
- In partnership with the Gulf of Maine Council on the Marine Environment, devise public education programs and produce material for their periodical, *Gulf of Maine Times*.
- Expand programs for the general public that include some form of experiential education.
- Develop an annual publication focusing on NH Sea Grant's local, regional, and national impacts for distribution to key clientele groups and the general public.
- Make the NH Sea Grant web sites integral parts of all of the program's information dissemination efforts.



- Use the UNH, local, regional, and national media efficiently and effectively to provide broader opportunities for disseminating Sea Grant information.
- Develop special information programs that target specific or multiple audiences.
- Continue to develop programs that enlist community volunteers in data collection, in the identification of sites of environmental concern, and in reporting to their communities on the health of the marine and coastal environment.

B. Developing a Technically Trained Workforce

Goal 1. Utilizing marine science courses and internships, produce highly trained graduates to fill important jobs in the science, engineering, and education fields.

Actions and Opportunities:

- Develop a communications product that provides students (and other interested parties) with an overview of the UNH marine community and the opportunities it provides for students.

- Investigate the feasibility of creating undergraduate marine science research fellowships/ internships open to all students pursuing an appropriate degree at a NH university or college.



- Investigate the feasibility of creating undergraduate marine science internships with agencies, decision-makers, aquaria, marine industry, etc. open to all students pursuing an appropriate degree at a NH university or college.
- Support the development of undergraduate courses in new and emerging fields.
- Continue Sea Grant support for UNH Tech 797.

Goal 2. Encourage more involvement of graduate students in research and outreach efforts.

Actions and Opportunities:

- Involve graduate students in outreach efforts.
- Promote the role graduate students play in the scientific process by focusing on them in communications products.
- Encourage Sea Grant PI's to include student (graduate and undergraduate) support in their research projects

Goal 3. Attract more candidates for the Knauss Fellowship and all other such Sea Grant opportunities.

Actions and Opportunities:

- Determine the most effective means to promote all fellowship opportunities.
- Feature the opportunities on the program web site and in appropriate program publications.
- Work with researchers to identify and recruit promising fellowship candidates.
- Explain fellowship opportunities to interested faculty and students at institutions of higher learning throughout the state.

NH Sea Grant Policy Advisory Committee

A wide range of marine stakeholders assisted us in the preparation of this strategic plan and we would like to acknowledge, gratefully, their participation in the process. We would especially like to thank the members of our Policy Advisory Committee, who obtained and integrated the information and ideas. The production process involved a mix of interviews, meetings, and writing, and much of this effort was borne by those listed here.

Franz Anderson
Dept. of Earth Sciences
Univ. of New Hampshire
Durham, NH 03824
tel: 603-862-4080
fea@cisunix.unh.edu

David Bartlett, Assoc. Director
EOS, Morse Hall
Univ. of New Hampshire
Durham, NH 03824
tel: 603-862-0322
david.bartlett@unh.edu

Kenneth Beal, Asst. Dir.
State, Federal & Constituent
Programs Office, NMFS
One Blackburn Drive
Gloucester, MA 01930
tel: 978-281-9267
ken.beal@noaa.gov

Will Bland, Gen. Mgr.
Little Bay Lobster/
Shafmaster Fishing Co.
18 Old Dover Road
Newington, NH 03801
tel: 603-431-3170
willb@leatherloft.com

Kathryn Cataneo, Exec. Dir.
Sponsored Research
Univ. of New Hampshire
Durham, NH 03824
tel: 603-862-2001
k.cataneo@unh.edu

Barbaros Celikkol
Dept. of Mechanical
Engineering
Kingsbury Hall Rm. 134
Univ. of New Hampshire
Durham, NH 03824
tel: 603-862-1940
celikkol@cisunix.unh.edu

Barbara Hopkins
16 Vaughns Lane
South Berwick, ME 03908
tel: 207 .384.5183
hopkins@harley.mv.com
bhopkins@cisunix.unh.edu

Bill Hubbard
Coastal Conservation Assoc.
51 Rogers Road
Center Barnstead, NH 03225
tel: 603.776.2992
onshore@worldpath.net

Peter Kendall
Portsmouth Fishermen's Co-op
PO Box 4159
Portsmouth, NH 03801
tel: 603.431.7078

Martin Klein
4 Old South Lane
Andover, MA 01810-3927
tel: 978.475.2713
nielk@aol.com

Rich Langan
Co-Director, CICEET
Nesmith Hall
Univ. of New Hampshire
Durham, NH 03824
tel: 603.862.0190
rlangan@cisunix.unh.edu

John E. Pike, Dean & Director
Cooperative Extension
Taylor Hall
Univ. of New Hampshire
Durham, NH 03824
tel: 603.862.1520
john.pike@unh.edu

Robert Robertson
Dept. of Resource Economics
Univ. of New Hampshire
Durham, NH 03824
tel: 603.862.2711
robertr@christa.unh.edu

Bruce Scammen
15 Greta's Way
Stratham, NH 03885
tel: 603.778.2966 (home)
tel: 603.772.4400 (work)

Peter Wellenberger
NH Fish & Game
Region 3
225 Main Street
Durham, NH 03824
tel: 603.868.1095
peter@greatbay.org



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