

Coastal Science Serving North Carolina

North Carolina Sea Grant Strategic Plan 2014-2017

Susan N. White, Executive Director

NORTH CAROLINA SEA GRANT'S VISION

North Carolina Sea Grant will, in the 21st Century, serve as a leader in addressing the state's urgent and long-term needs in ocean and coastal resource management, and in the successful transition to ecosystem-based approaches through sound science and educational excellence.

NORTH CAROLINA SEA GRANT'S MISSION

Through integrated research and outreach efforts, North Carolina Sea Grant will enhance sustainable use and conservation of ocean and coastal resources to benefit communities, economies and ecosystems.

THE CHALLENGE

Since its inception in 1970, North Carolina Sea Grant has provided leadership in focusing the research capabilities of North Carolina's major universities to address coastal topics, including economic development, ecosystem health and human resources. Census figures place North Carolina among the fastest-growing states. Many coastal and coastal watershed counties had seen unprecedented population growth prior to the economic slowdown. That growth added a variety of stresses — and increases hazard risks — along the state's ocean, inlet and estuarine shorelines and riverine floodplains. The role of Sea Grant as a critical catalyst for, and contributor to, North Carolina's coastal future is increasingly evident.

THE PLAN

This strategic plan will guide North Carolina Sea Grant's efforts to respond effectively to challenges that physically and culturally reshape coastal North Carolina. The plan reaffirms Sea Grant's core values of supporting and promoting:

- The most creative ideas and best research through merit-based peer review of investigator-initiated proposals.
- Integrated multidisciplinary and team approaches to problem solving through combinations of research, outreach and education aimed at priority issues.
- Cutting-edge research and its application by disseminating innovative ideas and new knowledge;
- Excellence in education and development of human resources equipped to address future challenges.
- Strong state and regional partnerships to address emerging coastal issues by sharing the best science to a variety of audiences.

North Carolina Sea Grant will consider proposals for research seeking to improve understanding, utilization and management of marine and coastal resources as related to North Carolina and the adjacent region. Special consideration will be given to proposals that address priority issues; can

support, engage or prompt ongoing outreach programs; and seek to build upon Sea Grant's strong partnerships with industry, government and the general public.

Program direction and priority issues are updated through input from:

- state, regional and federal resource management agencies;
- faculty and staff of North Carolina public and private universities;
- the North Carolina Sea Grant Advisory Board;
- professional, industry and community groups, as well as the public;
- marine science panels convened within the University of North Carolina system;
- the National Sea Grant Strategic Plan that reflects plans developed by the National Oceanic and Atmospheric Administration, and NOAA Office of Oceanic and Atmospheric Research; and
- federal, international, state and private foundation reports on ocean and coastal issues and policy, along with subsequent documents, including NOAA strategy papers on climate, weather and water, coasts, oceans and marine life.

The University of North Carolina system and private universities in the state are home to some of the very best researchers in the world. Sea Grant will use federal core and state-supported resources toward research projects that reflect this plan. The nurturing and maintenance of an excellent human resource base is critical to promoting effective research and outreach. Thus, our research funds provide training of graduate and professional students in coastal disciplines.

Results from Sea Grant research, as well as data available from the scientific community at-large, will be accumulated, assimilated and transferred to user groups by the North Carolina Sea Grant Extension Program. In turn, extension specialists will identify needs of a diverse user community that includes the general public, government institutions, educators, business and industry leaders, and interest groups — and, in turn, will share those needs with the academic communities.

In order to provide cutting-edge information and education to various resource users and the public, Sea Grant communicators will work with researchers and extension professionals to package and disseminate relevant and timely information to a variety of audiences, using a variety of outreach tools, including publications, Web sites and other electronic delivery modes, workshops, and media relations to reach the program's constituents.

North Carolina Sea Grant is a catalyst for partnerships among private and public users, managers of marine and coastal resources, and the academic community, thus generating innovative research and educational products. As director of two aquatically-focused, inter-institutional programs within the University of North Carolina system, the Sea Grant executive director interacts with the office of the system's vice-president for research, and will serve on system-wide and also North Carolina State University-based marine science councils. Direct reporting is to NC State's vice chancellor for research and graduate studies. Effective leadership offers a vision for discovery and learning, enabling science to be the basis for addressing emerging coastal and marine issues.

To understand the complex processes and issues that dictate the best use of marine and coastal resources in North Carolina, Sea Grant's efforts need geographic diversity and integrated approaches from the systems level. The complexity of coastal North Carolina includes the interaction of the coastal ocean and estuarine systems, a large semi-lagoonal sound, as well as the contiguous wetlands, tidal creeks, rivermouths and tributaries. These systems respond to acute events, such as storms, as well as long-term changes, including any changes in climate and the impacts of human uses. Many issues facing marine and coastal resource users transcend jurisdictional boundaries. Thus, North Carolina Sea Grant

encourages inter-institutional, multi-disciplinary and regional collaborations to identify complex system characteristics, including policy and legal systems, resulting impacts on resource management, and solutions.

FOCUS AREAS

Sea Grant is concentrating effort in five areas: healthy coastal ecosystems; sustainable coastal development; a safe and sustainable seafood supply; hazard resilience in coastal communities, and environmental literacy and career initiation. These five interrelated focus areas emerged from both a national and state-based strategic planning process as areas of critical importance to the health and vitality of the nation's coastal resources and communities. As such, they reflect issues of major importance to NOAA and North Carolina coastal stakeholders, are consistent with the work of the NOAA coastal program efforts, and are topical areas in which Sea Grant has made substantial contributions in the past and is positioned to make significant contributions in the future. The focus areas also reflect the vision and needs identified by North Carolina Sea Grant, its management, extension and administrative staff, its program advisory board, a web-based invitation to the public to make input, and the findings of several major regional planning and research priority reports pertaining to coastal resources.

In each of the five focus areas, Sea Grant has identified goals to pursue and approaches designed to take advantage of strengths in integrated research, outreach and education, and its established presence in coastal communities. Understanding relationships and synergies across focus areas is vital to achieving the focus area goals. Sea Grant is one of many partners working to address these complex and interrelated issues. Understanding how activities in one area can support and complement other activities, and using partnerships to accomplish shared goals, are approaches inherent to Sea Grant, and will be central to achieving the goals outlined in this plan.

ENVIRONMENTAL LITERACY AND CAREER INITIATION

Managing coastal and ocean resources in ways that will balance human needs with environmental health requires progress in three fundamental areas:

- We need management and decision-making processes that are based on sound information, engage all stakeholders who may benefit from making better resource decisions, and include mechanisms to evaluate trade-offs between human and environmental needs.
- We need better information about how coastal and ocean ecosystems function and how human activities affect these habitats and living resources.
- We need citizens who understand the complexities of coastal environments and the interactions between human use and the health of coastal ecosystems.

To facilitate progress in these areas and to help the nation understand, manage and use its coastal and ocean resources wisely, Sea Grant has identified three central goals in this focus area. These goals reflect the value Sea Grant places on education in all forms, and as an integrated component of all its efforts. They provide the foundation of Sea Grant's work as a scientific and educational organization, and are integral to the success of this plan.

Goal: To generate sound scientific information to advance understanding of the nature and value of our coastal and ocean resources; to identify new ways to conserve and use these resources; and to support evaluation of the environmental impacts and socio-economic trade-offs involved in coastal decision-making.

Short-term economic considerations often influence coastal decision-makers to take action without understanding the long-term social, environmental and economic consequences of their decisions. Ecosystem functioning and values, emerging and future economic opportunities, and the social and economic costs and benefits of various human activities need to be translated into factors understood by the general public in order for sustainable uses of coastal environments to be realized. Sea Grant has a long history of generating cutting-edge research and supporting technological innovations that can lead to informed conservation and use of coastal and ocean resources.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes for this goal area include:

- Identify issues and topics for state and regional socio-economic research and outreach that will enhance understanding of human behavioral change at the individual, organizational and policy-decision making scales.
- Identify the needs for and the capacity to develop or adapt, existing businesses, products, tools and technologies that will improve management and development of coastal resources.
- Establish and maintain linkages among university researchers and businesses, government bodies and agencies, non-governmental organizations, coastal communities, and the general public in order to better identify and address pressing coastal resource needs.
- Transfer information to citizens through communications activities, as well as through a variety of networks and partnerships, as means to boost general public understanding of environmental concepts, science, issues and solutions within the coastal context.

Goal: An informed public that not only understands the value and vulnerability of coastal and ocean resources, but demands informed science-based decisions about the conservation, use, and management of these resources, as well as a well-trained workforce that will make this a reality.

Several national, international and private foundational reports of the first decade of the 21st Century emphasized that restoring and sustaining our coastal and ocean environments requires an informed citizenry that understands the value and vulnerability of these resources. Clearly needed are scientists, planners, developers, engineers, and people involved in all water-related enterprises who understand the interactions between human activities and ecosystem health. NOAA has made ocean and aquatic literacy a strategic priority. Sea Grant has been a leader in K-12, undergraduate, graduate, professional and technical education in coastal and ocean-related areas for decades. Sea Grant is committed to playing a leadership role in partnership with the NOAA, its Office of Education, and others to advance coastal and ocean literacy. This can be done by capitalizing on Sea Grant's strong university partnerships, and by using its education and extension capabilities to develop educational programs for schools, professional education, and workforce training.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- With an emphasis on informal field-based experiences, support and enhance K-12 STEM teaching achievements via development of methodologies, materials, and social media.
- Identify the current knowledge base of students and educators in order to prioritize development of new materials and media approaches.
- Develop new inquiry-driven curricula and adapting formal, informal and newer information technology-based means for educators to connect students with marine and coastal concepts and to extend relevant research results to students, educators and environmental centers.

- Develop life-long learning experiences that target the needs of the widest spectrum of North Carolina residents, through public lectures, museum and aquarium programs, and presentations to non-governmental and local community organizations.
- Increase the number and diversity of highly qualified graduate and professional students in the marine and coastal professions, and increasing access to fellowships, internships, cooperative programs and field experiences.
- Identify present and future workforce needs that can be met through training by the state's universities and community colleges, and working in partnerships to initiate or expand such programs.
- Continue contributions to — and/or leadership in — regional and national Sea Grant and NOAA efforts.

Goal: Decision-making processes that involve the full-range of coastal interests, that integrate efforts of public and private partners at the federal, regional, state and local levels, and provide mechanisms for establishing common understandings and generating outcomes and public policies that balance multiple interests.

The continued in-migration of people to our state's coastal areas increases the complexity of coastal decision-making and creates greater potential for conflict among users at a time when coastal decision-making frequently can become fragmented and narrowly focused. Sea Grant's long-standing relationships with a wide variety of stakeholders in coastal communities and its reputation as a source of unbiased information enable it to play a leadership role in promoting effective information sharing, consensus building and collaborative integration of efforts in the coastal arena. Sea Grant can enhance its regional effectiveness by working closely with other NOAA coastal programs as well as with programs advanced by other federal and state agencies, regional ocean observation bodies, and non-governmental organizations.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Working with its program Advisory Board and other partners to identify priority topics and prepare research and outreach efforts to meet emerging issues.
- Continue leadership of the North Carolina Coastal Resources Law, Planning and Policy Center.
- Continue Sea Grant extension outreach to state, regional and national policy boards, commissions and review panels.

These three fairly cross-cutting goals within this focus area have been a foundation of North Carolina Sea Grant's work since it was established, and they are fundamental not only within this specific focus area, but also to success in the other focus areas outlined in this plan. The more specific goals and approaches outlined in the other focus areas often build on these same goals, generating the knowledge and creative solutions needed to address challenges and opportunities related to healthy coastal ecosystems, a safe and sustainable seafood supply, sustainable coastal development and hazard resilient communities.

HEALTHY COASTAL ECOSYSTEMS

Healthy coastal ecosystems are the foundation for life along the coast. However, increasingly rapid coastal development, global overfishing and other human activities are leading to water quality degradation, decline of fisheries, wetlands loss, proliferation of invasive species, and a host of other

challenges that need to be understood in order to restore and maintain these ecosystems. Ecosystem functioning does not respect traditional political boundaries, and thus responsible management of ecosystems requires new kinds of thinking and actions.

Sea Grant is a leader in regional approaches to understanding and maintaining healthy ecosystems, with planning efforts underway across the country to identify information gaps, set research priorities, and coordinate information and technology transfer to those who need it. Sea Grant has fostered efforts to address widespread problems and has hired staff, shared among several state programs, to tackle these problems. Sea Grant's regional consortia, nationwide networks and international contacts are particularly well-suited to helping the nation address ecosystem health at the appropriate local, state, regional, national and global levels.

Goal: Sound scientific information to support ecosystem-based approaches to managing the coastal environment.

To realize the full potential of ecosystem-based management approaches, we need research that will lead to better understanding of present day conditions, basic ecosystem processes, the impacts of coastal and upland land uses on the health of coastal and ocean environments, and the importance of healthy ecosystems and their critical and essential habitat to healthy fisheries. We also need to know more about how to transform our new knowledge and understandings into sound management principles and practices. Sea Grant will continue to build the scientific foundation needed by supporting research that provides accurate information related to ecosystem health and by accelerating the transfer of this information to coastal residents, resource managers, businesses and industries.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Develop integrated, multidisciplinary approaches or models to assess the carrying capacity of a wide variety of coastal habitats and environments, including small but highly sensitive tidal creeks.
- Develop techniques and models to determine input rates, fate, effects, and/or residence time of nonpoint sources of nutrients, toxins, pharmaceuticals and other contaminants and their transport and transformation in watersheds. This includes predicting hypoxic/anoxic conditions, determining effects of sedimentation and turbidity on water quality, and determining ecosystem and community responses to these inputs.
- Identify potentially invasive species and their pathways of introduction; and, via sustained outreach efforts, reduce intentional and accidental release of such invaders.

Goal: Widespread use of ecosystem-based approaches to managing land, water and living resources in coastal areas.

Achieving widespread use of ecosystem-based management approaches will require extensive efforts to communicate the effects of ecosystem degradation on natural resources, local economies and human health to a wide range of audiences in ways that motivate them to respond. Sea Grant's strong research and extension capabilities provide scientific information and technical assistance on ecosystem-based management approaches. At the same time, the organization's outreach and education capabilities engage citizens in stewardship activities that promote healthy ecosystems. All these programs can result in regional and other collaborative approaches to address problems that extend beyond traditional geographic or governmental boundaries.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Develop, gather and deliver research-based information that explains to all relevant stakeholders the importance of sustaining critical habitats, biodiversity, ecosystem services and wildlife corridors in both the ecologic and economic contexts.
- Via generation, synthesis, translation and dissemination of relevant science-based information, assist resource managers, regulatory entities, other interests and the general public in understanding the impacts of habitat alteration and loss of ecosystem function, as well as the levels and effects of marine debris and land fertilizers in coastal environments.
- Develop techniques and approaches for determining interactive effects of climatic and human perturbations on ecosystem trophic structure and transfer efficiency, and the fate of primary and secondary production in estuarine and coastal waters.

Goal: Restored function and productivity of degraded ecosystems.

Past activities and events have led to deterioration of nursery areas for wild fish populations, loss of wetlands, closure of beaches and shellfish beds, and proliferation of invasive species. Sea Grant will help reverse these trends by identifying and assessing impaired ecosystems, and supporting the development of new policies, technologies, and processes that promote restoration of ocean and coastal ecosystems in ways that balance the needs of the natural systems with the needs of the humans who inhabit them. Sea Grant will use its nationwide network of extension, education and communication specialists to provide the technical assistance needed, and to share new information and technologies with local, state, regional, national and international partners.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Develop measures, recommendations and protocols for ultimate use as “best management practices” (BMPs) in point source and NPS pollution control, smart growth, and low impact and green development initiatives.
- Develop techniques to be utilized by resource managers and riparian owners to enhance or rehabilitate degraded habitats, such as wetlands, streams, riparian buffers, oyster reefs and submerged aquatic vegetation.
- Quantify the interrelationships among land-use activities, stormwater quality and drainage, habitat and stream condition, hydrologic processes and the ecological response of receiving waters; then share such quantitative findings with coastal resource managers, owners and users.
- Develop techniques to respond to the challenges associated with sewage disposal and with identifying and understanding marine pathogens.
- Determine potential economic and biological impacts of beach nourishment and also the dredging of inlets and waterways; share and explain such impacts to relevant stakeholders.

SUSTAINABLE COASTAL DEVELOPMENT

Coastal communities in America provide vital economic, social and recreational opportunities for millions of Americans, but decades of population migration have transformed our coastal landscapes and intensified demand on finite coastal resources. The increase in population has resulted in new

housing developments and recreation facilities, a new generation of energy development activities, port expansions and other business activities. In addition, the prospect of rising sea levels will need to be examined, and if need be incorporated in new coastal development and investment plans and policies. These changes are placing tremendous pressure on coastal lands, water supplies, and traditional ways of life. To accommodate more people and activity, and to balance growing demands on coastal resources, we must develop new policies, institutional capacities, and management approaches to guide the preservation and use of coastal and ocean resources.

Sea Grant will engage a diverse and growing coastal population in applying the best available scientific knowledge, and use its extension and education capabilities to support the development of healthy coastal communities that are economically and socially inclusive, are supported by diverse and vibrant economies, and function within the carrying capacity of their ecosystems.

Goal: Healthy coastal economies that include working waterfronts, an abundance of recreation and tourism opportunities, and coastal access for all citizens.

Marine resources and coastal amenities sustain local and national economies through fisheries and aquaculture, seafood processing, trade, energy production, tourism, and recreation enterprises. Urban ports and waterways continue to accommodate expanding international trade, staging areas for offshore industries, growth in tourism and recreational boating, and changes in fishing fleets. At the same time, changing development patterns along the coast are threatening to displace traditional water-dependent industries and cut off water and beach access for coastal residents. Vacant industrial buildings and obsolete infrastructure facilities can be recaptured for new marine enterprises, public access, and planned mixed-use developments that bring enjoyment to residents and visitors alike.

Sea Grant's long-standing relationships with coastal communities and industries make it ideally suited to provide information, tools and techniques to support working waterfronts, responsible energy development, the development of accessible recreation and tourism activities, and adoption of sustainable development practices.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Advance community and general public understanding of current and future beach restoration and preservation techniques and approaches as tools to mitigate sea level rise and storm impacts.
- Assist and guide coastal communities, state agencies and/or businesses in identifying and/or modeling the economic and cultural importance, impact and sustainability of recreational and commercial fisheries and their related working waterfronts, and of nature-, heritage- and waterfront-based tourism.
- Explore the advantages, disadvantages, consequences and benefits of alternative sources of energy and water for coastal communities, and share findings with those communities.

Goal: Coastal communities that make efficient use of land, energy and water resources and protect the resources needed to sustain coastal ecosystems and quality of life.

The biggest challenge facing many coastal cities and towns today is how to manage growth in ways that do not diminish the health of the ecosystems these communities depend on. One way this is reflected nationally and internationally is in the high-level of concern about climate change and its associated

effects. To respond to the challenges of growth at a local and regional level, communities are looking for ways to use land and water, generate energy, and dispose of waste that will preserve environmental health and economic vitality.

Determining the amount of the land, water and other natural resources needed to sustain healthy communities is an essential first step in establishing sustainable policies and growth practices. Only when the dimensions of this environmental footprint are identified can coastal communities understand what their carrying capacity is and what will be needed for generations to come. Sea Grant and its university partners are in a unique position to conduct research and develop models and forecasts that will help communities with this process.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Collaborate with federal and state partners to better prepare coastal communities on the potential impacts and adaptation approaches of climate change, sea level rise, and/or storm, drought and flooding events.
- Assist local governments, state agencies and/or coastal community stakeholders in understanding the range and utility of socioeconomic, planning, law and policy approaches so as to enhance, preserve, conserve, and/or increase working waterfronts and other kinds of access to public trust waters.

Goal: Coastal citizens, community leaders and industries that recognize the complex inter-relationships between social, economic and environmental values in coastal areas and work together to balance multiple uses and optimize environmental sustainability.

According to NOAA reports, coastal counties constitute less than one-fifth of the land area of the U.S. (not including Alaska), but account for over half of the population and are among the most rapidly growing areas in the country. The pressures on our oceans, coasts and resources continue to grow. Citizens and decision-makers have an urgent need for tools that will help them evaluate the implications of land-use changes, coastal development pressures, and increased resource use in approaching the policy and management decisions they face. Regional cooperation and coordinated land-use and watershed planning are essential.

Sea Grant's well-established role as a trusted broker among a wide range of interests makes it a key player in providing sound information for decision-makers, convening stakeholders to seek common ground, and facilitating the development and implementation of new coastal policies, plans, management approaches and consensus-building strategies.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Engage and train government officials, non-governmental organizations, business owners, developers, and/or other coastal decision-makers to consider sustainability of coastal ecosystems and economies as they develop land- and water-use plans and water-supply investments.
- Broaden outreach efforts, in partnership with CES as appropriate, on the benefits and costs of rainwater retention, harvest, and diversion in land development and landscaping practices.

- Assess the potential for, and impacts of, sustainable offshore industries, including wind energy and oil and/or gas extraction development.

SAFE AND SUSTAINABLE SEAFOOD SUPPLY

The United States has witnessed the decline of many of its major fisheries while seafood consumption is on the rise, resulting in a seafood trade deficit of \$8 billion per year, according to statistics from the U.S. Department of Agriculture's Foreign Agricultural Service. At the same time, Sea Grant, through its research, extension and education activities, and work with partners, has produced important discoveries that have aided the stabilization and recovery of many endangered fisheries.

According to the NOAA Aquaculture Program, U.S. aquaculture is in its infancy, amounting to more than \$1 billion of a \$70 billion worldwide industry. Aquaculture creates important new opportunities to meet the increased demand for seafood, but a number of questions need to be addressed for its full potential to be realized. Seafood safety is a growing concern as international trade increases and fish diseases and contamination become bigger problems.

Sea Grant has key roles to play in advancing public understanding of the nature of these problems and opportunities. Through the use of its research, extension and education capacities, Sea Grant will support the kind of informed public and private decision-making that will lead to a sustainable supply of safe seafood long into the future.

Goal: A sustainable supply of safe seafood to meet public market and non-market demand.

Ensuring a sustainable supply of safe seafood requires an understanding of the effects of overfishing, past management decisions and climate change on U.S. wild fish populations as well as the role ecosystem-based fisheries management can play. It also requires better understanding of the range of complex issues related to developing the domestic aquaculture industry. Sea Grant will make major contributions by supporting research that provides the knowledge needed to understand the factors stressing fisheries and the complexities of aquaculture development. Sea Grant will also translate and transfer useful research findings through extension and education activities to ensure responsible and productive use of these resources in the future.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- For potential use by managers and non-governmental organizations, identify and quantify underlying levels of fishery stock biological and ecological interactions, including the ecological and economic impacts of harvest, threatened species protection, habitat loss, water quality, anthropogenic inputs and climate change.
- Develop information technology-based methods to improve accuracy, credibility and more timely collection of fish harvest data by fishery managers.
- Contribute to the development and application by resource managers of ecosystem-based management strategies/approaches that more fully incorporate human (i.e., economic, cultural and social) factors within the ecosystem.
- Develop tools/procedures to help resource managers/monitors diagnose disease and pathology, and to define fundamental mechanisms of host-pathogen environment interactions.

- So as to serve as the foundations and driving forces for sustaining fishery resources for future use, identify and articulate commonalities (i.e., goals, needs) shared by commercial and recreational fishers.

Goal: A healthy domestic seafood industry that harvests, produces, processes, and markets seafood responsibly and efficiently.

A healthy seafood industry requires harvesting techniques that minimize by-catch and damage to marine habitats. It requires development of value-added products, enhanced quality assurance, and education about how to market under-utilized species. Sea Grant will involve harvesters, recreational fishermen, producers and managers in being responsible stewards as well as successful entrepreneurs. Sea Grant will support development of new technologies and participate in collaborative efforts to increase the range of seafood products produced, enhancing American competitiveness in global markets.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Develop/disseminate information to help fishery users adapt to changes in the resource base (such as harvesting more abundant or underutilized species) and in fishery management strategies/approaches.
- Introduce new technology and gear to the fishing industry to reduce by-catch and mortality in commercial and recreational fisheries, thereby increasing both the efficiency and sustainability of harvest.
- Develop/enhance the commercial culture and production technology, efficiency and competitiveness for existing and new aquaculture species; share culture/production improvements with existing and prospective culturists.
- Optimize seafood-related manufacturing processes, examining functional food ingredients, and developing training programs to facilitate the production of value-added products and/or compliance with rigorous food-safety regulations. This includes improving traceability and truthful marketing to enhance quality and safety of seafood for domestic and global distribution, and converting seafood processing discards, by-products and wastes into value-added items for new markets. Inform seafood processor awareness and adoption or rejection of such new processes.

Goal: Informed consumers who understand the importance of ecosystem health and sustainable harvesting practices to the future of our domestic fisheries, appreciate the health benefits of seafood consumption and understand how to evaluate the safety of the seafood products they buy.

Increased attention to the safety of domestic and international seafood has created an urgent need for rapid assessment techniques, certification programs, and standards for domestic and international seafood products, so consumers will have reliable information to inform their buying decisions. Sea Grant will involve industry representatives in the application of seafood safety standard; train inspectors and wholesalers in how to assess seafood quality; develop educational materials related to seafood safety, quality, and security; and make materials readily available to consumers.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Demonstrate and evaluate strategic and niche marketing approaches, supply chains and business models for potential use in the seafood and fisheries industries, and ultimately for improving consumer understanding of the benefits of identifying and eating fresh, locally caught, and responsibly-managed fishery products.
- Educate consumers about:
 - the characteristics and differences among bioengineered species, farm- raised species and naturally occurring species;
 - the relationship between a healthy ocean ecosystem and both the sustainable harvest of fish and the human health benefits; and
 - the health benefits and risks stemming from consumption of seafood caught in ocean, sound, estuarine and riverine waters.

HAZARD RESILIENCE IN COASTAL COMMUNITIES

Sea-level rise, the increased number and intensity of coastal storms, the ongoing threat of oil spills, and other natural and human hazards are putting more people and property at risk along the nation's coasts, with major implications for human safety and the economic and environmental health of coastal areas. It is essential that residents of coastal communities understand these risks and learn what they can do to reduce their vulnerability and respond quickly and effectively when events occur. Sea Grant will use its integrated research, training and technical assistance capabilities, and its presence in coastal communities to play a major role in helping local citizens, decision-makers, and industries plan for hazardous events and optimize the ability of their communities to respond and rebuild.

Goal: Widespread understanding of the risks associated with living, working, and doing business along the nation's coasts.

Communities and businesses are increasingly vulnerable to hazardous events brought on by climate-related changes, land-use changes and increased economic activity in coastal waters. There is a great need for information and tools to help communities assess the risks they face and identify the options available to them to minimize those risks. Sea Grant will support the work of NOAA's Climate Program Office and its climate impact and adaptation-related activities. Sea Grant will work with other federal, state, and local partners, the banking and insurance industries, and others to develop forecasting and risk assessment tools, economic and environmental impact models, and other mechanisms that will help families, businesses, communities, and regions understand their risks and take them into account in making personal, business, and community-related decisions.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Evaluate the implications of acute weather events and climate variability and change on major coastal initiatives, public facility investments and local economies, and share with interested and concerned parties.
- Through exploration of coastal geological and hydrological processes and dynamics, as well as state-of-the-art engineering applications, develop and/or evaluate prediction methodologies and mitigation strategies that may factor in coastal landform and waterway response to natural hazards, such as storms, floods, rip currents, inlet shifts and dynamics, climate change, sea level rise and long-term erosion; and inform potentially affected, responsible, and interested entities.

Goal: Community capacity to prepare for and respond to hazardous events.

It is not enough for communities and businesses to understand their vulnerabilities, they must act on this knowledge and become more resilient or the human and economic losses will continue to mount. Individuals, businesses and communities need to develop comprehensive emergency preparedness and response plans that increase their resiliency and enable them to respond effectively. Sea Grant will contribute to this by building a sound knowledge base to improve forecasting capabilities, by identifying development and best management practices that reduce the vulnerability of people, buildings and businesses to coastal hazards, and by advancing ways communities can manage and recover from these events when they occur.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Help coastal decision-makers, communities, businesses and key stakeholders to remediate and mitigate against damage exposure through the initiation of pre-event studies and outreach efforts.
- Prepare coastal decision-makers, communities, businesses and key stakeholders for wind, wave, weather and climate events through identification of landform and infrastructural vulnerabilities, opportunities to improve human and community resiliency, preparedness and/or safety, and improved capacity to mobilize post-event recovery efforts.

Goal: Effective response to coastal catastrophes.

Coastal and ocean catastrophes require the nation to mobilize a full-range of public and private partners and resources to mount an effective response. Sea Grant is supporting the development of linked regional, national and international coastal observation networks, thereby improving the availability of information needed to respond to crises as they unfold. Sea Grant's knowledge of local contexts and communities can optimize response effectiveness by facilitating immediate links to local partners and capabilities. Sea Grant has a national network of scientists and outreach workers with broad knowledge and experience, and it will provide multi-disciplinary technical assistance to first responders, helping to minimize damage and promote recovery.

Approaches and Expected Outcomes

Priority research and outreach approaches and outcomes in this goal area include:

- Develop and refine demonstrations and outreach programs that offer retrospective and "lessons learned" from weather and human-induced adverse events.
- Quantify interactions between barrier island/estuarine dynamics and increased coastal development; translate the results into economic and community response models.

THE BENEFITS

Sea Grant has the responsibility to link relevant research results to people who use coastal resources. North Carolina Sea Grant is part of a nationwide network of programs with the mission of delivering science-based information for application in the management and sustained use of coastal and marine resources. The issues and opportunities described in the above focus areas are today's highest priority. We join NOAA Sea Grant and the Sea Grant network in building links between researchers and coastal communities.

Expansion of knowledge for its own sake is not adequate reason for Sea Grant support. Our focus is to increase the public application and benefits stemming from coastal and marine research conducted not only under Sea Grant sponsorship, but also credible research carried out under other public and private support. Sea Grant research proposals will be subjected to a three-tiered review process — peer review, programmatic review and whenever appropriate, user-group review — to ensure that the best science will go forward. No proposed project in research, education or outreach will be considered for funding unless the rationale (programmatic values), methods (project protocols) and prospective user relationships are deemed suitable. Proposed activities should have sufficient intellectual content to make them appropriate university functions.

By addressing high-priority issues through an integrated program of research, outreach and education, North Carolina Sea Grant will advance the following results:

- Effective and sustainable stewardship efforts that utilize and manage coastal and estuarine resources for the use and enjoyment of present and future communities.
- New applications of technology to improve the efficiency of use and the economic return for existing resources.
- Enhanced understanding of the ecological relationships in marine and coastal environments, so that science-based policy can be applied to protect habitats for future generations.
- State and coastal communities' increased resilience to coastal hazards and other changing physical and economic conditions.
- Collaborative solutions to state and regional issues drawing upon the expertise from a wide pool of researchers, industry, government and a host of community interests.
- Increased awareness and knowledge of marine and coastal concepts and issues by producing highly trained graduates, professionals and informed citizens.

The challenges before us are great. The issues are many. But through strong partnerships with all stakeholders — including university researchers, resource managers, coastal communities and their leaders, businesspeople, policy-makers, and individual citizens — North Carolina Sea Grant is poised to bring science-based solutions to the state over the next four years. We will offer relevant research and transferable results on crucial coastal topics.

North Carolina Sea Grant
North Carolina State University
Box 8605
1575 Varsity Drive, Module 1
Varsity Research Building
Raleigh, NC 27695-8605
919/515-2454 * www.ncseagrant.org

Susan N. White, Executive Director
Jack Thigpen, Extension Director
Katie Mosher, Communications Director
Mary Beth Barrow, Fiscal Officer

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