



June 2014

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## Coastal & Marine Science: Returns on Investments

North Carolina Sea Grant's portfolio of research and outreach efforts continues to address critical coastal issues, from water quality and ecosystem-based management to economic development topics, including innovative seafood marketing and hazard resiliency. Our April 2014 research symposium highlighted Sea Grant's significant value within the state, as did a 2013 review of marine science programs in the University of North Carolina system by experts from the American Association for the Advancement of Science.

After an extensive proposal review focusing on scientific rigor and anticipated use of results within North Carolina, Sea Grant researchers from across the University of North Carolina system started a new cycle of projects in February 2014. Topics include climate literacy, oyster restoration, nitrogen levels and fecal contamination in coastal waters, storm-surge forecasting, coastal workforce, and stocks of blue crab and flounder. Through core, minigrant and other research programs, Sea Grant provides data on many emerging issues. In recent years, our research findings have helped to provide leverage for about \$2 million annually in funding for additional studies — extending our program impacts in the state and beyond.

With headquarters at North Carolina State University and offices in Manteo, Morehead City and Wilmington, North Carolina Sea Grant is a state/federal partnership that connects leading researchers with coastal communities, businesses, agencies and organizations. We provide leadership for the N.C. Coastal Resources Law, Planning and Policy Center, and share several positions with the Water Resources Research Institute of the University of North Carolina and other partners to reduce administrative costs.

### ***Recent research and outreach impacts include:***

North Carolina Sea Grant continues its tradition of training future leaders. Annually **about 75 graduate students and 25 undergraduates** participate in Sea Grant research projects. Their work has contributed to many accomplishments and impacts in this report.

In addition, Sea Grant provides special **fellowships in coastal science and policy**. From 2009 to 2014, a total of 48 graduate students from five universities were selected as fellows on state or national topics.

A long-time partnership with the **N.C. Division of Marine Fisheries** has provided a detailed analysis for habitat protection and fishery management plans. A program with the **N.C. Coastal Reserve** explores innovative research, including how underwater sound patterns factor in estuarine ecosystems.

A new fellowship with the N.C. coastal law center on state policy topics is patterned after the **National Sea Grant Knauss Marine Policy Fellowship**. North Carolina is a leader in Knauss placements in federal

executive and legislative offices, including four fellows in 2014 and three fellows selected for 2015. Our graduate students also have earned **NOAA fellowships in fisheries population dynamics and coastal management**.

Local governments in the coastal region have limited staff members, who must wear multiple hats. To assist them, North Carolina Sea Grant is working with Hyde County to **identify coastal hazards** and use a customized analysis tool to help community leaders identify **roots of various problems**, such as recurring flooding, as well as potential solutions. Modeled after a pilot project in Plymouth, the process is being refined and expanded through a joint project with Georgia Sea Grant. Extension specialists also work with local leaders on **land-use decisions**, including Currituck County's review and selection of planning regulations that consider water quality.

Sea Grant helps coastal property owners, businesses and community officials to understand and prepare for anticipated increases in **flood insurance** premiums associated with federal legislation, known as the Biggert-Waters Act.

Recognized as a national expert, our coastal construction specialist also worked with local, state and federal partners to implement **wind-damage mitigation standards** set by government and insurance-industry leaders for new and existing buildings. Building adaptations based on Sea Grant recommendations reduce future wind and water damage, lower insurance costs and provide for more resilient communities.

With Sea Grant assistance, coastal communities are finding ways to revive seafood-based economies. **North Carolina Catch** draws upon varied areas of Sea Grant expertise to support local efforts for new marketing techniques and consumer education, including community-supported fisheries. Sea Grant's **seafood supply-chain analyses**, including participation in a major USDA-funded local foods project at NC State, also help identify infrastructure needs to meet rising inland demand for North Carolina-landed seafood.

**Value-added seafood products** offer seasonal diversification and increased revenues for processors, retailers and communities overall. Sea

Grant works with fish houses and processors to develop innovative recipes and business strategies to help local fisheries compete with foreign imports. One processor's **crabcakes now bring an estimated economic impact of \$225,000 per year**, sustaining about 60 seasonal jobs annually. Other products have included smoked soft-shell crabs, rainbow trout burgers and condiments complementing local seafood.

Coastal communities have increased interest in economic-development strategies based on tourism highlighting **environmental and cultural heritage**. The grassroots Saltwater Connections network grew out of a Sea Grant research project. Extension specialists are integral partners on projects such as the **Outer Banks Scenic Byway** and related sustainable development efforts.

Sea Grant assisted the NC Department of Cultural Resources in preserving and conserving maritime heritage through projects focusing on the **Queen Anne's Revenge, flagship of the pirate Blackbeard**. The ship was found near Beaufort Inlet.

Stream restoration is critical for improving water quality and aquatic habitat. Sea Grant, in a partnership with NC State, develops and conducts River Course workshops that through 2014 have taught 5,000 professionals about **stream assessment, design, construction and monitoring**. A southeast stream restoration conference also draws 500 practitioners, government officials and academia every two years. Resulting partnerships sustain more than **60 grant-funded projects** across the state that demonstrate and evaluate stream restoration practices in varied watershed conditions.

Among the state's traditional fisheries, **oysters** also provide habitat and other benefits. Sea Grant is co-sponsoring workshops in 2014 for state officials and community organizations to consider current and anticipated issues regarding **oyster restoration**.

Sea Grant is a key leader in oyster research such as quantifying "**ecosystem services**," including nitrogen removal. In another project, results identifying **effects of inundation** — including from potential sea level rise — on reef accretion and oyster density were published in an international journal. The results are being used by resource managers in the state, as well as regionally and nationally.

Other researchers have developed models to quantify population density, recruitment, survivorship and **maximum potential output** of two types of sub-tidal, fished oyster reefs in Pamlico Sound. The model is providing guidance to the NC Division of Marine Fisheries and US Army Corps of Engineers on future oyster restoration sites. Recent research findings on oyster predators also directly influenced **the choice of substrate for NC reef restoration** efforts.

A **new shellfish aquaculture business** is just one result of a Sea Grant-led multi-disciplinary effort. The multi-campus team also developed a GIS-based **shellfish aquaculture site-selection tool** to provide valuable information to growers and managers seeking productive locations for bottom-lease sites.

A **wetland mesocosm** study helped US Fish and Wildlife Service partners to determine if rerouted agricultural drainage water would harm the **Alligator River National Wildlife Refuge** ecosystems. Early results helped the agency to decide to allow a project to move forward as designed to manage various nitrogen levels in waters moving through the refuge toward Pamlico Sound.

In 2013, NC oceanfront towns saw a rise in **fatalities due to rip currents**. Sea Grant responded rapidly to local leaders' requests for more than 14,500 rip current awareness products in the Carolinas. Research with new "drifter" data-loggers and ongoing outreach efforts continue in 2014, including partnerships with NWS offices that offer daily surf-zone forecasts, local lifeguards, Sea Grant-network colleagues and international experts.

Sea Grant staff and researchers also partner with NWS colleagues to **improve storm surge and other tropical storm forecasting and warning communications**. An annual hurricane conference brings together NWS forecasters, state and local emergency management officials, and the media. A new core research project on storm surge started in 2014. Also, **town-hall meetings** after major storms help NWS partners to improve warning messages and encourage citizen-science reporting of water levels.

The great diversity of fisheries in our coastal and offshore waters is thanks to the state's location at the confluence of mid-Atlantic and South Atlantic

ecosystems. Varied research provided updated estimations of fish population, prey dependence and migratory trends of **striped bass, red drum, flounder** and other species. Such data help officials make informed decisions for sustainable fisheries management.

Sea Grant's successful **collaborative research programs** bring together fishermen, who have local knowledge of waters and species, and scientists, who have methods for data collection and analysis. Unfortunately, state budget cuts in 2013 eliminated the **N.C. Fishery Resource Grant Program**, which has provided critical data for fisheries management plans, such as for southern flounder. FRG also funded demonstrations of gear to increase targeted catch and reduce bycatch. Final FRG projects are being completed and reports from others often are requested. Sea Grant also continues to administer state program-funding collaborative research on **blue crabs and shellfish**.

A partnership with the National Marine Fisheries Service seeks to reduce **marine mammals' interactions** with fishing gear. Topics in recent years have included analysis of stocks and strandings of bottlenose dolphins, as well as efforts to reduce pilot whales likelihood of getting hooked in longlines.

Lost or **abandoned commercial fishing gear** degrades sensitive estuarine habitats. As fishermen and waterfront property owners are not allowed to move abandoned crab pots, Sea Grant stepped up to coordinate efforts to remove derelict pots from coastal waters. Following a stakeholder meeting, 27 volunteers **removed 620 pounds of solid waste and 380 pounds of derelict crab pots** near Roanoke Island. Another project also used derelict pots to build oyster reefs.

A Sea Grant-pilot project on video monitoring of **snapper-grouper fishery** vessels determined that simple data loggers provide information similar to that in the videos, yet the loggers could save fishermen in the South Atlantic region more than \$530,000 annually.

**Saltwater-fishing** tournaments enhance **food-web research** by providing fish stomachs, the contents of which are then analyzed by Sea Grant researchers to reveal feeding habits and predator/prey

relationships. Such data adds to ecosystem models and management plans.

In recent years, Sea Grant has hosted **marine recreational fishing forums** to bring together anglers, scientists and fisheries managers to share information and updates outside regulatory settings.

The state's **inner coast** — thousands of miles of estuarine shorelines that edge sounds, bays and other areas where fresh and salt waters meet — was the focus of a new management study led by Sea Grant's policy specialist. The recommendations, developed by a statewide team of experts, provide state and federal resource managers and coastal communities critical information on emerging issues in the estuarine region as they plan for the region's future.

New research focuses on **environmental literacy** of middle-schoolers, identifying target audiences and methods. Sea Grant also **provides guidance to many teachers** on coastal and environmental topics, thus extending our reach to **more than 20,000 students** per year. Graduate students team with varied educators to develop lessons that are shared online

and through workshops. Our marine education specialist, honored as a state and national leader, is working with teachers to develop lessons related to our **North Carolina's Amazing Coast** book that grew out of a partnership with Georgia Sea Grant.

Sea Grant's executive director co-chaired a special committee requested by the UNC System to **consider opportunities for an NC marine science consortium** that would include UNC campuses and Duke University.

**Minigrants** continue to provide great opportunities for **rapid response to emerging needs, allow new faculty to establish research expertise and to provide proof-of-concept models** that can leverage funding from major agencies, including the National Science Foundation and NOAA.

Sea Grant continues a partnership with **UNC-TV's weekly Science Now series** that is part of the *North Carolina Now* public affairs program. The Sea Grant communicators provide story ideas and often have complementary stories in *Coastwatch* magazine. Executive Director Susan White serves on the *Science Now* scientific advisory panel.

## North Carolina Sea Grant — A Few Fast Facts:

- 12 research projects from 5 universities were chosen for the 2014-16 Sea Grant Core Funding cycle.
- Research results were published in 24 peer-reviewed publications in 2013-14, including: *PLOS ONE*, *Microbial Ecology*, *Marine Ecology Progress Series*, *Integrative and Comparative Biology*, *Limnology and Oceanography: Methods*, *Estuarine Coastal and Shelf Science*, *Biogeosciences*, *Nature Climate Change*, *Molecular Ecology*, and *Ecological Application*, among others.
- Sea Grant sponsored or co-sponsored 27 workshops or meetings, drawing 1,464 attendees in 2013-14. Researchers, graduate students and staff members also presented results to targeted audiences more than 140 times in public or professional meetings.
- 40 public coastal-resource management bodies — including federal and state agencies, and county- and community-level authorities — have used results of Sea Grant research and outreach in the past 4 years.
- At least 15 fishery management plans were developed in recent years using Sea Grant research.
- 2 new businesses were created and 4 businesses were retained in 2013-14 as a result of Sea Grant activities.
- 4 local seafood groups continue to grow with Sea Grant mentoring and consultation. Combined, the groups now include about 163 fishermen, 127 restaurants and dealers, and 121 other community partners.
- Our flagship publication, *Coastwatch* magazine, provides 5 issues every year. In 2013-14, it again earned honors from the national APEX competition and NC Association of Government Information Officers.