A Proposal to Maximize the Impact of UNC Coastal and Marine Sciences

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The Importance of Coastal and Marine Environments in North Carolina

The 21 counties in the outer coastal plain and tidewater region alone are home to almost 900,000 North Carolinians and fully 10% of the state population[1]. In the last 30 years, several of those counties have experienced between 76 and 150% population growth[2]. In addition to manufacturing jobs, coastal county residents serve North Carolina's tourism industry, marine trades, fisheries, and port logistics and depend on the vitality of these coastal and marine occupations to support families and local economies[3]. North Carolina is home to the largest number of small-vessel fisheries in the United States, and farm raised fish and shellfish contribute $15 million annually to the North Carolina economy[4]. Visitors to coastal counties spent over $2.5 billion in 2007, over 15% of the state's total tourism dollars that year[5]. The employment of over 70,000 North Carolinians in manufacturing and small businesses statewide depends on the existence of the ports in Morehead City and Wilmington[6]. To say that North Carolina's coastal counties are critical to the state's economy and well-being is an understatement.

Residents of coastal North Carolina are privileged to live in and among a unique coastal environment and ecosystem. North Carolina is home to the second largest estuary system in the country, which serves as the spawning grounds for red drum, striped bass and numerous other species. At Cape Hatteras, temperate and tropical species coexist where the cool Labrador Currents and the warm Gulf Stream currents meet, making North Carolina a unique site for the study of climate change and its effects on physical and biological activity. While our diverse coastal areas support all kinds of life, they at the same time offer an intriguing look into geological processes. Our barrier islands, inlets, and wetlands are worthy of awe for their beauty as well as for what they teach us about our fragile environment. As home to the densest concentration of shipwrecks on the entire United States coast, North Carolinians are aware of the importance of understanding our ever-changing coastal geography. These unique coastal features require North Carolinians to think carefully about transportation and development so that we can enjoy the natural beauty of the state now while preserving it for future generations.

Life is changing, more rapidly now than ever, for the residents of our coastal counties. North Carolinians weather more severe storms now than in the past and is second only to Florida in the number of severe storms that have made landfall worldwide in the last 100 years. The trend of increasing severe weather is expected to continue. While coastal residents often feel the brunt of these storms, the entire state has experienced notable effects. Of the ten worst hurricanes in North Carolina history, four have occurred in the last twenty years, and those four hurricanes have cost North Carolinians statewide almost $25 billion in damages[6]. North Carolina

families and businesses on the coast are more susceptible to losses from sea level rise than in any other area of the country except Louisiana[7]. A conservative estimate of sea level rise is 17 inches per 100 years, and places significant portions of at least six of our coastal counties underwater[8]. Climate change, sea level rise and more frequent severe storms all affect our coastal ecosystems and water quality which in turn affects the ability of North Carolinians to depend on fish and shellfish for their livelihood. The time is now to both preserve our current coastal cultures, resources, and economies, and to develop a comprehensive outlook on the future safety, health, economic, and education needs of these citizens.

Solutions in our own Backyard

Through the UNC Tomorrow effort, North Carolinians have charged UNC campuses to be even more responsive to their needs than ever before. UNC research and educational efforts in coastal and marine sciences already directly contribute to improving health, the environment, economic transformation, and the preparation of a highly skilled workforce. The UNC system is home to over 200 faculty, 200 professional staff and postdoctoral researchers, and 500 undergraduate and graduate students working on coastal and marine science issues. In FY08 UNC coastal and marine scientists managed over $96M in sponsored research and outreach programs. Many UNC professionals and programs in coastal and marine sciences are nationally and internationally acclaimed. UNC scientists provide data to the National Weather Service from our current ocean observing systems and our coastal computer models to forecast waves, water levels, flooding and rip currents. Researchers in our scientific diving program developed the nitrox mix tables that are used in dive operations around the world. The NC Division of Floodplain Mapping and FEMA have enlisted our scientists to create a new generation of coastal flood maps. UNC faculty use knowledge of prior storm events to advise the State on how to prepare for future storms and minimize impact to the coastal ecosystem and beaches. Our researchers have developed testing and other safety protocols that are used internationally to ensure that the seafood we consume is safe. The scope and impact of the work of UNC coastal and marine scientists is indeed impressive.

At present, however, UNC coastal and marine scientists lack the infrastructure and ability for timely, comprehensive, and coordinated responses to critical issues that deserve their combined expertise and attention. For example, at least thirteen separate observing programs are currently active through North Carolina universities, state agencies, and federal partners. These separate investments can be significantly leveraged through expanded infrastructure that improves coverage of real-time, non-real time and people/ship-based monitoring, as well as through the creation of reliable and comparable monitoring protocols between agencies and universities. UNC capabilities in coastal and marine sciences are also physically distributed across campuses and across NC's diverse coastline, which presents both a strength and an opportunity to enhance connectivity. The combined impact of UNC coastal and marine science

capabilities can far exceed any singular efforts on certain key critical issues presented herein. If UNC knowledge and discoveries could help lessen the damage from strong hurricanes by even 10% over the next 20 years, then this effort would save the citizens of the state $2.5 billion, assuming future storm trends mirror those of the past 20 years. For reasons such as these, the UNC system and campus leaders have initiated a strategy to maximize the impact potential of this collective group of scientists and educators.

Future Vision for UNC Coastal and Marine Sciences

The UNC system is uniting its considerable talent and resources across six major universities and research centers to focus on the most pressing issues North Carolina faces in sustaining our coastal and oceanographic environments. The UNC Coastal and Marine Science Council, comprised of marine science program directors across the system, is poised to lead North Carolina in addressing these complex issues that require their combined capacity. They propose to do so through a strategic focus on the following major goals and objectives (with UNC Tomorrow connections):

Goal 1: Protecting NC Citizens from Coastal and Marine Hazards (UNCT 4.6.2, 4.6.3, 4.7.1, 4.7.3)

North Carolina has no choice by to prepare for and respond to the increases in seal level rise and severe storms resulting from global climate change. Improved understanding of hazard threats, better land use and emergency planning, and real-time information on water, wind and other climatic and environmental conditions are essential to save lives, homes, and businesses during severe storms and manmade hazards. At present, hazards research, modeling and observing capacity in North Carolina is distributed across several different agencies, including UNC campuses, and offers incomplete coverage in key areas of the coast and little integration from research to end users. Additionally, an incomplete scientific record exists to document the geological changes along the coast and to help predict physical and biological responses to sea level rise and severe storms. A more robust and coordinated hazards program would empower state agency management officials and coastal managers to respond more quickly to environmental and weather events and provide information to strategically plan for development and emergency preparedness.

Objective 1: Create and maintain a research program that documents the varying rate of relative sea-level rise along the North Carolina coast over recent geological time to the present. Such a program would characterize the physical and ecological effects of sea-level rise and storms on the barrier islands, sounds, estuaries, and coastal lands, and model the likely effects of continued climate change on these coastal elements.

Strategy 1: TBD BY WORK GROUPS

Objective 2: Create and maintain a robust estuarine and coastal observing and modeling system that provides real time data on water, wind and other hazard characteristics and a corresponding database management system that provides an easily accessible archive.
Objective 3: Provide tools and training to state and local empower emergency managers, coastal planners and policy makers to access and utilize enhanced hazards data to improve coastal development policies, management, mitigation, emergency response and disaster recovery.

Goal 2: Maximizing Benefits of the NC Coastal and Marine Economy (UNCT 4.4.1, 4.4.2, 4.4.3, 4.4.5, 4.7.1)

North Carolinians are innovative and entrepreneurial, as evidenced by the unique economies and cultures that have developed through the diverse opportunities along our coastline. UNC coastal and marine science researchers are also innovators. The field exists at the intersection of chemistry, biology, physics, and geology, and that interdisciplinary nature fosters new ways of understanding living organisms, environmental processes, as well as devices and testing methods. The capacity is largely untapped for UNC coastal and marine science research to apply their innovations towards improved, saved, or new jobs for North Carolinians. Through concerted attention and resources in this area, our faculty will work with state and regional economic developers and community partners to build a statewide innovation network in coastal and marine sciences and associated biotechnology and increase their economic footprint, particularly in coastal counties of North Carolina.

Objective 1: Build regionally and culturally appropriate infrastructure to enhance and expand commercialization efforts from coastal and marine science discoveries and innovations
Objective 2: Lead in the growth of marine biotechnology efforts statewide, including aquaculture and mariculture industries, drug discovery and development paradigms, and testing markets.
Objective 3: Investigate the feasibility and impacts of traditional (e.g., oil and gas) and alternative (e.g., wind powered) energy production in the coastal region.
Objective 4: Create and maintain a research program to understand and document the socio-economics of NC coastal regions in order to preserve existing economic bases while growing a sustainable coastal economy for the future.

Goal 3: Preserving Coastal and Marine Water Quality and Ecosystems (UNCT 4.6.2, 4.6.3)

Maintaining water quality and desirable ecosystem function is becoming more and more difficult in the face of development pressure, climate change and associated sea level rise, and possible energy exploration. The environmental quality of our coastal regions must be maintained to retain its function as a critical wildlife and fisheries habitat, its appeal as a recreational and tourism destination, and its desirability as a place to live and work. Much knowledge is required to fully discover, evaluate and integrate the roles of ecosystems into

adaptive ecosystem based management strategies. The establishment of a coordinated observational network, as mentioned in Goal 1, is also a critical component of this program.

Objective 1: Develop and utilize observing system capabilities specifically targeted to the sounds, estuaries and rivers
Objective 2: Link federally funded observing systems in coastal and ocean waters with terrestrial observing systems to fully realize ecosystem management potentials
Objective 3: Utilize observing system assets as well as classical data sources to evaluate the state of and any changes in ecosystem services in NC coastal and estuarine waters.
Objective 4: Develop and implement specific testing regimes for coastal water quality parameters, including tests for specific human pathogens, and for toxic chemicals of both man-made and natural origin.

Goal 4: Educating Future Coastal and Marine Scientists (UNCT 4.1.1, 4.1.2, 4.2.1, 5.7)

The brightest minds are needed now and in the future to understand the constant changes and impacts of coastal and ocean environments. North Carolina is uniquely able to provide students with learning experiences in diverse coastal environments while working alongside renowned faculty from across the UNC system. A unified academic program, enriched with technology and experiential learning opportunities, would allow UNC to leverage faculty talent and diverse teaching environments in a way previously impossible and to make North Carolina home to the nation's top instructional programs in coastal and marine science and a destination for the world's leading experts in the field. Targeted outreach efforts, particularly those that introduce underserved middle and high school students to UNC assets in coastal and marine sciences, will encourage students to pursue studies and careers in critical STEM fields and ensure improved stewardship of North Carolina resources and attract future talent in the field.

Objective 1: Develop world class inter-institutional academic degree programs in Coastal and Marine Sciences that would capitalize on UNC's diverse coastal studies opportunities
Objective 2: Develop distance education and online learning options and supporting infrastructure
Objective 3: Develop programs at the interface of disciplines with marine sciences. Examples include coastal public health, business aspects of marine science, ocean education, and ocean engineering
Objective 4: Capitalize on unique UNC assets, including observing systems and diverse coastal facilities, to create integrated and powerful educational experiences for learners of all ages
Objective 5: Strengthen outreach and education partnerships with K-12 and community college systems
Objective 6: Recruit underserved and underrepresented students into coastal and marine sciences.

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