

NC State University Coastal and Marine Science Activities Self-Study

I. Overview of North Carolina State University

A. Activities Included

This report includes three chapters that each describe one coastal and marine science activity at North Carolina State University (NC State). Chapter 1 describes the Department of Marine, Earth and Atmospheric Sciences (MEAS) in the College of Physical and Mathematical Sciences. This department is dedicated to conducting fundamental and applied research in the geosciences to develop an understanding of the processes and critical issues regarding the Earth, oceans, atmosphere, and biosphere. Chapter 2 describes the Center for Marine Science and Technology (CMAST), which reports to the Vice Chancellor for Research, Innovation and Economic Development, Dr. Terri Lomax. This center's mission is to discover innovative solutions to questions and problems in marine systems and provide effective communication of these discoveries. Chapter 3 describes the work of the members of the NCSU Coastal and Marine Sciences Faculty who are not formally affiliated with either MEAS or CMAST. The Provost of NC State approved the Charter of the NCSU Marine Science Faculty in 1995 to facilitate the interaction of multidisciplinary faculty researching coastal and marine issues.

B. Importance to University Mission and Strategy

Since its founding as a land-grant institution 125 years ago, NC State has been responsive to the needs of North Carolina's citizens. With thousands of miles of tidal coastline, North Carolina's coastal environments are facing growing pressures due to increased population densities, environmental perturbations, and demands on natural resources. Addressing these coastal and marine issues using the integrated approach stated below is vital to fulfilling NC State's tripartite land-grant mission.

Mission

As a research-extensive land-grant university, North Carolina State University is dedicated to excellent teaching, the creation and application of knowledge, and engagement with public and private partners. By uniting our strength in science and technology with a commitment to excellence in a comprehensive range of disciplines, NC State promotes an integrated approach to problem solving that transforms lives and provides leadership for social, economic, and technological development across North Carolina and around the world.

The coastal and marine science activities described in this study play a critical role in fulfilling NC State's mission of teaching, research, and engagement. We prepare our students – graduate and undergraduate – to excel in careers in coastal and marine sciences research and applications. NC State's impressive research portfolio in coastal and marine sciences provides funding from diverse sponsors, e.g., Office of Naval Research, Department of Energy, National Oceanic and Atmospheric Administration (NOAA), and National Science Foundation, that contributes to the economic health of the University and supports research of strategic importance to North Carolina. Our engagement activities disseminate discoveries to excite K-12 students and their teachers about STEM disciplines, promote economic development, and help protect the health and well-being of citizens across North Carolina.

“The Pathway to the Future: NC State's 2011-2020 Strategic Plan” is the framework that guides university administrators in long- and short-term planning and decision-making. It has five overarching goals: enhance the success of students through educational innovation; enhance scholarship and research by investing in faculty and infrastructure; enhance interdisciplinary scholarship to address the grand challenges of society; enhance organizational excellence by creating a culture of constant improvement; and enhance local and global engagement through focused strategic partnerships.

At CMAST alone, more than 2,000 people have participated in marine-related learning experiences. These engaging educational experiences range from hands-on field and lab activities to connecting with researchers via distance education technology. Some participants are taking classes for college credit, while others are business owners learning how to protect their patrons' health through seafood handling workshops. The Center also offers unique opportunities for internships and graduate training at specialized facilities to develop North Carolina's workforce of tomorrow.

Interdisciplinary research has become an essential approach in addressing society's grand challenges, including those associated with coastal and marine issues. NC State has had an organized assemblage of faculty members engaged in interdisciplinary scholarship in coastal and marine sciences for over 17 years. In addition to the original membership from engineering and the physical and life sciences, the Coastal and Marine Sciences faculty now also includes members from social sciences and veterinary medicine – serving as a long-standing exemplar of the interdisciplinary scholarship the University seeks to enhance.

The faculty members of MEAS are globally engaged in collaborative activities that have led to adjunct appointments of NC State faculty by the Ocean University of China, joint publications with international institutions, and recruitment of some of the best and brightest international students to pursue their PhDs at NC State. While it is important for our science to have global impact, a key benefit of global engagement is the knowledge gained from international colleagues and the comparative understanding drawn from studying systems around the world that bear on coastal and marine issues in North Carolina.

C. Impact and Future Directions

Coastal and marine science activities at NC State have improved life-saving prediction of marine-coastal storms and understanding of the global carbon cycle and coastal ecosystems. Our researchers provide data and advice that is integrated into management plans for fisheries species and their habitat at both state and federal levels. NC State led one of the largest oyster restoration projects in the U.S. Our laboratory and molecular studies have identified novel behavioral responses by marine animals to hypoxia and the molecular basis for such behaviors. These are just a few examples of our impact.

The Provost formed the Academic Science Program Task Force in May 2011 as part of a strategic realignment initiative. With representation from all colleges, the task force was challenged with determining the **best ways to enhance the natural synergies between the science programs at NC State and to promote interdisciplinary collaboration and research while reducing administrative overhead**. As a result, the College of Physical and Mathematical Sciences will be transitioned to a broader, more comprehensive College of Sciences that includes the physical/chemical sciences, mathematical and statistical sciences, earth system sciences, and biological sciences. This new College of Sciences will facilitate deeper integration of coastal and marine sciences and atmospheric and geologic sciences with the life sciences.

NC State has several academic/research programs that are unique to the state of North Carolina, such as the College of Veterinary Medicine, our comprehensive College of Engineering (the 4th largest in the US), as well as the sole academic program in atmospheric sciences. Consequently, it is vitally important that NC State continue to address coastal and marine issues that pertain to coastal engineering, the health of coastal fauna, and coastal weather, such as hurricanes. Examples of current efforts include: the Renewable Ocean Energy Research Program; the monitoring of the Oregon Inlet Terminal Groin; and the study of RNMS Statistical Methods for Atmospheric and Ocean Sciences. In addition, NC State leads two federally-funded climate science organizations: NOAA's North Carolina Institute for Climate Studies and the U.S. Department of Interior's Southeast Climate Science Center. The North Carolina Institute for Climate Studies is focused on collaborative research into the use of satellite and in situ observations in climate research and applications and the preparation of the next generation of the workforce needed to address climate change. The Southeast Climate Science Center provides scientific

research needed to understand more about climate change and uses the research to work with natural- and cultural-resource managers to plan for climate change impacts. NC State will continue interdisciplinary efforts that combine our significant strengths in atmospheric and climate sciences with those in coastal and marine science and engineering.

Other unique strengths will be combined to create healthy, resilient communities and improve our ability to sustain and utilize the valuable resources at the interface between land and the ocean. The economies of coastal communities are improved through sustainable regional planning and tourism development – activities conducted by the Department of Parks, Recreation and Tourism and the College of Design. Efforts in product development and targeted marketing of local seafood will continue to improve food safety and coastal economies.

D. Organizational Structure

The figure below depicts the organizational structure of NC State units with relevant activities and illustrates NC State’s highly interdisciplinary approach to coastal and marine science. Although the NC Sea Grant College Program and Water Resources Research Institute are described in separate reports, they are included in the chart for completeness and to show the common reporting lines among coastal and marine science activities. Units with a formal relationship with CMAST are shaded gray, and units with coastal and marine science faculty who are members of neither MEAS nor CMAST are shown with a heavy border. Units with a (sometimes non-exclusive) focus on coastal and marine science are labeled with bold text.

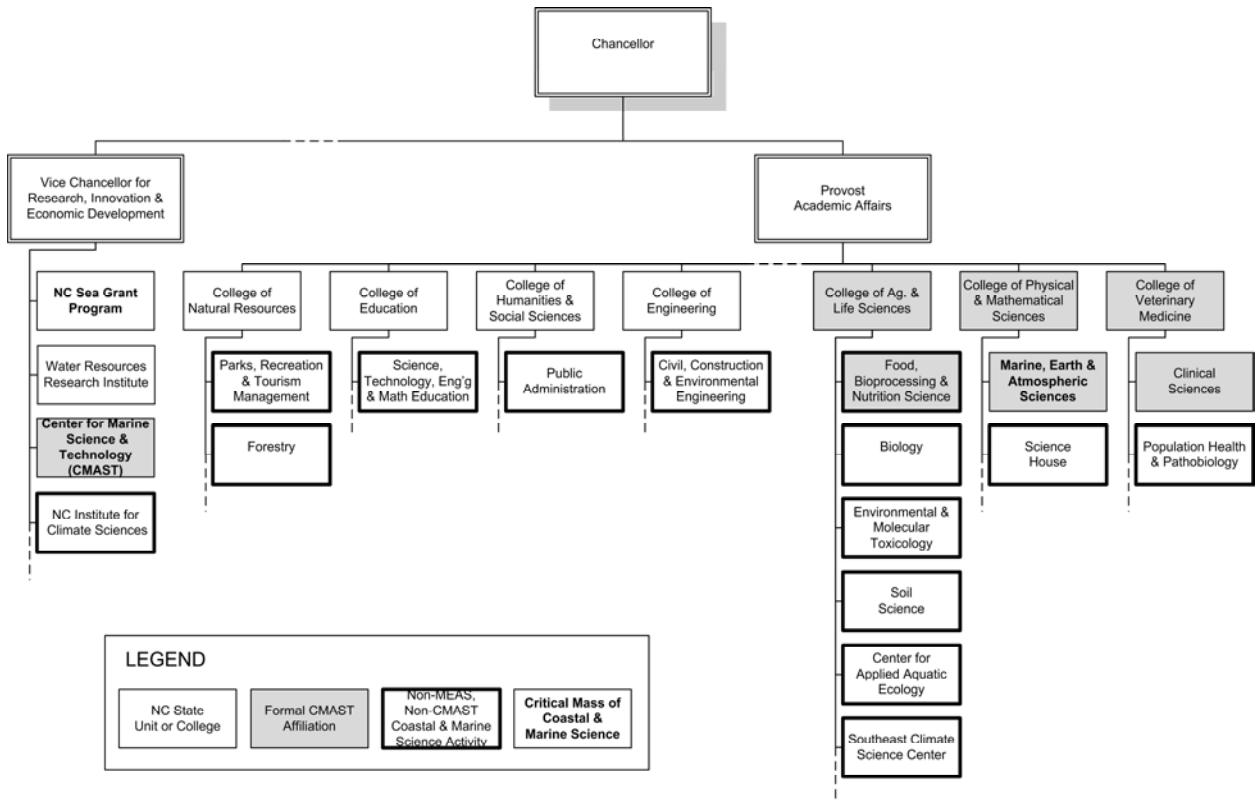


Figure 1. Organizational Structure of Units with Coastal and Marine Science Activity at NC State.

II. Coastal and Marine Science Activities at NC State

Chapter 1

A. Department of Marine, Earth, and Atmospheric Sciences (MEAS)

B. MEAS Narrative

Vision, Mission, & History

MEAS is one of the largest comprehensive geoscience departments in the country. Our vision is “to be an internationally-recognized hub of excellence in geoscience research and education, to the lasting benefit of our scientific disciplines, our graduates, and all humankind.” Our mission is:

- “- to conduct innovative fundamental and applied research in the geosciences in order to open up new understanding of the atmosphere, hydrosphere, geosphere, and biosphere, and the processes that connect them;
- to educate students who will become leaders in government and industry, and pioneers in the advancement of geoscience knowledge in academia;
- to teach introductory courses that reach hundreds of NC State non-geoscience majors every year, thereby promoting among NC State students a broader understanding of processes and critical issues regarding the Earth, oceans, atmosphere, and biosphere;
- to offer guidance, founded in our scientific expertise, on pressing societal issues related to the geosciences.”

The marine science program at NC State originated in the School of Engineering. In 1967 these programs were transferred from the School of Engineering to form the Department of Geosciences, composed of geology and new programs in physical oceanography and meteorology, in the School of Physical and Mathematical Sciences. For two years starting in 1979, the oceanography program joined the Department of Marine Science and Engineering (MSE), but in January 1981, MSE and Geosciences were integrated to form the present MEAS.

Marine Sciences at NC State began as a degree-granting interdepartmental graduate faculty, which in 1962 was under the aegis of the Center for Marine and Coastal Studies. The first oceanographer was hired in the Geosciences department in 1969, and in the 1970s additional marine scientists were hired, including three physical oceanographers in Geosciences and a marine biologist in Zoology. By 1979 a strong program in physical oceanography had been built, with additional positions in chemical, geological and biological oceanography, and in coastal engineering, distributed among 3 departments. These were coalesced into the Department of Marine Science and Engineering in 1979.

In 1981 the Department of Marine Science and Engineering was merged with the Department of Geosciences. MEAS houses three major disciplinary areas (geology, meteorology/atmospheric sciences, and marine sciences) under a single umbrella, providing all with the ability to offer MS and PhD degrees under a unified title with disciplinary emphases. Through the 1980s marine sciences in MEAS grew through addition of faculty with expertise in biological, geological and meteorological aspects of oceanography. New hires and replacements for departing faculty often bridged multiple disciplines, further enhancing the already interdisciplinary character of the department. The marine-oriented facet of MEAS built strengths in ecology and physiology of plankton and benthos, biogeochemistry and stable-isotope geochemistry, sedimentary processes, air-sea interaction and physical oceanography. In 1989 the growing department moved into the just-completed Jordan Hall.

About the time of the move to the new building, the degree programs at the undergraduate level were differentiated into several "concentrations". Each of the marine science concentrations was organized such that a high-performing student could, with minimal overlap and few "extra" courses, obtain BS

degrees in both marine science and the basic discipline of the concentration. A formal B.S. Degree in Marine Sciences was approved by General Administration in May, 1999. The graduate degrees (MS and PhD), on the other hand, remain under one umbrella. All are awarded in "Marine, Earth and Atmospheric Sciences", although internally the department distinguishes those three major disciplinary areas.

Unique, competitive, compelling, strategic importance

MEAS is home to a vibrant program of research, education and outreach in the coastal and marine sciences. Our research is highly interdisciplinary, and it has national and global reach and impact. We prepare our students, graduate and undergraduate, to excel in careers in coastal and marine sciences research and applications. The impressive portfolio of research, service, and outreach listed in this chapter points to the several themes that make coastal and marine sciences in MEAS unique, compelling, and of strategic importance.

Integration across the geosciences

Integration of coastal and marine sciences with earth and atmospheric sciences follows naturally from the makeup of MEAS and is manifested in collaborations among faculty and in the work of individual faculty. Interactions of the coastal and marine systems with the atmosphere are myriad, mutual, and vitally important. A major thrust of research in MEAS is in maritime storms: tropical cyclones and extratropical lows. These storms extract solar energy from the sea surface; they drive ocean dynamics; and they produce coastal hazards through waves and storm surges. All aspects of these processes are under investigation in MEAS. Profs. Anantha Aiyyer, Gary Lackmann, Fred Semazzi, and Lian Xie are completing a 5-year project supported by the Department of Energy to determine how tropical cyclone activity, a leading threat to the health and safety of NC's coastal residents, will change as Earth warms. Their findings reveal, for the first time, the complex interplay of physical processes that will determine whether hurricanes pose a greater hazard in the future. Prof. Lackmann similarly collaborates with Prof. Walt Robinson to investigate how mid-latitude lows will change in a warmer climate. In a recently accepted paper, they showed that the current generation of global climate models, such as those used for reports of the Intergovernmental Panel on Climate Change (IPCC), cannot capture these changes. While these storms (i.e., nor'easters) cause flooding and erosion on our coasts, in Europe they are the leading source of damaging weather. In recognition of this, the reinsurance industry, through the Risk Prediction Initiative, is, along with the National Science Foundation (NSF), supporting this research.

In the sphere of short and medium scale prediction, Prof. Fred Semazzi is part of a major NSF project, Expeditions in Computing: Understanding Climate Change, A Data-driven Approach. Within this effort, his project is developing new ways to make seasonal forecasts of tropical cyclone activity using data mining and network theory. Prof. Anantha Aiyyer, with funding from an NSF CAREER award, does fundamental research on the tropical atmospheric waves over the equatorial Atlantic Ocean that spawn and guide hurricanes. Closer to our shores, with support from NOAA and the Southeast Coastal Ocean Observing Regional Association (SECOORA), Prof. Lian Xie develops and applies models that couple the behavior of the atmosphere and ocean, including waves and sea-spray, to predict risks of coastal inundation, in the short term – dealing with the effects of an approaching hurricane – and in the long term – assessing impacts of climate change on flooding risks.

Wind energy is an emerging area of atmosphere-coastal/marine science integration. Prof. Sukanta Basu has two papers under review looking at coastal offshore meteorology in regard to its impacts on offshore wind farms. This understanding will be of critical importance, if, as expected, NC develops its substantial offshore wind-energy resource.

Coastal and marine sciences in MEAS similarly integrate the solid-Earth sciences. Prof. Helena Mitasova, in collaboration with colleagues in Engineering, deploys cutting-edge methods in high-resolution remote sensing and geospatial informatics to describe and predict the behavior of coastal

landforms. A more exotic link between Earth and marine sciences is in the work of Prof. Karl Wegmann, who used geophysical methods to date ancient shorelines, on the Greek island of Crete, showing that Paleolithic humans crossed large reaches of open water in the Mediterranean. Work by Profs. Paul Liu and Dave DeMaster explores the connections between river processes and the evolution of sea-floor bathymetry off the coast of Vietnam. Prof. Del Bohnenstiehl's groundbreaking observational work is leading to new assessments of hazards from undersea volcanoes and perhaps even the means to predict their eruptions.

Coastal and marine sciences at NC State addresses the issue of climate change from an Earth-systems perspective, exemplified by two outstanding early-career faculty. Prof. Chris Osburn brings sophisticated geochemical techniques to bear on studies of Earth's carbon cycle, the key biogeochemical cycle for understanding and projecting future greenhouse warming. In collaboration with Danish and Norwegian colleagues he has launched a project to determine the likely fate of the huge reservoir of carbon sequestered in sub-Arctic soils as the permafrost melts. This is a problem in marine biogeochemistry because the pathways of this carbon to the atmosphere are through the ocean. Prof. Nicholas Meskhidze, in collaboration with Prof. Markus Petters, studies the particulate interactions between the atmosphere and the ocean and their implications for a changing climate: how do particles produced physically and biogeochemically by the ocean affect clouds and thereby influence Earth's energy budget? How does the atmosphere process particles containing key nutrients, such as iron, so that they become bioavailable in the ocean and affect the carbon cycle?

In addition to integration across the geosciences, MEAS faculty draw on the great strengths of NC State in numerous technical areas, such as civil engineering and statistics. Similarly their national and international reputations enable collaborations with colleagues across the country and the globe.

Global reach

MEAS scientists work in the Arctic, the Antarctic, and everywhere in between. They have developed particularly strong relationships in East Asia, with universities in Taiwan, the Vietnamese Academy of Science and Technology, the Institute of Oceanography in the Chinese Academy of Sciences, and most notably with the Ocean University of China (OUC), the top marine science university in China. Exchange visits and joint research activities between MEAS and OUC faculty began in the 1980s and have accelerated since the 1990s. These collaborative activities led to adjunct appointments of MEAS faculty (Profs. Fountain, Xie, He, and Liu) by the OUC, the research faculty appointments of an OUC graduate in MEAS (Bin Liu), and more than twenty joint publications. More than twenty talks and seminars have been given at OUC by MEAS faculty over the past 5 years. We have drawn dozens of the "best and brightest" of OUC's students to pursue their PhDs in MEAS. Over the past decade, MEAS faculty have participated in five joint projects with OUC colleagues, and sixteen OUC faculty have visited MEAS, along with their students and postdocs.

Why is global reach and engagement important? NC State strives to be "Locally responsive. Globally engaged." In coastal and marine science, these goals are linked. While it is important and rewarding for our science to have global impact, the key benefit of our global reach is the knowledge we gain from international colleagues and the comparative understanding we draw from studying systems around the world that bear on coastal and marine problems here in NC.

Integration of physical and life science for marine studies

A long-standing and unique strength of coastal and marine sciences at NC State is in the integration of biological and physical studies of the marine environment. This integration is critical for addressing issues in the marine environment itself, while answering questions about the ocean's role in global biogeochemical cycles and climate. We have added to our existing strengths in this area, by hiring this past fall a rising star in plankton ecology, Prof. Astrid Schnetzer. Prof. Schnetzer brings expertise in genomic methods that allow her to identify precisely which organisms play which roles in the

ecosystem and how this changes as conditions change. She is also a leading expert in the ecology of harmful algal blooms. Through the work of Profs. Dave DeMaster and Carrie Thomas, MEAS addresses how marine food webs change over time and the implications of these changes for the global carbon cycle; this work, once again, closes the loop from the study of a specific marine system to the broader questions of the global carbon cycle and climate change.

Predictive computational modeling

MEAS is unusual among coastal-marine sciences programs in its remarkable strengths in predictive computational modeling of marine systems, on their own and coupled to other components of the Earth system. Accurate prediction of the coastal marine environment is hindered by the irregularity of the bottom and coastal boundaries, the small spatial scales of key phenomena, the importance and complexity of atmospheric forcing, and the scarcity of observations beneath the sea surface. Prof. Ruoying He's group meets these challenges using a high-resolution ocean model that captures the intricate behaviors of currents and eddies and their interactions with complex bathymetry. To address atmospheric forcing, this model is coupled to an atmospheric model, with particular attention paid to surface-wave dynamics at the air-sea interface. Forecasts need initial conditions, and Prof. He's group is doing important work in deriving them using satellite and in-situ observations. Prof. He was selected by the National Science Foundation to provide real-time forecasts for the location of the pollutant plume after the Gulf Horizon oil spill, and he is a leader in modeling and predicting the occurrences of harmful algal blooms, as well as interactions between the coastal ocean and storms. Prof. Lian Xie's group, described above, is another nexus of MEAS work on computational modeling coupling the atmosphere and ocean, and the among the atmospheric scientists in MEAS are leaders in storm (Profs. Lackmann and Aiyyer) and climate (Prof. Fred Semazzi) modeling.

Impacts on research, education, and society

The greatest impacts of the MEAS Coastal and Marine Sciences research are described thematically above. The published work with the greatest impact (Section E.1.a.) falls in several key areas:

- I. Impacts on the global carbon cycle and coastal ecosystems from terrestrial-marine interactions and changing ocean food webs (refs. 1, 13, 14, 15, 17).
- II. Quantitative prediction of marine-coastal storms and associated hazards (refs. 5, 7, 10, 19, 20).
- III. Marine-atmosphere interactions important for climate (refs. 3, 4, 11).
- IV. Assessment and predictions of hazards associated with marine geophysical activity (ref 2).
- V. Harmful algal blooms (refs. 8, 9, 16).
- VI. Physical evolution of the coasts (refs 6, 12, 18).

More generally, MEAS has a distinguished record of scientific publication. Since 2008 the department has generated 172 coast and marine science publications that have been cited 866 times, with over 250 citations for these recent publications in each of the past two years.

Our educational programs train undergraduate and graduates who succeed in continued education and in their careers. From recently compiled data on all MEAS MS and PhD graduates since 2006, we know that among these 156 graduates, approximately half of whom worked in coastal-marine sciences, 102 successfully obtained employment in their field, 29 had went on to further education (MS students pursuing a PhD), and one graduate changed fields. (We have no information on the remaining 24.) While we do not have similarly complete information for our B.S. graduates, anecdotally the great majority either finds coastal-marine science related employment or goes on to graduate school.

Impacts on society are necessarily harder to quantify. It is worth noting, however, that our research is strongly focused in areas that either have immediate impacts on society – predicting hazards, marine ecosystem health, changing coastlines – or that will emerge as important as changes in climate and the broader Earth system proceed.

Upcoming Challenges

The greatest challenges facing MEAS next year (and in coming years) are listed below.

- A shortage of laboratory and office space as we add faculty and as our faculty, particularly those early in their careers, grow their research groups and bring in more graduate students and post-docs.
- Our undergraduate marine sciences program is growing, and it will tax our present faculty to provide students with the needed instruction and advising, especially in the area of biological oceanography where their interest concentrates. Providing access to our summer field course may be especially challenging. Starting this year we are offering this course every summer (as opposed to every other summer), yet the number of students we can handle is constrained by lab and field resources at the coast, and our research-active faculty have limited time in summer for this course.
- Reduced faculty numbers in physical/dynamical oceanography: With retirements over the past several years (Profs. Janowitz and Pietrafesa) we have only two faculty to cover the physical oceanography instruction needed by our marine sciences majors. We have a great need of a basin-global scale physical oceanographer, who could provide needed teaching, as well as expertise and research to interact with the coastal focus in the He group and with climate scientists in MEAS. Currently we do not have the resources for such a hire. The group would also be strengthened by the addition of a satellite oceanographer.
- As indicated above, computational modeling is a strength in MEAS, yet NC State lacks a supercomputing facility, and the future of RENCI, which formally acted as system-wide facility, is uncertain. The computational groups in MEAS currently take a mixed approach, combining use of the Campus high-performance cluster (which is *not* a supercomputing facility) with maintenance of their own servers and with use of national facilities. While this has worked reasonably well for running models, the unavailability of high-capacity data storage at reasonably cost is a significant obstacle to research progress.

Future Directions

The trends in numbers of marine-sciences undergraduate students, graduate students, and research funding are positive, so we are confident that, absent a sudden major cut in federal research funds, the MEAS program is sustainable over the next several years. We expect our future trajectory will include:

- Continuing *integration of the coastal-marine sciences with the atmospheric and geologic sciences* in MEAS and with the *life sciences* both in- and outside the department. The latter will be facilitated starting in July 2013 when the College of Physical and Mathematical Sciences, transitions to the College of Sciences (CoS). CoS will include a biology department with more than 40 faculty arriving from the College of Agriculture and Life Sciences. The life sciences component of CoS is expected to grow with time, with some new faculty having joint appointments between Biology and other departments, including MEAS.
- A growing emphasis on *geosciences education and outreach*. MEAS currently has, in Prof. David McConnell's group, a nationally leading program in Earth-sciences education research, focused on improving the efficacy of college geology classrooms. A faculty search is underway for a faculty member with a focus on global-change science education. The successful candidate may have a coastal-marine focus. MEAS has a long-standing interest in outreach and increasing diversity in the coastal-marine sciences through Prof. Carrie Thomas's involvement in the COSEE program. We expect to increase this outreach/diversity engagement through collaborations with Science House and with the new Nature Research Center (NRC) of the NC Museum of Natural Sciences. The former is housed in our college, and Dr. Meg Lowman, director of the NRC, holds a faculty appointment in our college.

- Over the next five years we hope to further enhance our *interactions with the Center for Marine Sciences and Technology (CMAST)*, in extramurally funded research and in providing research and educational opportunities for our students. An obstacle to student involvement with CMAST has been the lack of suitable living space at the coast, which we hope will be addressed by the construction of a dormitory.

C. MEAS Resources

1. Personnel

- a.) MEAS faculty and key personnel are listed below in Table 1-C1. Because of the deep integration of earth and atmospheric sciences in the MEAS Department's coastal and marine sciences work, it is difficult to separate coastal and marine sciences completely from other activities. Thus, all MEAS faculty and key personnel are included in Table 1-C1 with an estimate of each person's percent of effort dedicated to coastal and marine sciences.

Table 1-C1. MEAS Personnel

Name	Position	Percent of Effort Related to Coastal & Marine Sciences
Aiyyer, Anantha	Associate Professor	50
Aneja, Viney	Professor	0
Basu, Sukanta	Associate Professor	20
Bohnenstiehl, Del	Associate Professor	80
Boyles, Ryan	Extension Assistant Professor	20
DeMaster, David	Professor	100
Eggleston, David	Professor	100
Fodor, Ronald	Professor	0
Fountain, John	Professor	0
Genereux, David	Professor	0
He, Ruoying	Professor	100
Hibbard, James	Professor	0
Kamykowski, Daniel	Professor	100
Kimberly, Michael	Associate Professor	10
Ksepka, Daniel	Research Assistant Professor	50
Lackmann, Gary	Professor	40
Leithold, Elana	Professor	70
Liu, Bin	Research Assistant Professor	100
Liu, Paul	Associate Professor	90
McConnell, David	Professor	20
Meskhidze, Nicholas	Associate Professor	70
Mitasova, Helena	Associate Professor	50
Osburn, Christopher	Assistant Professor	70
Parker, Matthew	Associate Professor	0
Petters, Markus	Assistant Professor	30
Robinson, Walter	Professor	20
Schnetzler, Astrid	Associate Professor	100
Semazzi, Frederick	Professor	20
Shaw, Ping-Tung	Associate Professor	100
Showers, William	Professor	90

Name	Position	Percent of Effort Related to Coastal & Marine Sciences
Thomas, Carrie	Research Associate Professor	100
Wegmann, Karl	Assistant Professor	40
Xie, Lian	Professor	100
Xue, Zuo	Research Assistant Professor	100
Yuter, Sandra	Professor	60
Zhang, Yang	Professor	20
Dodson, Ted	Electronics Specialist	90
Knies, Sara	Research Specialist	90
Zheng, Megan	Research Assistant	0
Curtis, Susan Jane	Computer Consultant	50
Epps, Christine	Accounting Technician	50
Graf, Beth	Accounting Technician II	50
Hickman, Margo	Executive Assistant	50
Hockaday, Connie	Student Services Assistant V	50
Holland, Laura	Admin. Support Associate	50
Mial, Phyllis	HR/Payroll Coordinator	50
Parker, Nathan	Technical Support Specialist	50
Puryear, Maggie	Undergraduate Advisor	50
Watkins, Mark	Lab Mechanic II	70

b.) Student Numbers

Undergraduate: As of fall 2012, there are 70 Marine Sciences majors, of which the great majority (about 90%) is in the Biological Oceanography concentration.

Graduate: MEAS does not distinguish graduate students by discipline. The department has 112 graduate students, 63 pursuing MS degrees and 49 pursuing PhDs. Approximately half of these students are engaged in research that is coastal-marine related

Postdocs: There are 2 postdocs working in coastal-marine sciences.

2. Funding

Coastal and marine science related revenue for MEAS (FY10 – FY14) is reported in Table 1-C2.

Table 1-C2: CMS-related MEAS Revenue

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Federal	1,349,935	1,615,480	1,786,901	1,584,105	1,822,639
State (not including university)	396,263	264,204	338,691	333,053	345,465
Institution (e.g., University)	2,863,742	3,074,074	2,903,374	2,752,668	2,932,408
Foundation	1,423	1,400	1,888	1,570	1,982
Other - Agency/Auxiliary Sales & Svc./Private C&G	620,537	580,988	586,451	595,992	598,180
Total	5,231,899	5,536,146	5,617,304	5,267,388	5,700,673

Coastal and marine science related expenses for MEAS (FY10 – FY14) are reported in Table 1-C3.

Table 1-C3: CMS-related MEAS Expenses

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Personnel	3,841,456	3,861,835	3,920,104	3,776,666	3,998,506
Programmatic	387,889	512,299	473,241	424,617	482,705
Physical infrastructure	409,906	409,906	409,906	409,906	409,906
Maintenance and operation	112,218	250,339	215,647	171,745	219,960
Equipment (>\$5,000)	142,828	12,535	43,503	33,676	44,373
Other Direct Costs*	235,328	273,949	257,931	255,736	263,089
Indirect Costs	507,247	558,072	647,793	571,037	680,183
Total	5,636,872	5,878,935	5,968,124	5,643,383	6,098,722

2. *Physical infrastructure*

MEAS principally occupies two buildings on the South Campus of NC State. Jordan Hall, built in 1987, has 67 thousand square feet, two-thirds of which are MEAS space, and approximately half of that, or 22 thousand square feet, is committed to coastal and marine sciences. The Jordan Hall Addition, built in 2007, adds 27 thousand square feet, of which approximately 9 thousand are used for MEAS coastal/marine science activities.

In addition, MEAS has a separate 6,700 square foot field support lab, almost entirely dedicated to coastal/marine activities, and in a separate building (the Varsity Research Building) a newly commissioned plankton biology laboratory, capable of genomic analyses, with 900 square feet of lab space and an additional 200 square feet of associated offices.

In Jordan and Jordan Addition, MEAS has three mass spectrometry geochemistry labs; two of these do mostly coastal/marine work while the third is dedicated to atmospheric aerosol research with a significant marine component. Additionally, there is a plankton biology lab and an electronics lab for developing and repairing marine instruments.

Jordan and Jordan Addition provide office space for all of our faculty, postdocs and graduate students (there are currently 112 graduate students in MEAS, of whom about half are working on coastal/marine related research), all of whom have desktop computers with high-speed connectivity, both wired and wireless, and access to numerous servers and printers. The buildings have several classrooms, all computer/network equipped, a similarly equipped seminar/meeting room, and the usual small conference room, staff offices, etc. need to support an academic department. The department has two facilities for videoconferencing: a dedicated room that seats about 20 and a “videoconferencing system on a cart” that can be deployed to any room. Two IT specialists provide information technology support.

MEAS has several trailerable boats and four vehicles: three 16-seat vans are used for field trips and field research, about half of which is coastal/marine related, and a sport-utility vehicle, capable of pulling a boat trailer, primarily used for coast/marine work.

D. MEAS Research, Teaching, Public and Professional Service

1. *MEAS Research*

Currently funded research projects, both extramural and intramural, are listed below in Table 1-D1.

Table 1-D1. MEAS Research

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
RiverNet, Continuous Monitoring of Water Quality In the Neuse and Cape Fear River Basins	NC Department of Environment & Natural Resources (DENR)	4,525,700	7/1/1999	6/30/2020	Showers, William J.
Raleigh National Weather Service Forecast Office Network Between NCSU MEAS	US Dept. of Commerce (DOC)	1	12/15/2005	2/22/2013	Lackmann, Gary M.; Fountain, John C.
Rapid Environmental Assessment Using an Integrated Coastal Ocean Observation Modeling System	US Navy-Office Of Naval Research	668,915	8/1/2006	12/31/2012	He, Ruoying; Fountain, John C.
GOMTOX: Dynamics of <i>Alexandrium Fundyense</i> Distributions in the Gulf of Maine - an Observational and Modeling Study of Nearshore and Offshore Shellfish Toxicity, Vertical Toxin Flux, and Bloom Dynamics in a Complex Shelf Sea	National Oceanic & Atmospheric Administration (NOAA)	472,058	9/1/2006	8/31/2013	He, Ruoying
Carolina Coastal Processes: Regional Coastal Processes Model Development	US Geological Survey (USGS)	175,000	6/15/2007	12/31/2012	He, Ruoying
Collaborative Research: Ship-based Observations of Air-sea Interaction and Stratocumulus Cloud-aerosol-drizzle Processes in VOCALS	National Oceanic & Atmospheric Administration (NOAA)	298,764	7/1/2008	6/30/2013	Yuter, Sandra E.
Collaborative Research: Assessment of T-wave Processes and Hydroacoustic Monitoring Capabilities in the Lau Basin	National Science Foundation	330,031	10/1/2008	9/30/2013	Bohnenstiehl, DelWayne R

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
CAREER: Dynamics of African Easterly Waves: Integrating phenomenological studies and Mathematical Instruction in Atmospheric Science	National Science Foundation	556,607	8/1/2009	7/31/2014	Aiyyer, Anantha
Collaborative Research: Intermittent and Steady State Processes in Orographic Precipitation	National Science Foundation	345,879	9/1/2009	8/31/2013	Yuter, Sandra E.
Eddy-Wind-Topography Interaction Dynamics	US Navy-Office Of Naval Research	138,487	1/1/2010	12/31/2012	He, Ruoying
Early Student Support for a Statistical Investigation of Internal Wave Propagation in the Northern South China Sea	US Navy-Office Of Naval Research	104,818	11/1/2009	10/31/2013	Shaw, Ping T.
Assessing Impacts of Climate and Land Use Change on Terrestrial-Ocean Fluxes of Carbon and Nutrients and Their Cycling in Coastal Ecosystems	National Aeronautics & Space Administration (NASA)	254,982	8/25/2010	8/24/2013	He, Ruoying
Improving Prediction of Severe Winds, Convection and Heavy Precipitation in the Southeastern United States	US Dept. of Commerce (DOC)	375,000	5/1/2010	4/30/2013	Lackmann, Gary M.; Aiyyer, Anantha ; Parker, Matthew D;
How Will Global Warming Change the Storm Tracks? Investigating the Importance of Diabatic Processes Using High-resolution Simulations	National Science Foundation	548,963	9/15/2010	8/31/2013	Lackmann, Gary M.; Robinson, Walter A
On the Cutting Edge:A Community Resource Transforming Geoscience Education	National Science Foundation	61,303	9/15/2010	8/31/2013	McConnell, David A

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
Collaborative Research GARNET II: Self-regulated Learning and the Affective Domain in Physical Geology	National Science Foundation	252,541	10/1/2010	9/30/2013	McConnell, David A
NASA Earth and Space Science Fellowship (NESSF) Program-Casey Burleyson	National Aeronautics & Space Administration (NASA)	90,000	9/1/2010	8/31/2013	Yuter, Sandra E.
Collaborative Research: Connectivity in Western Atlantic Seep Populations: Oceanographic and Life-History Processes Underlying Genetic Structure	National Science Foundation	354,406	10/1/2010	9/30/2014	Eggleston, David B.; He, Ruoying
Active Outer Forearc Basin Formation by Synconvergent Extension above the Hellenic Subduction Zone, Crete, Greece	American Chemical Society	100,000	1/1/2011	8/31/2013	Wegmann, Karl W.
Global Characteristics of Marine Stratocumulus Clouds and Drizzle	National Aeronautics & Space Administration (NASA)	226,621	2/8/2011	2/7/2014	Yuter, Sandra E.
COSEE SE: Addressing New Challenges	National Science Foundation	252,255	10/1/2010	9/30/2013	Thomas, Carrie J.
Collaborative Research: Cloudiness Transitions within Shallow Marine Clouds Near the Azores	US Dept. of Energy (DOE)	337,033	9/15/2011	9/14/2013	Yuter, Sandra E.
Enhancing Short Term Wind Energy Forecasting For Improved Utility Operations	US Dept. of Energy (DOE)	75,111	10/1/2010	3/31/2013	Basu, Sukanta

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
Collaborative Research: Isotopic, Geochronologic, and Tectonic Character of the Western Piedmont, Virginia - Implications for the Closing of Iapetus	National Science Foundation	272,638	3/15/2011	2/28/2014	Hibbard, James P.
Type 2: Climate Mitigation and Earth System Management from Local to Global Scale: Modeling Technology-Driven Futures	National Science Foundation	2,299,999	4/1/2011	3/31/2015	Zhang, Yang; Sun, Ge; McNulty, Steven George
Quantifying the Relationship Between Organic Aerosol Composition and Hygroscopicity / CCN Activity	US Dept. of Energy (DOE)	99,332	9/1/2011	8/31/2013	Petters, Markus
Incorporating Climate Change Effects into Next-Generation Coastal Inundation Maps: An Integrated Approach	National Oceanic & Atmospheric Administration (NOAA)	260,000	9/1/2011	8/31/2013	Xie, Lian ; Fuentes, Montserrat ; Liu, Jingpu ; Semazzi, Fredrick H.
Real-Time Coastal Ocean Forecasting in Support of Management of Coastal Resources and Emergency in the SECOORA Region	National Oceanic & Atmospheric Administration (NOAA)	61,746	6/1/2011	11/30/2012	Xie, Lian
High-resolution Modeling Studies of the Changing Risks of Damage from Extratropical Cyclones	Bermuda Institute for Ocean Sciences (BIOS)	40,000	10/1/2011	5/31/2013	Robinson, Walter A; Lackmann, Gary M.
Diversity In Geosciences-Making A Pathway to Success (DIG-MAPS)(Track 2)	National Science Foundation	1,249,544	9/15/2011	8/31/2016	Fountain, John C.; Picart, Jose' A; Shafer, David M.

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
Terrain Dynamics Analysis Using Space-time Domain Hypersurfaces and Gradient Trajectories Derived From Time Series of 3D Point Clouds	US Army - Army Research Office	110,000	4/1/2011	3/31/2013	Mitasova, Helena
InTeGrate: Interdisciplinary Teaching of Geoscience for a Sustainable Future	National Science Foundation	116,666	12/1/2011	11/30/2012	McConnell, David A
Quantitative Assessments of Radiative and Optical Properties of Marine Biogenic Aerosol	National Aeronautics & Space Administration (NASA)	95,000	8/15/2011	8/14/2013	Meskhidze, Nicholas
Southeast Coastal Ocean Observing Regional Association(SECOORA): An Environmental Monitoring and Assessment Program To Support Decision-Makers Needs For Coastal and Ocean Data and Products	National Oceanic & Atmospheric Administration (NOAA)	151,000	6/1/2011	5/31/2013	He, Ruoying
Identifying and Quantifying Biologically-Available Sources of Organic Nitrogen in the Neuse River Basin, NC	Environmental Protection Agency (EPA)	302,000	3/1/2012	12/31/2014	Osburn, Christopher Lee
Gulf Integrated Spill Response Consortium	Consortium for Ocean Leadership, Inc.	70,000	9/1/2011	12/31/2012	He, Ruoying
Metapopulation Dynamics Guides Oyster Restoration and Shell Budgets in NC	NCSU Sea Grant Program	(\$66,273 – see CMAST grant listing)	2/1/2012	1/31/2013	Eggleston, David B.

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
Total Suspended Sediment Source Contributions to a Regionally Important Municipal Drinking Water Source, Falls Lake North Carolina: A Sediment Fingerprinting Approach	Sigma Xi, Scientific Research Society	1,000	5/6/2011	12/31/2012	Wegmann, Karl W.; Voli, Mark T
Identifying Sustainable Substrates for Oyster Restoration and Artificial Reefs	NCSU Sea Grant Program	(\$60,000 – see CMAST grant listing)	5/15/2011	5/14/2013	Eggleston, David B.
Collaborative: Interacting Effects of Local Demography and Larval Connectivity on Estuarine Metapopulation Dynamics	National Science Foundation	(\$555,804 – see CMAST grant listing)	3/15/2012	2/28/2015	Eggleston, David B.
Dissertation Research: Underwater Soundscapes and Their Potential Role in the Settlement of Estuarine Benthic Invertebrates	National Science Foundation	(\$14,999 – see CMAST grant listing)	7/1/2012	6/30/2014	Eggleston, David B.; Bohnenstieh IDelWayne R.
Wave Optics of Deep Atmospheric Turbulence: From Underlying Physics Towards Predictive Modeling, Mitigation and Exploitation	US Air Force - Office of Scientific Research (AFOSR)	55,124	9/15/2012	9/14/2015	Basu, Sukanta
Development of In-Vivo Marine Magnetic Spectral Resonance Imaging (MMSRI) Capabilities	National Science Foundation	(\$332,590 – see CMAST grant listing)	8/1/2012	7/31/2013	Eggleston, David B.; Stoskopf, Michael K.
Workshop on Production Mechanism, Number Concentration, Size Distribution, Chemical Composition, And Optical Properties Of Sea Spray Aerosols; Raleigh, NC; June 4-6, 2012	National Science Foundation	12,000	4/15/2012	3/31/2013	Meskhidze, Nicholas ; Petters, Markus

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
River-Derived Sediments Transport and Accumulation in the Gulf of Tonkin, Vietnam and other Asian Continental Shelves	US Navy - Naval Oceanographic Office	75,000	1/1/2012	2/28/2013	Liu, Jingpu ; DeMaster, David J.
Production Mechanism, Number Concentration, Size Distribution, Chemical Composition, and Optical Properties of Sea Spray Aerosols Workshop, Summer 2012	US Dept. of Energy (DOE)	6,000	6/1/2012	5/31/2013	Meskhidze, Nicholas ; Petters, Markus
Can You Hear Me Now? Estuarine Soundscapes and Their Role in Larval Settlement	National Science Foundation	456,414	9/1/2012	8/31/2015	Eggleston, David B.; Bohnenstiehl, DelWayne R
Production Mechanism, Number Concentration, Size Distribution, Chemical Composition, and Optical Properties of Sea Spray Aerosols	National Aeronautics & Space Administration (NASA)	6,000	6/5/2012	6/4/2013	Meskhidze, Nicholas ; Petters, Markus
Quantifying the Effects of Anthropogenic Emissions on Bioavailable Iron Production in Mineral Dust Particles	NC State Faculty Research & Prof. Devel. Fund	4,000	7/1/2012	6/30/2013	Meskhidze, Nicholas ; Petters, Markus
Real-Time Coastal Ocean Forecasting in Support of Management of Coastal Resources and Emergency in the SECOORA Region	National Oceanic & Atmospheric Administration (NOAA)	56,434	9/1/2012	8/31/2013	Xie, Lian
Total (\$)		16,344,372			

2. MEAS Teaching and Instruction

a.) MEAS courses taught for degree credit are listed below in Table 1-D2.

Table 1-D2. MEAS Teaching and Instruction for Degree Credit

Course number, title, and level	Instructors (all are MEAS faculty unless otherwise indicated)	Description	Enrollment at last offering
MEA 100: Earth System Science: Exploring the Connections (Intro undergrad)	D. DeMaster, D. Kamykowski	An introduction to the processes of and linkages among major components of planet Earth.	97 (S12)
MEA 200: Introduction to Oceanography (Intro undergrad)	W. Showers	The ocean as a part of our environment including interactions between atmosphere and ocean, ocean circulation, physical and chemical properties of sea water, marine geology and marine biology.	82 (S12)
MEA 210: Oceanography Lab (Intro undergrad/majors)	P. T. Shaw	Complements the lecture course in Oceanography.	
MEA 220: Marine Biology (Undergrad majors)	C. Thomas	Introduction to marine plants and animals, their adaptations to life in the sea and ecological interactions in selected marine environments	95 (S12)
MEA 250: Introduction to Coastal Environments (Undergrad majors)	P. Liu	A global survey of coastal habitats, the processes that shape these dynamic environments, and the physicochemical controls that regulate their indigenous biological communities.	56 (S12)
MEA 251: Introduction to Coastal Environments Laboratory (Undergrad majors)	D. DeMaster	Complements the lecture course Introduction to Coastal Environments (MEA 250).	
MEA 323: Earth System Chemistry (Undergrad majors)	C. Osburn	Chemistry of the earth with an emphasis on the interactions of the biosphere, geosphere and atmosphere.	23 (S12)
MEA 411/562: Marine Sediment Transport (Undergrad/grad majors)	E. Leithold	Quantitative study of sediment transport in the marine environment	16 (F11)

Course number, title, and level	Instructors (all are MEAS faculty unless otherwise indicated)	Description	Enrollment at last offering
MEA 449/549: Principles of Biological Oceanography (Undergrad/grad majors)	D. Eggleston, D. Kamykowski	Biological productivity and trophic relationships in plankton, nekton and benthos; community ecology of selected habitats	18 (F11)
MEA 454/554: Marine Physical-Biological Interactions (Undergrad/grad majors)	D. Kamykowski	Space-time relationships between physics and biology	8 (S12)
MEA 459: Field Investigation of Coastal Processes (Undergrad majors)	D. DeMaster	Coastal zone processes and dynamics with emphasis on the forcing factors that regulate changing coastal landforms, the ecology and physicochemical character of coastal ocean water-masses, seabed morphologies, landscape academes, etc.	15 (Sum 12)
MEA 460/540: Principles of Physical Oceanography (Undergrad/grad majors)	P.-T. Shaw	Introduction to principles and practices of physical oceanography.	22 (F11)
MEA 462: Observational Methods and Data Analysis in Marine Physics (Undergrad majors)	R. He	Practical experience in the observational techniques used by physical oceanographers.	14 (S12)
MEA 463: Fluid Physics (Undergrad majors)	W. Robinson	A derivation of the basic equations governing fluid motion in a rotating coordinate system with application to simplified oceanic flows.	9 (F11)
MEA 464: Ocean Circulation Systems (Undergrad majors)	P.-T. Shaw	Dynamical processes governing ocean circulation.	12 (S12)
MEA 467: Marine Meteorology (Undergrad majors)	L. Xie	Basic equation and concepts; review of ocean and atmospheric circulations; ocean mixed layer, air-sea interaction and coastal ocean and meteorological processes, marine boundary layer and cloud processes.	18 (S12)
MEA 469: Ecology of Coastal Resources (Undergrad majors)	D. Eggleston	Anthropogenic impacts on estuarine and coastal marine ecosystems.	7 (S10)

Course number, title, and level	Instructors (all are MEAS faculty unless otherwise indicated)	Description	Enrollment at last offering
MEA 473/573: Principles of Chemical Oceanography (Undergrad/grad majors)	D. DeMaster	Chemical processes controlling the composition of oceans, including discussions of chemical equilibria, biological cycling of nutrients and use of chemical tracers in marine environment; consideration of origin and chemical history of oceans.	9 (F11)
MEA 570: Geological Oceanography (Grad majors)	P. Liu	A comprehensive overview of the geological aspects of oceanography.	7 (S12)
MEA 581: Fluid Mechanics in Natural Environments (Grad majors)	J. Yu (CCEE)	Free surface flows of water and air occurring in natural fluid systems and influencing environmental transport and mixing; review of fundamental principles of fluids, covering the scales relevant to both engineering and geo-physical applications.	8 (F12)
MEA 582: Geospatial Modeling and Analysis (Grad majors)	H. Mitsova	The course explains digital representation and analysis of geospatial phenomena and provides foundations in methods and algorithms used in GIS analysis and modeling.	28 (S12); 19 (S12 Delta)
MEA 700: Environmental Fluid Mechanics (Grad majors)	W. Robinson	Basic concepts and laws governing motion of atmosphere and oceans developed from first principles, including approximations valid for environmental flows, kinematics, dynamics and thermodynamics of fluid flows as well as introduction to environmental turbulence.	15 (F11)
MEA 735: Fourier Analysis of Geophysical Data (Grad majors)	P.-T. Shaw	Application of Fourier analysis to interpretation of low-frequency motions in ocean and atmosphere.	5 (S12)
MEA 743: Ocean Circulation (Grad majors)	P.-T. Shaw	Basic study of mechanics of ocean circulation with emphasis on various simple models of circulation systems.	

Course number, title, and level	Instructors (all are MEAS faculty unless otherwise indicated)	Description	Enrollment at last offering
MEA 744: Dynamics of Shelf Circulation (Grad majors)	R. He	Description and models of dynamic processes on the shelf, including seiches and tides in gulfs, propagation of tides and storm surges, wind-induced coastal upwelling, continental shelf waves and coastally trapped waves; steady circulation driven by winds, river plumes and density forcing, formation of shelf-break fronts; and influence from deep-ocean currents.	5 (F08)
MEA 750: Marine Benthic Ecology (Grad majors)	D. Eggleston	Marine benthic systems in deep sea and in shallow waters, focusing upon abiotic and biotic processes regulating density, diversity and taxonomic and functional composition.	9 (F08)
MEA 759: Organic Geochemistry (Grad majors)	C. Osburn	Sources and fates of organic material in the geochemical environment.	6 (F11)

b.) A non-credit course offered by MEAS faculty is listed below in Table 1-D3.

Table 1-D3: Non-Degree Credit Instruction

Workshop/Instruction title	Dates offered	Instructor(s) and Affiliation(s)	Brief description of instruction (1 sentence)	Enrollment Figures Total/on-site/distance edu
Climate Change	Spring 2011	Aiyyer, DeMaster, Leithold, Liu, Robinson	Six-lecture sequence http://www.meas.ncsu.edu/05-encore_presentations.html	~50

c.) MEAS Public Service, Outreach and Community Engagement

MEAS faculty outreach and community engagement that directly relate to coastal and marine sciences are listed below.

Ryan Boyles

- Defense Coastal Estuarine Research Program, Washington, DC, June 19, 2012
- Ocean Science Education Leadership Institute, SE Center for Ocean Sciences Education Excellence, Raleigh, NC, June 25, 2010
- Wilmington-Cape Fear Home Builders Association, Wrightsville Beach, NC, March 23, 2010
- LeadershipNC Environmental Session, Morehead City, NC, March 3, 2009

- Climate, Weather, and Tourism in North Carolina: Issues and Opportunities, ECU Center on Sustainable Tourism, Greenville, NC, November 15, 2008

Dave DeMaster

- Took part in Climate Change Science and Policy Workshop. May 18th-22nd, 2011. Interdisciplinary activity between NC State (Fred Semazzi, Lian Xie, and Dave DeMaster, plus public health expert and vet school disease expert) and the University of Surrey, United Kingdom.
- Gave lecture as part of the NCSU Global Issues Seminar Series: “Climate Change: Oceans, Ice Sheets, and the Carbon Cycle”. Oct. 19th, 2010.
- Gave Climate Change Seminar to Metcalf Hall undergraduates at NC State. Requested by Kelly Johnson Resident Hall Advisor. October 28th, 2009.
- “Implications of Global Climate Change and Sea-Level Rise for North Carolina” (Nov. 23-24, 2009).
- My wife and I presented a workshop on Climate Change: Science, Policy, and Ethics at our local church (May 17, 2010)

Dan Kamykowski

- Several hundred pictures were taken during the October 2008 cruise by Jan Healy for presentation to environmental classes at Green Hope High School. A sampling remains available on the web at: <http://picasaweb.google.com/janhealy>
- Thomas and Kamykowski participated in interviews for a COSEE case study posted at http://www.cosee.net/engaging_scientists/index.html. The case study is part of a NSF-funded award to the University of Southern Mississippi (S. Walker, OCE 0943509, ARRA monies) designed to highlight ways scientists effectively communicate their broader impacts.

Helena Mitasova

- Member, Albemarle-Pamlico National Estuary Program Science and Technical Advisory Committee, 2008-2012

Chris Osburn

- Multiple presentations on Neuse River Basin and Estuary research to the Lower Neuse Basin Association, Upper Neuse River Basin Association, NC Association for Water Quality
- Appearance on NC NPR’s *State of Things* and local television to discuss Deepwater Horizon disaster.

Carrie Thomas

- Countless COSEE-SE activities <http://www.cosee-se.org/> (this is what they do).

Lian Xie

- Served on 2008 Summer Olympic Weather Support Team on Coastal Wind Forecasts for sailing competitions.

E. MEAS Outputs and Impacts

1. Publications

a.) Selected MEAS refereed publications for the period January 1, 2008 – present are listed below.

1. Blair, N.E., Leithold, E.L., Brackley, H., Trustrum, N., Page, M., and Childress, L.B., 2010: Terrestrial Sources and Export of Particulate Organic Carbon in the Waipaoa Sedimentary System: Problems, Progress and Processes: *Marine Geology* **270**, 108-118.

2. Bohnenstiehl, D.R., R. P. Dziak, H. Matsumoto, T.-K. Andy Lau, 2012: Underwater acoustic records from the March 2009 eruption of Hunga Ha'apai – Hunga Tonga volcano in the Kingdom of Tonga, *J. Volcanology and Geothermal Research*.
3. de Szoek, S. P., S. E. Yuter, D. B. Mechem, C. W. Fairall, C. D. Burleyson, P. Zuidema, 2012: Observations of stratocumulus clouds and their effect on the eastern Pacific surface heat budget along 20 deg S. *J. Climate*, in press.
4. Gantt, B., N. Meskhidze, and D. Kamykowski, 2009: A new physically-based quantification of isoprene and primary organic aerosol emissions from the world's oceans, *Atmos. Chem. Phys.* 9, 4915-4927, doi:10.5194/acpd-9-2933-2009.
5. Gentry M. S., and G. M. Lackmann, 2010: Sensitivity of simulated tropical cyclone structure and intensity to horizontal resolution. *Mon. Wea. Rev.* **138**, 688–704.
6. Hardin E., Kurum O., Mitasova H., Overton MF, 2012: Least cost path extraction of topographic features for storm impact scale mapping, *Journal of Coastal Research* **28**(4), 970-978.
7. Hill, K. A., and G. M. Lackmann, 2011: The impact of future climate change on TC intensity and structure: A downscaling approach. *J. Climate*, **24**, 4644–4661.
8. He, R., D. J. McGillicuddy, D. Anderson and B. Keafer, 2008:, Gulf of Maine Circulation and Harmful Algal Bloom in Summer 2005- Part 2: Coupled Biophysical Modeling, *Journal of Geophysical Research*, **113**, C07040, doi:10.1029/2007JC004602.
9. He, R., Chen, K., K. Fennel, G. Gawarkiewicz, D. McGillicuddy, 2011: Seasonal and Interannual Variability of Physical and Biological Dynamics at the Shelfbreak Front of the Middle Atlantic Bight: Nutrient Supply Mechanisms. *Biogeosciences*, **8**, 2935-2946, doi: 10.5194/bgd-8-1555-2011.
10. Liu, B., H. Liu, L. Xie, C. Guan, and D. Zhao, 2011: A coupled atmosphere-wave-ocean modeling system: Simulation of the intensity of an idealized tropical cyclone. *Mon. Wea. Rev.*, **139**, 132-152.
11. Meskhidze, N., J. Xu, B. Gantt, Y. Zhang, A. Nenes, S. J. Ghan, X. Liu, R. Easter, and R. Zaveri, 2011: Global distribution and climate forcing of marine organic aerosol – Part 1: Model improvements and evaluation, *Atmos. Chem. Phys.*, **11**, 11689–11705, doi:10.5194/acp-11-11689-2011.
12. Mitasova, H., Hardin, E., Kurum, M.O., Overton, M.F., 2010: Geospatial analysis of vulnerable beach-foredune systems from decadal time series of lidar data, *Journal of Coastal Conservation, Management and Planning* **14**(3), 161-172.
13. Osburn, C.L., Handsel, L.T., Mikan, M.P., Paerl, H.W., and M.T. Montgomery, 2012: Fluorescence tracking of dissolved and particulate organic matter quality in a river-dominated estuary. *Environmental Science and Technology* dx.doi.org/10.1021/es3007723.
14. Null, K., D. Corbett, D. DeMaster, J. Burkholder, C. **Thomas**, and R. Reid, 2011: Porewater advection of ammonium into the Neuse River Estuary, North Carolina, USA. *Estuarine, Coastal and Shelf Science*, **95**, 314-325.
15. Pohlman, J. W., J. E. Bauer, W. F. Waite, C. L. Osburn, and N. R. Chapman, 2011: Methane hydrate-bearing seeps as a source of aged dissolved organic carbon to the oceans. *Nature Geoscience* **4**, 37-41.
16. Sinclair, G. A., Kamykowski, D., 2008: Benthic-pelagic coupling in sediment associated populations of *Karenia brevis*. *Journal of Plankton Research* **30**: 829-838 doi:10.1093/plankt/fbn042.
17. Smith, C.R., D. DeMaster, C. Thomas, P. Srsen, L. Grange, and F.DeLeo, 2012: Pelagic-benthic Coupling, Food Banks and Climate Change on the West Antarctic Peninsula Shelf. *Oceanography*, **25**, 188-201.

18. Wegmann, K. W., D. R. Bohnenstiehl, J. D. Bowman, J. A. Homburg, J. D. Windingstad, & D. Beery, 2012: Assessing Coastal Landscape Change for Archaeological Purposes: Integrating Shallow Geophysics, Historical Archives and Geomorphology at Port Angeles, Washington, USA, *Archaeological Prospection*, doi:10.1002/arp.1431, doi: 10.1002/arp.1431.
19. Xie, L., B. Liu, and S. Peng, 2010: Application of scale-selective data assimilation to tropical cyclone track simulation. *J. Geophys. Res.*, **115**, D17105, doi:10.1029/2009JD013471.
20. Xie, L., H. Liu, and M. Peng, 2008: The effect of wave-current interactions on the storm surge and inundation in Charleston Harbor during Hurricane Hugo 1989. *Ocean Modelling*, **20**, 252-269.

b.) Selected MEAS non-refereed publications for the period January 1, 2008 – present are listed below.

1. Nunalee, C., & **Sukanta Basu**, 2012: Mesoscale modeling of coastal low-level jets: Implications for offshore wind resource estimation, *Wind Energy*, in review.
2. Nunalee, C. G., and **Basu, S.**, 2012: Mesoscale modeling of low-level jets over the North Sea. *Wind Energy: Proceedings of the Euromech Colloquium*, in review.
3. **Bohnenstiehl, D.R.** and R.P. Dziak, Mid-Ocean Ridge Seismicity, 2008: In J. Steele, S. Thorpe, and K. Turekian (eds.), *Encyclopedia of Ocean Sciences, First Online Update*, Academic Press, London, UK.
4. Dziak, R.P., **D.R. Bohnenstiehl**, D.K. Smith, 2012: Hydroacoustic monitoring of spreading centers

past, present, and future. *Oceanography* **25**(1):116-127.

5. Matsumoto, H., **D.R. Bohnenstiehl**, R.P. Dziak, M. Park, R.W. Embley, 2011: Use of an Autonomous Hydrophone Array to Assess Hydroacoustic Propagation through the ACZ and Blockage by the Islands and Bathymetric Ridges in the Scotia Sea, Final Report to the Nuclear Explosion Monitoring Research and Engineering (NEMR&E) Program, Contract Number: 08NA28654.
6. Smith, C.R., **D.J. DeMaster**, C.J. Thomas, P. Srsen, and F. DeLeo, 2012: Pelagic-benthic coupling, food banks, and climate change on the West Antarctic Peninsula Shelf *Oceanography Magazine*. (Most recent FOODBANCS Project – initial publication), in press.
7. Ragueneau, O., D.J. Conley, **D.J. DeMaster**, H.H. Durr, and N. Dittert, 2010: Biogeochemical transformations of silicon along the land-ocean continuum and implications for the global carbon cycle. In *Carbon and Nutrient Fluxes in Continental Margins, IGBP Series* (Eds. K.K. Liu, L. Atkinson, R. Quinones, L. Talaue-McManus), Springer-Verlag, pp. 515-528.
8. Anderson, D. M., McGillicuddy, Jr. D. J., Keafer, B. A., **He, R.**, Townsend, D. W., 2011: Population Dynamics of *Alexandrium fundyense* in the Gulf of Mexico: Outlook for Improved Management and Forecasting, pp 1-6, invited review paper, 14th International Conference on Harmful Algae Blooms, Crete Greece, Nov 2010.
9. Gawarkiewicz, G.G., Nelson, J., **He, R.** et al., 2011: NSF Ocean Observing Initiative White Paper on Middle Atlantic Bight Shelfbreak Frontal and Exchange Processes.
10. **Kimberley, M.M.**, 2009: *Discussing Oceans*, Wiley and Sons, NY, 305 p. The ISBN is 978-0-470-391778. This book includes a seven-hour DVD in the book jacket. The ISBN for the DVD is 978-0-555-04253-3.
11. **Leithold, E.L.**, Blair, N., Childress, L., and Marden, M. 2011: Using continental margin organic geochemical stratigraphy to reconstruct watershed history– Lessons from the Waipaoa

- Sedimentary System, New Zealand: AGU Chapman Conference on Source to Sink Systems, Oxnard, California, October, 2011.
12. **Leithold, E.L.**, Blair, N. E., and Childress, L.B., 2011: Deciphering the offshore biogeochemical record of Holocene erosion in the Waipaoa watershed, New Zealand: Goldschmidt Conference, Prague, Czech Republic, August, 2011.
 13. **Meskhidze, N.**, C. R. McClain, M. D. Petters, E. Vignati, O. Stetzer, C. Osburn, and D. J. Kieber, 2010: Marine Aerosol-Cloud-Climate Interaction, Editorial, *Advances in Meteorology*, 2010, Article ID 250896, doi:10.1155/2010/250896.
 14. Hardin, E., *Kurum, O., **Mitasova, H.**, Overton, M.F., 2012: GIS-based approach to analysis of storm vulnerability change at PeaIsland, NC, new breach location, Proceedings of the 33rd International Conference on Coastal Engineering (ICCE 2012), Santander, Spain.
 15. Starek, M.J., **Mitasova H.**, Harmon, R.S., 2011: Fort Fisher, NC Past and Present: A Geospatial Analysis using LiDAR and GIS, Proc. 9th International Military Geosciences Conference.
 16. Hardin, E., **Mitasova, H.**, Overton, M.F., 2011: Quantification and characterization of terrain evolution on the Outer banks, NC, Proc. Coastal Sediments 2011, Miami, FL, p. 739-753.
 17. **Thomas, C.** and L. Spence. 2012: Building Bridges: Proceedings from the Invitational Working Conference on Building Diversity in the Ocean Sciences. <http://www.cosee-se.org/files/southeast/ProceedingsDocument.pdf>
 18. Spence, L., **C. Thomas**, J. Kim, D. Mewborn, & T. Pearsall. 2009: Results of a Survey on Diversity in Ocean Sciences Workforce in Federal and State Agencies and in Institutions of Higher Education in North Carolina, South Carolina and Georgia. <http://www.coseese.org/files/southeast/COSEE%20Broadening%20Participation%20%2012-15-09.pdf>
 19. Marshall, B., **C. Thomas**, & L. Spence. 2009: COSEE Southeast and Ocean Sciences: A Report Based on a Regional Survey. [www.cosee-se.org/files/scientist/Report Survey Scientists andCOSEE SE final.pdf](http://www.cosee-se.org/files/scientist/Report_Survey_Scientists_andCOSEE_SE_final.pdf)
 20. **Wegmann, K. W.**, J. A. Homburg, D. R. Bohnenstiehl, J. D. Bowman, J. D. Windingstad, and E. K. Huber (2010), Geomorphology of the City of Port Angeles Waterfront, in *Technical Report 10-82*, edited, p. 121, Statistical Research, Inc., Tucson.

2. Technical Outputs

Technical outputs such as CDs, software programs, databases, algorithms, and/or measurement instruments are listed below.

Aiyyer:

- “CSTAR Tropical Cyclone Inland Winds Project: Best Practices for Forecasters” (part of annual Tropical Cyclone Webinar held on April 27, 2012). The training slides presented at the annual Tropical Webinar included direct research to operations aspects of the project, including land reduction and gust factor guidelines for use in the TCMWindTool to develop sustained wind speed and gust forecasts.

Bohnenstiehl:

- The Modified Basal Outlining Algorithm (MBOA) for the Detection and Characterization of Volcanic Highs using MATLAB. First Public Release 2011. http://www4.ncsu.edu/~drbohn/MBOA/MBOA_home.html

Boyles: State Climate Office products important for the NC Coastal Zone include:

- Routine 72 hour experimental weather forecasts for NC including the only model in NC to incorporate NC ECONet and CoastWatch sea surface temperature data:

<http://www.nc-climate.ncsu.edu/model>

- Wind Rose analysis tool, producing wind frequency summaries for all monitoring stations:
<http://www.nc-climate.ncsu.edu/windrose.php>
- Hurricane Tracks and Landfall/Proximity Statistics for NC and surrounding states:
<http://www.nc-climate.ncsu.edu/climate/hurricanes>
- Rainfall estimates based on NWS radar and surface gauge blends:
<http://www.nc-climate.ncsu.edu/precip>

He:

- The Gulf of Maine harmful algal bloom (HAB) is the first 3-dimensional dynamical HAB forecasting system in the world. The model's seasonal forecasts and short-term nowcast/forecast had been proven critical for coastal managers in New England, and federal and state agencies to make decisions as to where and when to close beaches and nearshore shellfish beds to protect public health. This groundbreaking research has been highlighted by NSF and NOAA, and extensively reported by news media, as shown below.
 1. [Algal Studies Aimed at Avoiding Harmful Blooms](#). 2011, NC State *Results* Magazine, XI, No.1
 2. [News Release: Researchers Report Potential for a Moderate New England 'Red Tide' in 2011](#). April 8, 2011, WHOI Media Relations Office.
 3. [News Release: Researchers Issue Outlook for a Significant New England 'Red Tide' in 2010](#). February 24, 2010, WHOI Media Relations Office.
 4. [Researchers Issue Outlook for a Significant New England 'Red Tide' in 2010](#) February 24, 2010, NOAA.
 5. [“Moderately Large” Potential For Red Tide Outbreak in Gulf of Maine Region](#), April 29, 2009, Science News.
 6. [Marine Scientists Warn of “Moderately Large” Potential for Spring, Summer Red Tide Outbreak in Gulf of Maine](#), April 22, 2009, NSF.
 7. [Researches Report “Moderately Large” Potential for Red Tide Outbreak in Gulf of Maine Region](#), April 22, 2009, NASA Earth Observatory.
 8. [Researchers Successfully Forecast 2008 Red Tide](#), August 8, 2008, New tool provides early warning of harmful algal bloom along New England coast, *Oceanus*, Vol 46, No. 3, pgs. 6-7.
 9. [Pieces Are in Place for a New England Red Tide](#), May 12, 2008, Doyle Rice, *USA Today*, Aaron Gouveia, *Cape Cod Times*.
 10. [In Computer Models and Seafloor Observations, Researchers See Potential for Significant 2008 "Red Tide" Season](#) April 24, 2008, WHOI Media Relations Office.
 11. [ECOHAB-funded GOMTOX Findings Support Fisheries Management Decision](#) July 2007, NCCOS Center for Sponsored Coastal Ocean Research.
 12. [NOAA Website on the 2005 New England HAB Event](#) February 2007, NOAA.
 13. [Building a Computer Model to Forecast Red Tides](#) May 31, 2006, A variety of variables goes into the mathematical mix that simulates harmful algal blooms *Oceanus*, Vol. 45, No. 2, pgs. 34-35.

14. [New Maps Provide Clues to the Historic 2005 Red Tide Outbreak in New England And Hints for 2006](#) April 13, 2006, WHOI Media Relations Office.
 15. [Red Tide--Gone For Now, But Back Next Year?](#) July 15, 2005, WHOI researchers extend investigations of *Alexandrium* bloom of 2005 and look for signs of future trouble, *Oceanus*, Vol. 44, No. 2, pgs. 4-5.
- The 3-dimensional regional ocean environment nowcast/forecast system has been providing crucial regional “ocean weather” predictions to assist in search & rescue, coastal resource management, environmental protection, and fundamental research in the South Atlantic Bight and Gulf of Mexico (SABGOM, <http://omgsrv1.meas.ncsu.edu:8080/ocean-circulation>). During the Deepwater Horizon Oil Spill incident in summer 2010, SABGOM ocean circulation predictions were used by NOAA OR&R to support state and federal rapid responses in the disaster mitigation efforts. Some examples related to Dr. He’s work on predicting the Deepwater Horizon oil spill in summer 2010 are given below:
 1. [Scratching the Subsurface](#). June 28, 2010, Nature News.
 2. [Gulf Stream Has Swept Goo to N.C. Coast in the Past](#), May 6, 2010, News and Observer
 3. [S.C. Shores Could See Oil Residue from Gulf Spill](#), May 4, 2010, The Charleston Post and Courier.
 4. [Scientists: Oil Spill Could Eventually Reach Outer Banks](#), May 13, 2010, The Raleigh Telegram.
 5. [Gulf Contamination Unlikely to Reach Carolinas, But It’s Happened Before](#), May 5, 2010, Charlotte Observer.
 6. [Could Gulf Oil Spill Reach North Carolina](#), May 4, 2010, WFMY News 2
 7. [Scientist: Carolina Coast to See Oil Eventually](#), May 24, 2010, NBC -17 and WRAL in North Carolina
 8. [Spilled Oil Could Ride Current to Carolinas](#), StarNews, May 7, 2010.
 9. [Oil Spill](#), Wikipedia, The Free Encyclopedia
 10. [New Current Could Delay Arrival of Gulf Oil Spill on Outer Banks](#), May 27, 2010, NBC17
 11. [OMG Predicting the Path of an Oil Spill](#), May 27, 2010, NCSU News Update
 12. [Summary of South Atlantic Sea Grant Programs: Summit on Oil Spill Physical Oceanography](#), June 11, 2010, NC Sea Grant
 13. [Giant Underwater Plume Confirmed-Gulf Oil Not Degrading](#), August 19, 2010, National Geographic Daily News

Liu:

- Online “Global River and Delta Systems” web database and Source-to-Sink Information Center: <http://www.meas.ncsu.edu/sealevel/s2s/>, with more than 150 scientists from all over the world registered.

Showers:

- Online provision of RiverNet data: <http://rivernet.ncsu.edu/stations.html>

3. Commercialization and Technology Transfer

Commercialization activities and technology transfer to either private or governmental entities are listed below.

Bohnenstiehl:

- Work is sponsored by the National Nuclear Security Administration and the Comprehensive

Nuclear Test Ban Treaty Organization: most recently Matsumoto, 2011 - see above.

- Involvement with the development of an acoustic glider: Matsumoto, H., J.H. Haxel, R.P. Dziak, D.R. Bohnenstiehl, and R.W. Embley, 2011: Mapping the sound field of an erupting submarine volcano using an acoustic glider. *J. Acoust. Soc. Am.*, 129(3), doi: 10.1121/1.3547720.
- Development of an inductive modem system to control the timing of autonomous hydroacoustic devices: H. Matsumoto; D.R. Bohnenstiehl; R.P. Dziak; L. Williams; R. Gliedge; C.N. Meinig; P. Harben, 2010: A vertical hydrophone array coupled via inductive modem for detecting deep-

ocean seismic and volcanic sources MTS/IEEE Seattle, *OCEANS 2010*.

He:

- Funded by NOAA PCM program, the Gulf of Maine Harmful Algal Bloom (GOM-HAB) Modeling System is being transferred to NOAA National Centers for Environmental Prediction (NCEP) and NOAA National Ocean Service (NOS).

Mitasova:

- Coastal toolbox for GIS-based analysis of barrier island shoreline and topography and its evolution. <http://www4.ncsu.edu/~ejhardi2/vTransect.html>

Showers:

- *RiverNet* is a program that is designed to understand nitrogen fluxes in watersheds with different land uses. This is achieved through the continual collection of different types of water quality data in an effort to provide the information needed to promote the long-term sustainability of natural and managed watersheds and to develop successful remediation strategies. <http://rivernet.ncsu.edu/>

4. Awards and Honors

Awards and honors conferred to faculty, staff, and students as a result of their MEAS activities for the period January 1, 2008 – present are listed below.

He:

- College of Physical and Mathematical Sciences 2012 nominee NC State Alumni Association Outstanding Research Award

Meskhidze:

- Invited oral presentation *Improved representation of dust-nutrient deposition to the surface ocean*, International Workshop on Climate Change Projection and High Performance Computing Climate 2012, March 12-15, 2012, Maui, Hawaii.
- Invited oral presentations *The Effect of Ocean Biogeochemistry on Aerosol, Clouds and Climate and Modeling of Atmospheric Transport and Deposition of Soluble Iron to the Oceans*, ICTP Workshop on Aerosol Impact in the Environment: from Air Pollution to Climate Change, Trieste, Italy, 2011
- Invited expert, WMO SDS-WAS/GESAMP Expert Workshop on Modeling and Observing the Impacts of Dust Transport and Deposition on Marine Productivity, Malta, 2011
- Invited oral presentation *Ocean-Aerosol Science and STM*, ACE Science Workshop - NASA Headquarters, Washington, DC, 2011
- Invited Tutorial presentation *The Effect of Ocean Biogeochemistry on Aerosol, Clouds and Climate*, AAAR- American Association for Aerosol Research (AAAR) 28th Annual Conference, Minneapolis, MN, 2009.

Mitasova:

- Sol Katz award for exceptional Open source geospatial community service, 2010.

Robinson:

- Member National Science Foundation, Advisory Committee for Geosciences (AC-GEO), 2010-12.

Xie:

- 2008: Certificate of Appreciation for contributing to the 2008 Summer Olympic Game, Qingdao Meteorological Bureau.

F. MEAS Publication and Citation Summary (Jan. 1, 2008 to present)*

Coastal & Marine Sciences publications:	172
Sum of times cited:	866
Sum of times cited without self-citations:	773
Citing articles:	760
Citing articles without self-citations:	703
Average citations per item:	5.03
H-index:	16

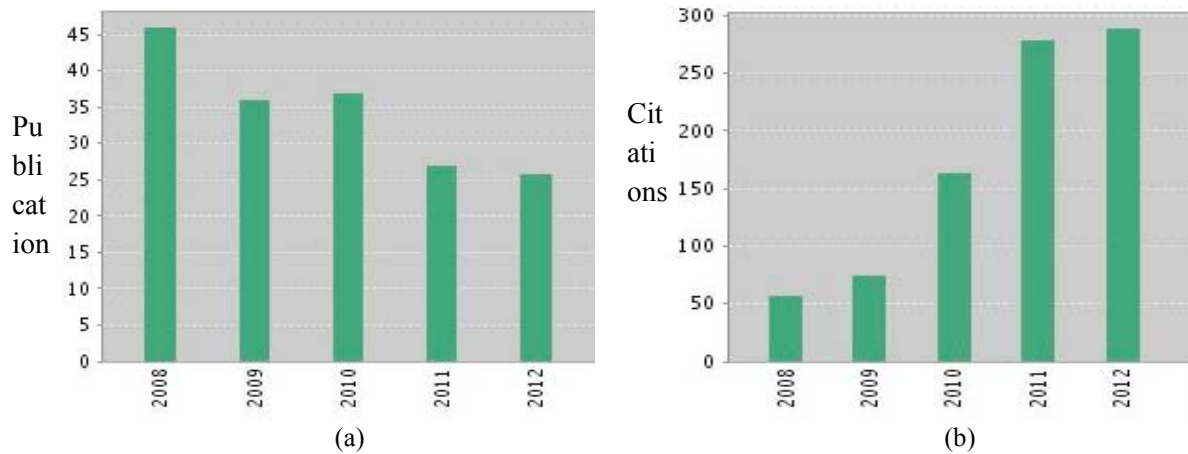


Figure 2. (a) MEAS Publication Summary (2008-present); (b) MEAS Citation Summary (2008-present).

*Source: Web of Science, accessed Oct. 23, 2012.

Chapter 2

A. Center for Marine Sciences and Technology (CMAST)

B. CMAST Narrative

Vision, Mission, & History

The principal mission of NC State’s CMAST (www.cmast.ncsu.edu), located in Morehead City, NC is to discover innovative solutions to questions and problems in marine systems and provide effective communication of these discoveries. Some examples of these questions and communication of these discoveries are archived in our CMAST Newsletters (CMAST Communicator), which may found on our website. In fact, the Summer 2012 issue, entitled “CMAST: Being in the Right Place All the Time”, may be especially helpful to the external review team in that it highlights the synergies among the various marine science programs in NC, and what makes CMAST unique. CMAST facilitates multidisciplinary studies among research scientists, educators and extension specialists from the

participating NC State colleges, as well as with other educational institutions and agencies concerned with marine sciences and coastal natural resources, and provides a focal point for citizen contact. The strategic plan for CMAST (see Section B.5 Future Directions below) aligns with that of (1) NC State University, (2) Strategic Planning for Marine Laboratories as recommended by the National Association of Marine Laboratories, and (3) core strengths of CMAST Faculty.



Figure 3. NC State's Center for Marine Sciences and Technology, Morehead City, North Carolina.

NC State has faculty, staff and graduate students in residence at CMAST from three colleges, i.e., Agricultural & Life Sciences (CALS), Physical & Mathematical Sciences (PAMS), and Veterinary Medicine (CVM). There are four *resident* faculty and three *rotating* faculty from the Departments of MEAS, Biology, Environmental & Molecular Toxicology, Food, Bioprocessing and Nutrition Sciences, and Clinical Sciences. Rotating faculty include Drs. David Eggleston (Professor MEAS) and Michael Stoskopf and Suzanne Kennedy-Stoskopf (CVM), who spend time each week at the CMAST facility.

The CMAST facility was designed with special attention to the support of advanced research instrumentation and distance learning technology. By virtue of its cooperative nature, the facility houses four institutional partners: (1) NC State, (2) Carteret Community College (CCC), (3) NC Sea Grant, and (4) NC Cooperative Extension. CMAST shares dedicated wet-lab space with UNC-Chapel Hill's Institute of Marine Science, and joint aquaculture programs with the adjacent CCC and NC State's Marine Aquaculture Research Center, located ~ 35 minutes away. In 2011, there were seven NC State resident and rotating faculty, two postdoctoral research scientists, three veterinary medicine (DVM) residents, ten technical and professional staff, four support staff, and ten graduate students. At any given time, NC State has 35-40 personnel stationed at the facility. NC Sea Grant has two professional staff and one support staff. NC Cooperative Extension has six field faculty and two support staff. CCC has ten instructors and one support staff. Therefore, total occupancy at CMAST is approximately 60, with a capacity of 80 when fully occupied.

The charter for CMAST was established at NC State on February 10, 1997. In the charter, the primary goal of CMAST was to bring together scientists and specialists in education and extension from the participating colleges at NC State into a more cooperative and cohesive organization. In addition, CMAST was to provide a focal point for citizen contact with NC State's marine science faculty and for improved faculty interaction with other universities and agencies concerned with the coastal environment.

According to the charter, CMAST was to focus on aspects of marine sciences that differed from and complemented the collective emphases on marine sciences at the University of North Carolina at Chapel Hill (UNC-CH), East Carolina University (ECU), and the University of North Carolina at Wilmington (UNC-W). This involved establishing distinct capabilities focused on: (1) atmospheric/land/ocean couplings along the coast using advanced technologies and models to improve predictions and/or measurements in marine meteorology; (2) mariculture and aquaculture, and enhancement of shellfish and finfish stocks; (3) seafood science, processing and packaging; (4) marine clinical medicine, pathology, and epidemiology and toxicology; (5) agriculture effects on the coastal environment; (6) coastal and marine engineering and mineralogy; (7) wetland forestry, parks and recreation; (8) marine textiles; (9) marine, fisheries and other coastal resource economics; and (10) formal extension programs.

A codicil on August 11, 2000 supplemented the original charter and described; the (1) Framework and status of the CMAST administrative and advisory structure; (2) Proposed programmatic involvement by four NC State Colleges (Veterinary Medicine, Agricultural & Life Sciences, Physical & Mathematical Sciences, and Education & Psychology); and (3) Housing and budgeted facilities maintenance and operations support. The CMAST director during 2000-2006 was Dr. David Green, who was resident in Carteret County and served as Director of the Seafood Technology Program within NC State's CALS at the time CMAST was established. Dr. David Eggleston (Professor, MEAS/PAMS) became director in 2006. The director is appointed by the University's Chancellor. The administrative and financial structure for CMAST shifted from PAMS to the Vice Chancellor's Office for Research and Innovation (now Research, Innovation and Economic Development) in 2010 as a means to streamline reporting and accounting. The CMAST program and director are reviewed annually by a CMAST Administrative Committee, comprising the Vice Chancellor for Research, Innovation, and Economic Development, the Deans of the three main colleges involved in CMAST, (i.e., CALS, CVM, PAMS), and the Chair of the Marine Science Faculty.

Unique, competitive, compelling, strategic importance

CMAST is a nexus for partnerships with federal, state, county, and private organizations with research and education capabilities centered in the Morehead City/Beaufort areas of NC. Faculty based at CMAST represent a unique blend of basic and applied research foci, as well as extension and teaching activities. NC State has the only college of veterinary medicine in NC, and CMAST is the only marine center in NC to house veterinary medicine faculty that conduct research and training in Aquatic Animal Health. CMAST also supports one of the most highly rated veterinary medicine residency programs for aquatic animal health in the U.S. NC State also has the only food science program in NC, and CMAST is the only marine center in NC with a seafood technology program, with very active and broad-ranging extension activities with industry. Another unique CMAST strength is fisheries research. NC State has the only fisheries and wildlife program in NC for undergraduates, and CMAST is the only marine center in NC with a formal strategic partnership with NC Sea Grant and the NC Division of Marine Fisheries that supports training for graduate students on projects of direct benefit to the state of NC.

There are eight major research and extension programs based at CMAST: (1) Aquatic Animal Health (lead Dr. Craig Harms), (2) Marine Metabionics and MMRISF (lead Dr. Michael Stoskopf), (3) Environmental Medicine Consortium, Drs. Michael Stoskopf and Suzanne Kennedy-Stoskopf, (4) Marine One Health Initiative (lead Dr. Suzanne Kennedy-Stoskopf), (5) Marine Ecology and Conservation (lead Dr. David Eggleston), (6) Marine and Estuarine Fisheries Ecology (lead Dr. Jeff Buckel), (7) Environmental and Molecular Toxicology (lead Dr. Pat McClellan-Green), and (8) Seafood Technology (lead Dr. David Green). CMAST, in partnership with the NC Division of Marine Fisheries, also houses the Marine Mammal Stranding network for the central NC coast, coordinated by Dr. Vicky Thayer.

Impacts on research, education, and society

The Marine Health Program at CMAST has developed and validated drug treatment protocols, identified novel and unexpected pathogens, and devised safe and effective restraint and anesthesia protocols for a wide range of aquatic animals. The finding of *Bartonella henselae* (best known as the vector-borne agent of cat scratch disease) in marine mammals and sea turtles, and at higher prevalence in stranded than in healthy, free-ranging marine mammals, raises unresolved questions about pathogen linkages between terrestrial and marine environments. Techniques developed to safely anesthetize adult leatherback sea turtles (300 - 450 kg) on nesting beaches, and submerged hatchling leatherbacks (35 - 45 g) and adult diamondback terrapins, have allowed complex sensory biology investigations defining visual and auditory capabilities that may be useful in designing mitigation strategies for fisheries and acoustic interactions in these high profile protected aquatic species. Trainees have found positions in academia, federal government, and leading public aquariums and zoological institutions.

The Marine Ecology and Conservation Program at CMAST provides data and advice that is integrated into management plans for fisheries species and their habitat at both state and federal levels. This program was one of the first to describe the positive and negative consequences of intense disturbance by hurricanes on estuarine ecosystem functions and services such as water quality, fisheries, and prevalence of harmful algae. This program teamed with the NC Coastal Federation and NC Division of Marine Fisheries to secure a \$7 million Oyster Restoration grant through NOAA and the American Recovery and Restoration Act (ARRA), which resulted in one of the largest oyster restoration projects in the U.S. Field measurements and modeling studies have guided the location of marine protected areas and provided scientific support for seasonal catch and size restrictions on over-exploited species. Laboratory and molecular studies have identified novel behavioral responses by marine animals to hypoxia, and the molecular basis for such behaviors.

A significant area of research within the Marine and Estuarine Fisheries Ecology program at CMAST is the estimation of discard, fishing, and natural mortality rates in finfish. Mark-recapture techniques were used to estimate discard mortality of caught and released black sea bass; these discard mortality estimates were lower than previously assumed resulting in a large impact on the results from the most recent stock assessment for this species in the southeast U.S. Natural and fishing mortality rates for red drum and spotted seatrout were estimated from a combination of conventional mark-recapture and telemetry data; these estimates have been used in the assessment and the management of these fishes both regionally and in NC.

Research by the CMAST Seafood Technology Program has led to a number of innovative process and product development accomplishments. For example, this program has developed a new molecular method for quantification of histamine-producing bacteria in mixed culture as an early warning technique for reducing the risk of histamine fish poisoning. This program worked to validate a heat shock process in shell oysters to eliminate risks associated with raw consumption of Gulf-state oysters. Industry-related work resulted in the development of a cold-binding technique for restructuring scallop meats, Scallop Medallions™, which led to significant market expansion and diversification of the U.S. scallop industry.

The Marine Environmental and Molecular Toxicology laboratory has made several novel discoveries regarding endocrine disruption and perturbation of metabolic activity in marine species. For example, researchers have identified physiological and molecular mechanisms underlying reproductive failure of oysters due to contaminated sediments, as well as identifying factors related to impaired immune response in oysters and how disease prevalence is affected by exposure to pesticides.

During CMAST's twelve year history, more than 2,000 people have been connected with a marine-related learning experience. From taking classes for college credit, to hands-on field and lab activities for K-12 students, to workshops for seafood business owners, CMAST is becoming a central hub for

learning. Educational opportunities are offered at CMAST via programs through distance education of NC State credit classes, graduate training, experiential learning opportunities for K-12 teachers and students, workshops, seminars, and internships. The multi-disciplinary faculty and staff at CMAST offer a wealth of knowledge for potential students and the facility provides space and technology for classes, much of which is hands-on and inquiry-based. There are five major modes for teaching and training: (1) curriculum courses, (2) graduate training opportunities, (3) K-12 outreach, (4) workshops and training, and (5) residencies and fellowships.

Upcoming Challenges

The potential of CMAST programs are limited due primarily to (1) a lack of housing for visiting faculty, staff and students, which in turn prohibits (2) a critical mass of faculty that will provide synergies in research and support a Semester-At-The-Coast educational program for undergraduates.

Housing

Housing is necessary to (1) provide cost-effective lodging on a short-term basis, which will allow students to gain valuable educational and hands-on research experiences at the coast, (2) allow faculty to better use CMAST to facilitate teaching and research, and (3) create a living and learning environment at CMAST, where visiting faculty, staff, and students bring new energy to and exchange ideas with CMAST programs.

Critical Mass

Lack of critical mass of faculty at CMAST has been a challenge since its inception. The original charter for CMAST called for 9 new faculty – three from each of the three main colleges participating in the center. To date, only two tenure-track positions have been filled: Drs. Jeff Buckel (CALS) and Craig Harms (CVM). The remaining faculty commute between Raleigh and Morehead City (Drs. Eggleston, Kennedy-Stoskopf, and Stoskopf), or have an extension appointment that was based in Carteret County prior to the center being built (Dr. D. Green), or have a visiting assistant professorship (Dr. P. McClellan-Green). A total of 3-7 new faculty would fill gaps in CMAST-based programs and on main campus, and allow NC State to be much more competitive in funding areas such as Ocean Health and Coastal Sustainability Sciences (see Future Directions below).

Additional faculty would also help anchor a Semester-At-The-Coast Program for undergraduates. CMAST is under-utilized as a teaching tool during Fall and Spring Semesters. CMAST provides a unique off-campus experience for undergraduates, where different colleges and departments are brought together under a single umbrella program with strong ties to local university, state/federal programs, and NGOs. A Semester-At-The-Coast Program would provide: (1) a unique coastal learning environment for NC State undergraduates via enhanced interactions with coastal education/research/extension programs at other local universities, state & federal agencies, and NGOs; (2) focus on contemporary science and societal challenges, (e.g., global climate change, sustainable coastal resource use, ecosystem restoration); and (3) provide integrated, interdisciplinary classes and out-of-class experiences within a given Semester-At-The-Coast.

Future Directions

The strategic plan for CMAST involves attaining the following 7 overarching goals.

1. Enhancing scholarship and research by investing in faculty and infrastructure.
2. Enhancing interdisciplinary scholarship to address the grand challenges of society.
3. Enhancing the success of our students through educational innovation, and synergies between research and education.
4. Fostering local and global engagement through focused strategic partnerships.

5. Increasing the scientific value of CMAST by increasing the flow of information, and understanding value of that information.
6. Ensuring easy access by scientists and students to CMAST.
7. Increasing the operational effectiveness of CMAST.

CMAST’s strategic plan aligns with that of (1) NC State, *The Pathway to the Future 2011-2020*, (2) recommendations for “Building and Operating the Field Stations and Marine Laboratories of the Future: A Strategic Planning Report” (Billick et al. 2012), and (3) CMAST’s core strengths.

Goals 1-3 will be attained through:

- the addition of faculty that fill key gaps in research programs of national significance via NC State’s Faculty Excellence cluster hire program and strategic departmental hires;
- engaging new faculty to anchor a Semester-At-The-Coast program for undergraduates; and
- providing housing for visiting faculty, students, and staff.

Additional faculty may be obtained via an NC State Faculty Excellence cluster hire in *Coastal and Marine One Health & Sustainability* that: (1) targets funding opportunities in sustainability sciences from NSF and ocean health opportunities from NOAA, EPA, and NIH; (2) bridges gaps in our research programs, (e.g., need for ecosystem modeler, eco-physiologist to lead MRI Program, etc.); and (3) complements CMAST-based teaching needs and research gaps at other UNC-System marine science programs. CMAST-based housing will be obtained by pursuing two options: (a) a fundraising campaign led by the Office of Research, Innovation and Economic Development in conjunction with CVM, PAMS, and CALS; and (b) initiating a Semester-At-The-Coast program as soon as new faculty hires are in place, using temporary housing facilities in the Morehead City/Beaufort area for students. Option (b) will be used to generate proof-of-concept and funding data that will justify a construction bond to build the guest house.

Goal 4 will be attained by continuing to follow our current model for successful partnerships via our extension faculty and associated networks, (e.g., clinical support for NC Aquarium System, Marine Mammal Stranding Network, seafood industry partnerships, MSEP), as well as a growing portfolio of research and scientific society partnerships.

Goal 5 will be attained by continuing to invest in a part-time CMAST communications specialist that helps to communicate discoveries by CMAST scientists and the value of those discoveries to a wide range of audiences, (e.g., campus-based faculty and administrators, local community, state and federal agencies, NGOs, and elected officials).

Goal 6 will be attained by ensuring an adequate operating budget, having an objective space policy, providing housing for visiting faculty, and providing staff support to facilitate requests for assistance.

Goal 7 will be attained by continually working with our partners in the facility (CCC, NC Cooperative Extension, and NC Sea Grant), as well as the Office for Research, Innovation, and Economic Development and the colleges involved in CMAST to refine operating procedures and funding in the most efficient manner possible.

C. CMAST Resources

1. CMAST Personnel

a.) CMAST faculty and key staff are listed below in Table 2-C1.

Table 2-C1. CMAST Personnel

Name	Title and Department/College	Role
Buckel, Jeffrey	Professor, Biology/CALS	Faculty Member

Name	Title and Department/College	Role
Eggleston, David	Professor, MEAS/PAMS	Faculty Member, CMAST Director
Green, David	Professor, Food, Bioprocessing and Nutrition Sciences/CALS	Faculty Member, Director of Seafood Lab
Harms, Craig	Associate Professor, Clinical Sciences/CVM	Faculty Member
Kennedy-Stoskopf, Suzanne	Research Professor, Clinical Sciences/CVM	Faculty Member
McClellan-Green, Patricia	Research Ass't Professor, Environmental & Molecular Toxicology/CALS	Faculty Member
Stoskopf, Michael	Professor, Clinical Sciences/CVM	Faculty Member, Director of EMC

2. CMAST Funding

Listed below in Table 2-C2 is CMAST revenue (FY10 – FY14).

Table 2-C2: CMAST Revenue

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Federal					
State (not including university)					
Institution (e.g. University)	241,444	257,682	303,803	389,265	397,050
Foundation					
Other*					
Total	241,444	257,682	303,803	389,265	397,050

Listed below in Table 2-C3 are CMAST expenses (FY10 – FY14).

Table 2-C3: CMAST Expenses

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Personnel	194,573	219,546	199,486	243,368	248,236
Programmatic	21,609	26,002	32,847	70,897	72,315
Physical infrastructure					
Maintenance and operation	25,262	12,134	62,726	75,000	76,500
Equipment (>\$5,000)			8,743		
Other Direct Costs*					
Indirect Costs					
Total	241,444	257,682	303,803	389,265	397,051

3. Physical infrastructure

The 51,000 sq. ft. facility, which opened in August 2000, is located on the western edge of the CCC campus and sits directly on the western shore of Bogue Sound. NC State owns and operates the CMAST facility, and CCC provides services such as housekeeping, maintenance, and security. NC

State shares the cost of these services in a 76:24 NC State:CCC split. Previous cost analyses indicated that cost-sharing between NC State and CCC saves the state ~\$200K per year. Other partners in the CMAST building, such as NC Cooperative Extension and NC Sea Grant, do not share in expenses associated with operating and maintaining the building. The CMAST director has overall responsibility for maintenance of the CMAST building.

The CMAST building contains 40 offices, three conference rooms, three video-teleconference rooms, ten research laboratories, four teaching laboratories, two multi-use equipment rooms, two wet processing laboratories, two test kitchens, a seafood processing laboratory and pilot plant, two field staging rooms, an electronics shop, a machine shop, and a walk-in cooler and freezer. The research laboratories, each 1260 sq. ft., are outfitted with broadband access, emergency power backup, sinks, chemical hoods, safety showers, and flammable storage cabinets. The teaching laboratories (biology, physics, computer science, general courses) accommodate 24 students each and also include broadband and wireless connectivity, chemical hoods, sinks, and overhead LCD projectors. CMAST serves as a point-of-presence (PoP) for an ARRA broadband initiative that provides high-speed bandwidth from the North Carolina Research and Education Network (NCREN) via CMAST to its research and education partners, including CCC, UNC-CH/IMS, DUML, and NOAA. By serving as a PoP, CMAST has reduced its costs for internet connectivity to \$0 from an initial high of over \$100K per year.

There is also a separate CMAST warehouse facility with three acres of secure outdoor storage areas for equipment and supplies, as well as staging areas for field operations. CMAST maintains a fleet of nine research vessels and five vehicles. The research vessels were purchased by individual faculty via grant funding, and are also maintained by grant funding. A total of one van, one truck, and one car are maintained via CMAST’s operating budget, and all remaining vehicles are paid for via research grants.

CMAST has dedicated wet-laboratory space at the nearby UNC-CH IMS facility, and also partners with the adjacent CCC aquaculture program for access to sea-water systems. CMAST activities have nearly outgrown available wet-lab space, and we will need an expansion of wet-space in the next 1-2 years.

Pending changes to infrastructure involve the construction of an addition to the first floor of the main CMAST building that will provide dedicated space for an existing horizontal bore, high field magnetic resonance imaging and spectroscopy (MRI/S) magnet devoted to the *in-vivo* study of marine and aquatic biota. A wide-bore magnet dedicated to *in vivo* MRI/S studies in marine and coastal systems does not currently exist in the USA. This project is being funded by a \$350K grant from NSF’s program for Field Stations and Marine Labs (FSMLs) and cost-sharing (\$174K) from NC State. This unique capability will bring together a strategic cross-disciplinary team of marine scientists, magnetic resonance scientists, biochemical engineers, biologists, and biochemists who will collaborate to both operate and utilize the unique instrument.

D. CMAST Research, Teaching, Public and Professional Service

1. CMAST Research

Listed below in Table 2-D1 are currently funded projects of CMAST researchers.

Table 2-D1. CMAST Research

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
Marine Fisheries Fellowship Program	NC Department of Environment & Natural Resources (DENR)	104,972	7/1/2010	6/30/2013	Buckel, Jeffrey A.
Effects of Habitat Alteration and Biotic Interactions on Survival of Juvenile Estuarine Fish	NCSU Sea Grant Program	167,191	2/1/2010	1/31/2013	Buckel, Jeffrey A.; Hightower, Joseph E.
North Carolina Sea Grant College Program: Marine Fisheries Fellowship	NCSU Sea Grant Program	56,421	2/1/2010	1/31/2013	Buckel, Jeffrey A.; Voiland, Michael P
Diet Composition of Predatory Fishes Captured in North Carolina	NC Department of Environment & Natural Resources (DENR)	140,608	8/1/2011	7/31/2013	Buckel, Jeffrey A.
Are Fish Productivity Metrics Related to Anthropogenic Alterations of Habitat?	NCSU Sea Grant Program	69,903	2/1/2012	1/31/2013	Buckel, Jeffrey A.; Hightower, Joseph E.
Collaborative Research: Connectivity in Western Atlantic Seep Populations: Oceanographic and Life-History Processes Underlying Genetic Structure	National Science Foundation	(\$354,406 - see Eggleston in CMAST grant listing)	10/1/2010	9/30/2014	Eggleston, David B.; He, Ruoying

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
Metapopulation Dynamics Guides Oyster Restoration and Shell Budgets in NC	NCSU Sea Grant Program	66,273	2/1/2012	1/31/2013	Eggleston, David B.
Identifying Sustainable Substrates for Oyster Restoration and Artificial Reefs	NCSU Sea Grant Program (prime funding)	60,000	5/15/2011	5/14/2013	Eggleston, David B.
Collaborative: Interacting Effects of Local Demography and Larval Connectivity on Estuarine Metapopulation Dynamics	National Science Foundation	555,804	3/15/2012	2/28/2015	Eggleston, David B.
Dissertation Research: Underwater Soundscapes and Their Potential Role in the Settlement of Estuarine Benthic Invertebrates	National Science Foundation	14,999	7/1/2012	6/30/2014	Eggleston, David B.; Bohnenstiehl, DelWayne R
Development of In-Vivo Marine Magnetic Spectral Resonance Imaging (MMSRI) Capabilities	National Science Foundation	332,590	8/1/2012	7/31/2013	Eggleston, David B.; Stoskopf, Michael K.
Can You Hear Me Now? Estuarine Soundscapes and Their Role in Larval Settlement	National Science Foundation	456,414	9/1/2012	8/31/2015	Eggleston, David B.; Bohnenstiehl, DelWayne R

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
Building Capacity to Control Viral Foodborne Disease: A Translational, Multidisciplinary Approach	US Dept. of Agriculture (USDA)	9,982,503	6/1/2011	5/31/2013	Jaykus, Lee-Ann ; Phister, Trevor Gardner; Chapman, Benjamin ; Green, David P. ; Velev, Orlin D.
Building a Stronger Bridge in Acidified Food Products Training and Certification	US Dept. of Health & Human Services (DHHS)	871,514	9/21/2011	8/31/2013	Green, David P. ; Arritt, Fletcher ; Harris, Gabriel ; Jaykus, Lee-Ann
Veterinary Medical Services Rendered to the North Carolina Museum of Natural Sciences	NC Department of Environment & Natural Resources (DENR)	65,000	7/1/2011	6/30/2014	Lewbart, Gregory A.; Christian, Larry S; Harms, Craig A.
Collaborative Development of Stranded Cetacean Euthanasia Recommendations (previous title: Virginia Aquarium - Prescott Cetacean Euthanasia Grant subcontract)	National Oceanic & Atmospheric Administration (NOAA)	7,500	4/1/2012	10/31/2012	Harms, Craig A.

Project Title	Prime Sponsor	Amount Awarded (\$)	Project Start	Project End	PI/Co-PIs
Southeast Climate Science Center	US Geological Survey (USGS)	(\$882,508 – see D. Shea in Chapter 3, Table 3-D1. CMSF Research)	9/23/2010	8/15/2015	Shea, Damian ; Boyles, Ryan ; Dunn, Robert R.; Eggleston, David B. ; Haddad, Nicholas M.; Gilliam, James F.; Kennedy-Stoskopf, Suzanne ; Moorman, Christopher E.; Overton, Margery F.; Semazzi, Fredrick H.; Stoskopf, Michael K. ; Fitzpatrick, Scott M.; Robison, Daniel
Aquarium Health Management	NC DENR	356,476	10/1/2009	9/30/2012	Stoskopf MK (PI); CoPI's: Harms CA, Kennedy-Stoskopf S, Lewbart GA.
Development of In-Vivo Marine Magnetic Spectral Resonance Imaging (MMSRI) Capabilities	National Science Foundation	332,590	8/1/2012	7/31/2013	Eggleston, David B. ; Stoskopf, Michael K.
Total		\$13,640,758			

2. Teaching and Instruction (if applicable)

a.) Courses taught for degree credit by CMAST faculty are listed below in Table 2-D2.

Table 2-D2. Teaching and Instruction for Degree Credit

Course number, title, and level	Dates offered	Instructor(s) and affiliations	Brief description of course	Enrollment Data Total/on-site/distance
Advanced Topics in Zoological Medicine, CBS 817, Graduate and DVM	Every Fall semester	Kennedy-Stoskopf (course coordinator, CVM); multiple faculty	Prepares our residents in zoological medicine with an Aquatic emphasis to sit and pass their boards to become diplomates in the American College of Zoological Medicine.	22 average/20 CVM/2 CMAST
Advanced Topics in Zoological Medicine, CBS 818, Graduate and DVM	Every Spring semester	Kennedy-Stoskopf (course coordinator, CVM); multiple faculty	Prepares our residents in zoological medicine with an Aquatic emphasis to sit and pass their boards to become diplomates in the American College of Zoological Medicine.	20 average/18 CVM/2 CMAST

b.) Workshops, continuing education, and other non-credit bearing instruction offered by CMAST faculty is listed below in Table 2-D3.

Table 2-D3: CMAST Non-Degree Credit Instruction

Workshop/Instruction Title	Dates offered	Instructor(s) and Affiliations	Brief description of instruction	Enrollment Figures Total/on-site/distance edu
Carteret Community College, Morehead City, NC	2/1/2010	J.A. Buckel, Department of Biology	Guest lecture in aquaculture class-age and growth of fishes	8
National Science Foundation – COSEE program, K-12 teachers	6/1/2010	J.A. Buckel and graduate students	Fisheries activities including beach seining, fish identification, and water quality.	30
NC State’s Continuing Education Program– Sportfishing School	June 2008- June 2012	J.A. Buckel, Department of Biology	Lecture on Fishery Management and Conservation	~35/year
HACCP Workshops one	2012	David Green	Segment Two HACCP workshop, classroom portion of online Seafood HACCP Training	20, onsite

Workshop/Instruction Title	Dates offered	Instructor(s) and Affiliations	Brief description of instruction	Enrollment Figures Total/on-site/distance edu
HACCP workshops four	2011	David Green	Hazard Analysis and Critical Control Point training for members of the seafood processing industry and regulatory officials satisfying FDA requirements under Title 21 CFR Part 1232.	30 participants in Morehead City and Raleigh NC
HACCP workshops six	2010-2012	David Green	Hazard Analysis and Critical Control Point training for the tobacco industry	110 participants in Winston Salem NC and Clarksville TN
HACCP workshops four Seafood HACCP Alliance Train-the-Trainer	2010-2011	David Green	Organize and deliver National Seafood HACCP Alliance train-the-trainers workshop for new supervisory instructors based on new HACCP curriculum manual	Maryland and Michigan
ISTS Sea Turtle Medicine Workshop	April 11-15, 2011	Craig A. Harms, CMAST and CVM	Sea turtle anesthesia	12
National Marine Fisheries Service workshop	June 30-July 1, 2010	Craig A. Harms, CMAST and CVM	Strategic Planning for the Assessment of Impact of the Deepwater Horizon Oil Spill on Marine Mammals and Sea Turtles.	24
International Whaling Commission	April 13-15, 2012	Craig A. Harms, CMAST and CVM	Welfare Issues Associated with the Entanglement of Large Whales	53
National Marine Fisheries Service Northeast Region	November 17-18, 2009	Craig A. Harms, CMAST and CVM	Evaluating Sea Turtle Injuries in Northeast Fishing Gear	18
Sea Turtle Biology, Roger Williams University	2012	Craig A. Harms, CMAST and CVM	Medicine and surgery. Aquavet I	14

Workshop/Instruction Title	Dates offered	Instructor(s) and Affiliations	Brief description of instruction	Enrollment Figures Total/on-site/distance edu
Sea Turtle Biology, Roger Williams University	31-May-11	Craig A. Harms, CMAST and CVM	Medicine and surgery. Aquavet I	12
Sea Turtle Biology, Stonybrook Southhamton	June 16 2010	Craig A. Harms, CMAST and CVM	Medicine and surgery. Aquavet I	15
Sea Turtle Biology, Woods Hole	31-May-08	Craig A. Harms, CMAST and CVM	Medicine and surgery. Aquavet I	17
Southeast North Carolina Red Fox Workshop, Wilmington, NC/ Infectious Diseases in the Red Fox (<i>Vulpes vulpes</i>): It's Not Just about the Fox	Jan. 19-20, 2010	Kennedy-Stoskopf, CMAST and CVM	Workshop explored the role of red fox and depredation of sea turtles and shorebirds; I described disease risks at the fox/human/companion animal interfaces	35/http://www.nccoastaltraining.net/Past-Events/147.aspx
NC One Health Collaborative (OHC)/One Health Intellectual Exchange Group (IEG)	Monthly June-November; weekly January-April since 2011	Kennedy-Stoskopf (co-chair of NC OHC), coordinate IEG with faculty from NC State CVM, Duke and UNC-CH	NC One Health Collaborative seeks to promote and improve the health and well-being of all species by enhancing collaborations among physicians, veterinarians, public, environmental and other local/global health professionals, and increasing public awareness	Average 35 session
Seventh Crissey Zoological Nutrition Symposium, Raleigh, NC	2012	M. Stoskopf Chair	Nutrition of zoological species	70
Sixth Crissey Zoological Nutrition Symposium, Raleigh, NC Dec 2010	2010	M. Stoskopf Chair	Nutrition of zoological species	68

Workshop/Instruction Title	Dates offered	Instructor(s) and Affiliations	Brief description of instruction	Enrollment Figures Total/on-site/distance edu
Fifth Crissey Zoological Nutrition Symposium, Raleigh, NC Dec 2010	2008	M. Stoskopf Chair	Nutrition of zoological species	65
Fourth Crissey Zoological Nutrition Symposium, Raleigh, NC	2007	M. Stoskopf Chair	Nutrition of zoological species	70
Red wolf advisory team meeting at Manteo, NC	2008	M. Stoskopf Chair	Management of red wolf recovery	16

c.) Public Service, Outreach and Community Engagement

Outreach and community engagement activities offered by CMAST personnel are listed below in Table 2-D4.

Table 2-D4. CMAST Public Service, Outreach and Community Engagement

Public Service / Outreach / Engagement program name and brief description (one sentence)	Dates	Personnel Involved	Participants in program (e.g. K-12 teachers)	Number of participants
Beach seine and GPS instruction (geocache)	Oct. 2008	J.A. Buckel and graduate students	White Oak Elementary 5 th graders	100
Ethical angling for snapper and grouper off North Carolina	Feb. 2008	P.J. Rudershausen and J.A Buckel	Saltwater Fishing Light Tackle Club	45
Three presentations (NC habitat, bluefin tuna, black sea bass)	Mar-08	J.A. Buckel and graduate students	NC Public Fisheries Forum attendees	80
Radio interview with Dr. Bogus fishing show. FM 107.1, Morehead City, NC	2008, 2010, 2011	T. Ellis and J. Buckel	Spotted seatrout tagging program	Radio audience
Educational booth on fish tagging programs	Feb. 2009	T. Ellis and J. Buckel	<i>Fisherman's Post</i> fishing school	50
Carteret County Marine Science Academy Camp-beach seining and water quality	Jun-09	J.A. Buckel and graduate students	7 th to 9 th graders	55
Eastern North Carolina - Science Café	Jan. 2010	P.J. Rudershausen, T. Burgess, and J. Buckel	Cooperative research in the NC snapper-grouper fishery	50
Two presentations (spotted seatrout tagging & reef fish discard mortality)	Apr-11	T. Ellis, P. Rudershausen, and J. Buckel	NC Public Fisheries Forum attendees	80

Public Service / Outreach / Engagement program name and brief description (one sentence)	Dates	Personnel Involved	Participants in program (e.g. K-12 teachers)	Number of participants
Tagging studies on recreationally important NC fishes	Jul-12	J. Buckel and T. Ellis	Fin-Addicts Fishing Club	25
Take a kid fishing foundation	June 2008- June 2012	J.A. Buckel and graduate students	Underprivileged NC K-12 students	~3-5 direct interactions per year
Educational fish touch tank at Morehead City, NC Seafood Festival	Oct. 2009- Oct. 2012	CMAST personnel	NC Seafood Festival attendees	>~500 per year
Science Cafe	Quarterly 2008-Pres	D. Eggleston, Organizing Committee	General Public	40-60 each session
Center for Ocean Sciences Education Excellence	Jul-11	Global climate change activities	Middle-school teachers	28
Leadership Carteret	Winter 2008-Pres	J. Miller	Civic Leaders	~ 20/Yr
High School Student Hands-On Research	Summer 2008-Pres	D. Eggleston	5 th -12 th graders; Hands-on Research	~15/Yr
CMAST Summer Fellows Program	Summer 208-Pres	D. Eggleston	Undergraduates	1-2/Yr
Mariner's Menu blog. Biweekly contributions (24 in 2010) on seafood quality and safety to educate and engage the public regarding utilization of NC seafood.	2010	David Green, NCSU; Joyce Taylor, NC Sea Grant; Barry Nash, NC Sea Grant	General public	
Carteret County Marine Science Academy Presentations on Food Processing and Preservation; Seafood Safety; Fish Identification; Sensory Science; during annual summer program	2008 - present	David Green, Greg Bolton, NCSU	7 th , 8 th , and 9 th grade students	avg 50 students per year, approx. 250 students total
Great Decisions Lecture Series: State of the Oceans. Climate change and marine animal health	20-Mar-12	Craig A. Harms, CMAST and CVM	NCSU School of Public & International Affairs	>60
Panel on Euthanasia, Aquatic Working Group and Reptiles, Zoo and Wildlife Working Group	2010-2011	Craig A. Harms, CMAST and CVM	American Veterinary Medical Assoc.	>70

Public Service / Outreach / Engagement program name and brief description (one sentence)	Dates	Personnel Involved	Participants in program (e.g. K-12 teachers)	Number of participants
Oil spill health effects: marine mammals, sea turtles and birds. Public Health “One Health” Forum, North Carolina Oil Spill Response, Recovery and Health	29-Jul-10	Craig A. Harms, CMAST and CVM	UNC Gillings School of Global Public Health	>100
Contract veterinarian for oiled sea turtle response, Deepwater Horizon Oil Spill, Gulf of M	June 21-29, 2010 & August 1-8 2010	Craig A. Harms, CMAST and CVM	Audubon Institute, New Orleans, LA & Gulf World, Panama City, FL	15
Marine mammal sedation, euthanasia and peri-euthanasia issues in North Carolina & 3 hr lecture and 3 hr laboratory instruction in Wildlife Field Anesthesia and Stranded Marine Mammals course	November 18-21, 2008	Craig A. Harms, CMAST and CVM	National Park Service, Biological Resources Management Division, Cape Hatteras National Seashore, Buxton, NC,	22
Karen Beasley Sea Turtle Rescue and Rehabilitation Center, Board of Directors	2002-present	Craig A. Harms, CMAST and CVM		
North Carolina Aquarium at Pine Knoll Shores, IACUC and Research Committee	2011- present	Craig A. Harms, CMAST and CVM		
North Carolina Aquarium at Pine Knoll Shores, Citizen Advisory Committee	2000 - present	Craig A. Harms, CMAST and CVM		
North Carolina Marine Fisheries Commission Sea Turtle Advisory Committee	2010- present	Craig A. Harms, CMAST and CVM		
North Carolina Aquarium at Pine Knoll Shores, Citizen Advisory Committee	2000- present	Craig A. Harms, CMAST and CVM		
Gateway Program serves under-represented counties in Eastern NC to attract students into a career in veterinary medicine	Summer 2010 and 2011	Suzanne Kennedy-Stoskopf	Middle grade students	28-36

Public Service / Outreach / Engagement program name and brief description (one sentence)	Dates	Personnel Involved	Participants in program (e.g. K-12 teachers)	Number of participants
One Health Exhibit Design Committee for the new wing of the NC Museum of Natural Sciences	2009-2012	Suzanne Kennedy-Stoskopf	Museum staff and NC government agencies	4
Science Matters, a program to train graduate students to communicate effectively with the general public	2008-2009	Suzanne Kennedy-Stoskopf (PI on NC State University Extension, Engagement, and Economic Development Grant)	Graduate students from CBS and FWCB	12
Society of Toxicology	2011-present	Patricia McClellan-Green		
American Society for Biochemistry and Molecular Biology	1990-present	Patricia McClellan-Green		
Society of Environmental Toxicology and Chemistry (SETAC)	1997-present	Patricia McClellan-Green		
Carolina Society of Environmental Toxicology and Chemistry (CSETAC)	1997-present	Patricia McClellan-Green		
N. C. Society of Toxicology (NCSOT)	1983-present	Patricia McClellan-Green		
International Society for the Study of Xenobiotics (ISSX)	1993-2004	Patricia McClellan-Green		

d.) Professional Service

Advisory, regulatory, and other professional services offered by CMAST personnel are listed below in Table 2-D5.

Table 2-D5. CMAST Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service provided
NC Marine Fisheries Commission's Southeast Regional Advisory Committee	2008	N. Bacheler and J. Buckel, Department of Biology	Presentation: validation of seine survey for red drum
South Atlantic Fishery Management Council – red snapper and greater amberjack	2008	J.A. Buckel, Department of Biology	Scientific advisor – assessment and review workshops

Board or Group name	Dates	Activity member name and affiliation	Service provided
National Oceanic & Atmospheric Administration, Beaufort, NC-Carolina's acoustics workshop	2008	J.A. Buckel, W. Mitchell, & P. Rudershausen, Department of Biology	Presentation on use of acoustics to monitor marine and estuarine fish
National Oceanic & Atmospheric Administration, University of Maryland Eastern Shore	2009	J.A. Buckel, Department of Biology	Program review of graduate program in marine fisheries
South Atlantic Fishery Management Council	2009	P.J. Rudershausen and J.A. Buckel, Department of Biology	Presentation on discard mortality estimates of black sea bass
South Atlantic Fishery Management Council	2009	P.J. Rudershausen and J.A. Buckel, Department of Biology	Presentation on using acoustics to monitor deepwater reef fishes
National Marine Fisheries Service, Woods Hole, MA	2009	J.A. Buckel, Department of Biology	Program review of Food Habits Dynamics Program
NC Marine Fisheries Commission's Striped Bass Advisory Committee	2010-2011	J.A. Buckel, Department of Biology	Co-chair; committee provided advice on fishery management plan
American Fisheries Society's Early Life History Section – annual meeting	2011	J.A. Buckel, Department of Biology	Co-organizer for International Larval Fish Conference, Wilmington, NC
National Marine Fisheries Service, Beaufort, NC	2011	J.A. Buckel, Department of Biology	Review and selection panel for Fisheries Sampling Branch Chief
National Marine Fisheries Service, Beaufort, NC	Mar-12	J.A. Buckel, Department of Biology	Review of Reef Fish Monitoring Program
South Atlantic Fishery Management Council's Science and Statistical Committee	2005-present	J.A. Buckel, Department of Biology	Scientific advisor
NC Governor's Cup Billfishing Conservation Series	2005-present	J.A. Buckel, Department of Biology	Scientific advisor
NC Marine Fisheries Commission's Strategic Habitat Area Committee	2006-2011	J.A. Buckel, Department of Biology	Advisor on Albemarle Sound and Pamlico Sound strategic habitat identification
American Fisheries Society's Early Life History Section	2006-present	J.A. Buckel, Department of Biology	Webmaster

Board or Group name	Dates	Activity member name and affiliation	Service provided
American Fisheries Society's Early Life History Section	2010-present	J.A. Buckel, Department of Biology	Treasurer
NC Marine Fisheries Commission's Finfish Advisory Committee	2011-present	J.A. Buckel, Department of Biology	Advisor on finfish management issues
Various scientific journals (Ecology, Marine Ecology Progress Series, PNAS) and funding agencies (NSF, Sea Grant, NOAA, EPA))	1993-Pres	David Eggleston, CMAST	Reviewer & panel member
Applied Marine Biology Program, Carteret Community College	2005-Pres	David Eggleston, CMAST	Board Member
EPA	2008-Pres	David Eggleston, CMAST	UNC GA/NC State Representative, National Ecological Services Research Partnership
NC Marine Science & Education Partnership	2006-Pres	David Eggleston, CMAST	Board Member
Blue Crab Advanced Research Consortium	2001-2009	David Eggleston, CMAST	Principal Investigator
NC Biotechnology Center, Agri-Business Working Group for Marine & Aquaculture	2009-11	David Eggleston, CMAST	Team Member
Southeastern Estuarine Research Society	2010-2012	David Eggleston, CMAST	Board Member-At-Large
International Scientific Committee for Conference on Sea Ranching & Stock Enhancement	2009-11	David Eggleston, CMAST	Member
Southeastern Estuarine Research Society	2012-Present	David Eggleston, CMAST	Secretary, Board Member
Southern Association of Marine Laboratories	2011-Present	David Eggleston, CMAST	Treasurer, Board Member
Southern University Research Association	2012-Present	David Eggleston, CMAST	NC State Rep to Coastal & Environmental Committee
University of GA, Long-Term Ecological Research Reserve	2012-Present	David Eggleston, CMAST	Board Member
<i>Journal of Aquatic Food Product Technology</i> TM	2007-present	David Green, CMAST	Editor-in-Chief
Academy of Outstanding Faculty Engaged in Extension (AOFEE)	2011-2013	David Green, CMAST	Executive Committee

Board or Group name	Dates	Activity member name and affiliation	Service provided
Institute of Food Technologists, Aquatic Food Products Division	2009-present	David Green, CMAST	Professional leadership committee chair and technical session's abstract reviewer
National Seafood HACCP Alliance Steering Committee, Editors Committee, Train-the-Trainers Committee		David Green, CMAST	
CALS marine resources faculty	2009	David Green, CMAST	Executive committee member
West European Fish Technologists' Association, Core Members Committee	2009	David Green, CMAST	Ex-officio member
American College of Zoological Medicine Diplomate	1996-2004	Craig A. Harms, CMAST and CVM	Examination Committee
American College of Zoological Medicine Diplomate	2002-2003	Craig A. Harms, CMAST and CVM	Chair
American College of Zoological Medicine Diplomate	2008-2009	Craig A. Harms, CMAST and CVM	Vice-President
American College of Zoological Medicine Diplomate	2011-2012	Craig A. Harms, CMAST and CVM	Past President & Executive Committee
International Association for Aquatic Animal Medicine	2004-2008	Craig A. Harms, CMAST and CVM	Board member & newsletter editor
International Association for Aquatic Animal Medicine	2008-2009	Craig A. Harms, CMAST and CVM	President-Elect & Program Chair
International Association for Aquatic Animal Medicine	2009-2010	Craig A. Harms, CMAST and CVM	President
International Association for Aquatic Animal Medicine	2010-2011	Craig A. Harms, CMAST and CVM	Past-president & board member
American Association of Zoo Veterinarians	2012-present	Craig A. Harms, CMAST and CVM	AAZV Research Grant Committee
Working Group for Marine Mammal Unexplained Mortality Events - NOAA	2005-2011	Suzanne Kennedy-Stoskopf, CVM and CMAST	Review mortality events and determine if federal funding is needed to document causes
Society for Biochemistry and Molecular Biology	1992-present	Patricia McClellan-Green, CALS and CMAST	Congressional Liaison Committee
30 th Annual Meeting Society of Environmental Toxicology and Chemistry	November 19-23, 2009	Patricia McClellan-Green, CALS and CMAST	Judge
Chesapeake Research Consortium Regional Conference	March 25-26, 2009	Patricia McClellan-Green, CALS and CMAST	Invited Participant
Annual Meeting Society of Environmental Toxicology and Chemistry	November 16-20, 2008	Patricia McClellan-Green, CALS and CMAST	Judge

Board or Group name	Dates	Activity member name and affiliation	Service provided
Environmental Health Summit, Pharmaceuticals in the Environment, North Carolina Biotechnology Center	November 10-11, 2008	Patricia McClellan-Green, CALS and CMAST	Invited Participant
American Veterinary Medical Guidelines Working Group - Aquatic	2009-present	M. Stoskopf, Professor CVM	Production of Eutha Guidelines
Red Wolf Recovery Implementation Team, USFWS	1999-present	M. Stoskopf, Professor CVM	Chair

E. CMAST Outputs and Impacts

1. Publications

a.) Selected CMAST refereed publications for the period January 1, 2008 – present are listed below.

1. Anderson ET, Harms CA, Stringer EM, Cluse WM. 2011. Evaluation of hematology and serum biochemistry of cold-stunned green sea turtles (*Chelonia mydas*) in North Carolina. *J Zoo Wildl Med* 42: 247-255, DOI: 10.1638/2010-0217.1. (corresponding author, trainee first author)
2. Anderson ET, Stoskopf MK, Morris JA, Clarke EO, Harms CA. 2010. Hematology, plasma biochemistry, and tissue enzyme activities of invasive lionfish (*Pterois volitans*) off North Carolina, USA. *J Aquat Anim Health* 22: 266-273. (corresponding author, trainee first author).
3. Bacheler, N.M., L.M. Paramore, J.A. Buckel, and J.E. Hightower. 2009. Abiotic and biotic factors influence the habitat use of an estuarine fish. *Marine Ecology Progress Series* 377:263-277.
4. Bacheler, N.M., J.A. Buckel, J.E. Hightower, L.M. Paramore, and K.H. Pollock. 2009. A combined telemetry – tag return approach to estimate fishing and natural mortality rates of an estuarine fish. *Canadian Journal of Fisheries and Aquatic Sciences* 66:1230-1244.
5. Björnsdóttir-Butler, Kristin, Bolton, Greg, Jaykus, Lee-Ann, McClellan-Green, Patricia D., and Green, David P. 2010. Development of molecular-based methods for determination of high histamine producing bacteria in fish. *Internat. J. Food Microbiol.* 139(3): 161-167.
6. Bjornsdottir, Kristin, Bolton, Gregory E., McClellan-Green, Patricia D., Jaykus, Lee-Ann and David P. Green. 2009. Detection of gram-negative histamine producing bacteria in fish: a comparative study. *J. Food Protection* 72(9): 1987-1991.
7. Blickley, T. Michelle and Patricia McClellan-Green. 2008. Toxicity of Aqueous Fullerene (nC₆₀) in Adult and Larval *Fundulus heteroclitus*. *Environ. Toxicol. Chem.* 27: 1964-1971.
8. Eggleston, D. B., D. M. Parsons, G. T. Kellison, G. R. Plaia and E. G. Johnson. 2008. Functional response of sport divers to lobsters with application to fisheries management. *Ecological Applications* 18:258-272.
9. Eggleston, D. B. and D. M. Parsons. 2008. Disturbance-induced spill-in of Caribbean spiny lobster to marine reserves. *Marine Ecology Progress Series* 371: 213-220.
10. Eggleston, D. B., N. B. Reynolds, L. L. Etherington, G. Plaia, L. Xie. 2010. Tropical storm and environmental forcing on regional blue crab settlement. *Fisheries Oceanography* 19(2): 89-106.

11. Harms CA, Harms RV. 2012. Venous blood gas and lactate values of mourning doves (*Zenaidura macroura*), boat-tailed grackles (*Quiscalus major*) and house sparrows (*Passer domesticus*) following capture by mist net, banding, and venipuncture. *J Zoo Wildl Med* 43: 77-84
 12. Harms CA, Eckert SA, Jones TT, Dow Piniak WE, Mann DA. 2009. A technique for underwater anesthesia compared with manual restraint of sea turtles undergoing auditory evoked potential measurements. *J Herp Med Surg* 19: 8-12.
 13. Harms CA, Maggi RG, Breitschwerdt EB, Clemons-Chevis CL, Solangi M, Rotstein DS, Fair PA, Hansen LJ, Hohn AA, Lovewell GN, McLellan WA, Pabst DA, Rowles TK, Schwacke LH, Townsend FI, Wells RS. 2008. *Bartonella* species detection in captive, stranded and free-ranging cetaceans. *Vet Res* 39: 59, DOI: 10.1051/vetres:2008036.
 14. Henson-Ramsey, Heather, Ashley Schneider, Michael Stoskopf. 2011. A Comparison of Multiple Esterases as Biomarkers of Organophosphate Exposure and Effect in Two Earthworm Species. *Bulletin of Environmental Contamination and Toxicology* 86(4):373-378. DOI 10.1007/s00128-011-0236-9
 15. Henson-Ramsey H, Kennedy-Stoskopf S, Levine J, Taylor SK, Shea D, Stoskopf MK. 2008. Acute Toxicity and Tissue Distributions of Malathion in *Ambystoma tigrinum*. *Archives of Environmental Contamination and Toxicology* 55(3): 481-487.
 16. Hunsicker, M., Ciannelli L., Bailey K., Buckel J., White W., Link J., Essington T., Gaichas S., Anderson T., Brodeur R, Chan, KS, Chen K, Englund G, Frank K, Freitas V, Hixon M, Hurst T, Johnson D, Kitchell J, Reese D, Rose G, Sjodin H, Sydeman W, van der Veer H, Vollset K, Zador, S. 2011. Functional responses and scaling in marine predator-prey interactions: contemporary issues and emerging concepts. *Ecology Letters* 14:1288-1299.
 17. Lee, Haakil, Andrey Tikunov, Michael Stoskopf and Jeffrey M. Macdonald. 2010. Application of Chemical Shift Imaging to Marine Sciences. *Marine Drugs*. 8(8):2369-2383; doi:10.3390/md8082369
 18. Minter, L.J., M.K. Stoskopf, M. Serrano, O. Burrus, G.A. Lewbart (2012) Suspected Lead Toxicosis in an Electric eel, *Electrophorus electricus* (Linnaeus). *Journal of Fish Diseases*. 35:603-606. doi:10.1111/j.1365-2761.2012.01386.
 19. Romano, Jocelyn A., Rittschof, Daniel, McClellan-Green, Patricia and Eric R. Holm (2010). Variation in toxicity of copper pyrethrin among populations and families of the barnacle, *Balanus amphitrite*. *Biofouling* 26: 341-347.
 20. Tikunov, Andrey P., Christopher B. Johnson, Haakil Lee, Michael K. Stoskopf, and Jeffrey M. Macdonald. 2010. Metabolomic Investigations of American Oysters Using ¹H-NMR Spectroscopy. *Marine Drugs*. 8(10):2578-2596 doi:10.3390/md8102578
- b.) Selected CMAST non-refereed publications for the period January 1, 2008 – present are listed below.
1. Eggleston, D. B., W. F. Herrnkind and A. H. Hines. (in press). Behavior and ecology of mobile animals: insights from *in situ* observations. Pages XX-XX in M. Lang (Editor), *Research and Discoveries: The Revolution of Science Through Scuba*. Smithsonian Institution Press, Washington, D. C.
 2. Ellis, T., Chappell, S., Deaton, A., Loeffler, M. and J. Buckel. 2009. Use of biological and habitat data to identify strategic habitat areas for Albemarle Sound. Final Report to the NC Division of Marine Fisheries.
 3. DeVlieger, D., Gall, K., Garrido, V., Green, D., Hicks, D., Kraemer, D., Latt, T., Lum, K., Otwell, S., Pivarnik, L., Rippen, T., Ruzicka, K., Snellman, E., Tom, P., Zimmerman, D. 2011. HACCP: Hazard Analysis and Critical Control Point Training Curriculum, Fifth Ed. Florida Sea Grant, SGR127. 238 pp.

4. Kenworthy, W. Judson, Christine A. Buckel, Dean E. Carpenter, David B. Eggleston, Don Field, Cecilia S. Krahforst, Joseph J. Luczkovich and Gayle R. Plaia. 2012. Development of submerged aquatic vegetation monitoring protocols in North Carolina. Final report to the NC Division of Marine Fisheries. Coastal Recreational Fishing License Fund Project 172 pp.
5. Harms CA (ed.). 2009. Proceedings of the International Association for Aquatic Animal Medicine, Vol. 40. 2 – 7 May 2009, San Antonio, Texas, 205 pp., <http://www.vin.com/Proceedings/Proceedings.plx?CID=IAAAM2009&O=Generic>
6. Harms CA. 2012. Echinoderms. In: Lewbart GA (ed). Invertebrate Medicine, 2nd ed. Ames, Iowa: Wiley-Blackwell, pp. 365 – 379.
7. Harms CA, Lewbart GA. 2011. The veterinarian's role in surgical implantation of electronic tags in fish. *Rev Fish Biol Fisheries* 21: 25-33. DOI 10.1007/s11160-010-9185-3
8. Lipcius, R., D. Eggleston, and 11 others. 2012. Report of the Workshop on the Value of Coastal Habitats for Exploited Species (WKVHES), International Council for Exploration of the Seas, 25-29 June 2012, Copenhagen, Denmark. ICES CM 2012/SSGSUE:05. 70 pp.
9. Maggi RG, Harms CA, Breitschwerdt EB. 2012. Bartonellosis: an emerging disease of humans, domestic animals, and wildlife. In: Aguirre AA, Ostfeld RS, Daszak P (eds). *Conservation Medicine: Applied Cases of Ecological Health*. New York: Oxford University Press, pp. 239 – 256.
10. McClellan-Green, P. in press. Endocrine disruption in mollusks (processes and testing); in *Methods of Measuring the Hazards and Predicting the Risks of Endocrine Disrupters for Wildlife*, Matthiessen, Peter (editor), John Wiley & Sons, Inc.
11. McClellan-Green, Patricia D., Oberdörster, Eva, Zhu, Shiqian, Blickley T. Michelle and Mary L. Haasch 2007. Impact of Nanoparticles on Aquatic Organisms. In *Nanoparticles: Characterization, Dosing and Health Effects*. (Eds) N. Monteiro-Riviere and C. L. Tran, Taylor & Francis, CRC Press, New York, NY. pp 391-404.
12. McClellan-Green, Patricia, Celandier, Malin and Eva Oberdorster. 2005. Hepatic, Renal and Adrenal Toxicology in Reptile Toxicology, Gardner, S. and E. Oberdorster (eds), CRC Press, LLC, pp 103-124.
13. Mitchell, W.A., J.C. Taylor, J.A. Buckel, J.E. Hightower, and T. Pratt. 2011. Feasibility of using mobile hydroacoustic surveys for estimating spawning stock size of blueback herring in western Albemarle Sound, North Carolina. Final Report to the NC Fishery Resource Grant. 07-FEG-09.
14. Oberdörster, Eva, McClellan-Green, Patricia and Mary Haasch 2006. Ecotoxicity of engineered nanomaterials. In *Wiley-VCH Book Series on Nanotechnology for Life Sciences*, Vol. 5, *Nanomaterials-Toxicity, Health and Environmental Issues*. Pp 35-50.
15. Piniak WED, Mann DA, Eckert SA, Harms CA. 2012. Amphibious hearing in sea turtles. In: Popper AN, Hawkins A (eds). *The Effects of Noise on Aquatic Life*, *Advances in Experimental Medicine and Biology* 730: 83 – 87, Springer Science+Business Media, DOI 10.1007/978-1-4419-7311-5_18.
16. Rudershausen, P.J. and J.A. Buckel. 2009. Estimating discard mortality of black sea bass (*Centropristis striata*) and other reef fish in North Carolina using a tag-return approach. Final Report to the NC Fishery Resource Grant. 07-FEG – 01.
17. Stoskopf, M.K. 2012. Carnivore Reintroduction. In: *Carnivore Biology*, edited by R. Powell and L. Boitano. Oxford Press, Oxford. Pp. 89-112.
18. Stoskopf, M.K. 2010. Marine Mammals. *The Merck Veterinary Manual*, Tenth Edition Pp.
19. Stoskopf, M.K. 2009. Normal Hematology of Elasmobranchs. *Schalm's Textbook of Veterinary Hematology*, Williams and Wilkins, Baltimore, MD.

20. Stoskopf, M.K. and L. Posner. 2008. Fish Anesthesia. In: Anesthesia and Analgesia for Laboratory Animals, edited by Richard Fish, Marilyn Brown, Peggy Danneman, and Alicia Karas. Elsevier Pp 519 – 534.

2. *Technical Outputs*

Technical outputs such as CDs, software programs, databases, algorithms, and/or measurement instruments of CMAST researchers are listed below.

Harms:

- Contributor to Stokes L, Epperly S (eds.) 2008. Sea Turtle Research Techniques Manual. NOAA Technical Memorandum NMFS-SEFSC-579, 92 pp.

Kennedy-Stoskopf:

- **WolfScout (2012)** – a prototype data management system that integrates “raw data” from unrelated data bases in order to manipulate diverse information to address specific questions related to the impacts of weather and landscape on animal movements and potential disease transmission. Collaborative venture: Suzanne Kennedy-Stoskopf (CVM, Clinical Sciences), Robert Fornaro (CE, Computer Sciences) and Chris DePerno (CNR, Forestry)

Stoskopf:

- **Stoskopf, M.K.** (Editor) (2011) Veterinary Illustration: 2011. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2011) Marine Mammal Medicine 2011. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2011) Herptile Medicine: 2010. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2011) Primate Medicine 2010. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2009) Wild Carnivore Medicine 2009. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2009) Health and Safety in the Third World 2009. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2009) Herptile Medicine: 2006 and 2008. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2008) Primate Medicine 2008. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2007) Wild Carnivore Medicine 2007. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2006) Primate Medicine 2006. Course CD. NCSU EMC
- S.K. Stoskopf and **Stoskopf, M.K.** (Editors) (2006) Environmental Medicine and Policy 2006. Course CD. NCSU EMC
- S.K. Stoskopf and **Stoskopf, M.K.** (Editors) (2005) Environmental Medicine and Policy 2005. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2005) Wild Carnivore Medicine 2005. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2004) Primate Medicine 2004. Course CD. NCSU EMC
- **Stoskopf, M.K.** and C. Harms (Editors) (2003) Ferret Medicine 2003. Course CD. NCSU EMC
- **Stoskopf, M.K.** and A. Acton (Editors) (2003) Wild Carnivore Medicine 2003. Course CD. NCSU EMC

- **Stoskopf, M.K.** and C. Harms (Editors) (2002) Ferret Medicine 2002. Course CD. NCSU EMC
- **Stoskopf, M.K.** (Editor) (2002) Advanced Herptile Medicine 2002. Course CD. NCSU EMC
- **Stoskopf, M.K.** and M. Loomis (Editors) (2002) Third World Medicine 2002. Course CD. NCSU EMC
- **Stoskopf, M.K.** (2002) Thailand 2002: Image CD. NCSU Veterinary International Programs.
- **Stoskopf, M.K.** (2002) South Africa 2002: Image CD. NCSU Veterinary International Programs.
- Suzanne Kennedy- Stoskopf and **Stoskopf, M.K.** (Editor) (2002) Environmental Policy 2002: Course CD. NCSU EMC
- **Stoskopf, M.K.** (2002) South Africa 2001: Image CD. NCSU Veterinary International Programs.
- **Stoskopf, M.K.:** (1998) Marine Mammal Medicine: A CD ROM Tutorial. Aquatic Diagnostics, Apex, North Carolina
- **Stoskopf, M.K.:** (1997) ACZM EXAM IMAGES CD ROM. Aquatic Diagnostics, Apex, North Carolina
- **Stoskopf, M.K.:** (1997) Important Issues in Wildlife Medicine, Volume I: A CD ROM Tutorial. Environmental Medicine Consortium, Raleigh, North Carolina
- **Stoskopf, M.K.:** (1996) Marine Mammal Medicine: Lecture Templates. Aquatic Diagnostics, Apex, North Carolina
- **Stoskopf, M.K.;** North, S.: (1989) Canine Clinician: A Differential Diagnostic Aid. N-Squared Computing, Silverton, Oregon.
- **Stoskopf, M.K.;** North, S.: (1988) Feline Clinician: A Differential Diagnostic Aid. N-Squared Computing, Silverton, Oregon.
- **Stoskopf, M.K.;** North, S.: (1987) Avian Clinician: A Differential Diagnostic Aid. N-Squared Computing, Silverton, Oregon.
- **Stoskopf, M.K.:** (1986) Examination Database and Keying Program. American College of Zoological Medicine.
- **Stoskopf, M.K.;** North, S. (1986) Aqua Medic: A Differential Diagnostic Aid. N-Squared Computing, Silverton, Oregon.

3. **Commercialization and Technology Transfer** – None to report.

4. **Awards and Honors**

Awards and honors conferred to faculty, staff, and students as a result of their participation in CMAST are shown below in Table 2-E1.

Table 2-E1. CMAST Awards and Honors

Award or Honor	Date	Name	Brief Description
Best student presentation	2008	N.M. Bacheler, student, Department of Biology	For presentation of dissertation research at Tidewater Chapter of the American Fisheries Society

Award or Honor	Date	Name	Brief Description
Nancy G. Pollock dissertation award	2009	N.M. Bacheler, student, Department of Biology	For 2008 dissertation. Rewards outstanding scholarly research that has positive impact on economy of North Carolina.
Award For Excellence, College of Agriculture and Life Sciences	2009	P.J. Rudershausen, Research Assistant, Department of Biology	Recognizes individuals who go above and beyond their job description.
Excellence in Fisheries Education	2011	J.A. Buckel, Department of Biology	Tidewater Chapter of the American Fisheries Society
Best student presentation	2012	J.W. Morley, student, Department of Biology	For presentation of dissertation research at Tidewater Chapter of the American Fisheries Society
National Oceanic & Atmospheric Administration, Walter B. Jones Memorial Award	2012	T.A. Ellis, student, Department of Biology	Recognizes Excellence in Coastal and Marine Graduate Studies
Outstanding Extension Service Award	2009	David Eggleston, CMAST	Excellence in extension/outreach
NSF Doctoral Dissertation Improvement Award	2012	Ashlee Lillis, PhD student	Enhancement of dissertation research
NSF Graduate Fellowship	2010	Robert Dunn, MS student	Graduate student support
NC Sea Grant/NMFS Population Dynamics Fellowship	2008-12	Brandon Puckett, PhD student	Graduate support & training in population dynamics
Best student presentations & posters	2008-12	Robert Dunn, Ashlee Lillis, Brandon Puckett	Various national and regional meetings hosted by American Fisheries Society, Southeastern Estuarine Research Association, & Benthic Ecology Meetings
Visionary Leadership Award, Epsilon Sigma Phi, Xi Chapter Annual Meeting	17-Nov-11	D. Green, CMAST	
IFT Fellow Award, Institute of Food Technologists Annual Meeting	July 17-21, 2010	D. Green, CMAST	

Award or Honor	Date	Name	Brief Description
Best student presentation	2008	N.M. Bacheler, student, Department of Biology	For presentation of dissertation research at Tidewater Chapter of the American Fisheries Society
Nancy G. Pollock dissertation award	2009	N.M. Bacheler, student, Department of Biology	For 2008 dissertation. Rewards outstanding scholarly research that has positive impact on economy of North Carolina.
Award For Excellence, College of Agriculture and Life Sciences	2009	P.J. Rudershausen, Research Assistant, Department of Biology	Recognizes individuals who go above and beyond their job description.
Excellence in Fisheries Education	2011	J.A. Buckel, Department of Biology	Tidewater Chapter of the American Fisheries Society
Best student presentation	2012	J.W. Morley, student, Department of Biology	For presentation of dissertation research at Tidewater Chapter of the American Fisheries Society
National Oceanic & Atmospheric Administration, Walter B. Jones Memorial Award	2012	T.A. Ellis, student, Department of Biology	Recognizes Excellence in Coastal and Marine Graduate Studies
Stange Award for Meritorious Service, Iowa State University College of Veterinary Medicine	Oct-11	Craig A. Harms, CMAST and CVM	
Outstanding Extension Service Award & induction into the Academy of Outstanding Faculty Engaged in Extension (AOFEE), NC State	Apr-11	Craig A. Harms, CMAST and CVM	
Southeast United States Marine Mammal Stranding Network Award, NOAA	2007-2009	Craig A. Harms, CMAST and CVM	Dedication in responding to elevated numbers of large whale strandings

Award or Honor	Date	Name	Brief Description
NC State Outstanding Extension Service Award	2009-2010	Suzanne Kennedy-Stoskopf	Activities related to promoting One Health in NC (One Health Intellectual Exchange Group); service to various professional organizations that promote health and well-being of animals (e.g. Association of Zoos and Aquariums, American Board of Veterinary Specialties); speaking to middle-school kids about careers in veterinary medicine related to wildlife and the environment.
Academy of Outstanding Faculty Engaged in Extension	2011	Suzanne Kennedy-Stoskopf	Activities related to promoting One Health in NC (One Health Intellectual Exchange Group); service to various professional organizations that promote health and well-being of animals (e.g. Association of Zoos and Aquariums, American Board of Veterinary Specialties); speaking to middle-school kids about careers in veterinary medicine related to wildlife and the environment.
ACZM Diplomate Status	2011	Karen Wolf	Former resident achieves highest level of professional recognition in discipline
ACZM Diplomate Status	2010	Sathya Chinnadurai	Former resident achieves highest level of professional recognition in discipline
ACZM Diplomate Status	2012	Eric Anderson	Former resident achieves highest level of professional recognition in discipline
ACZM Diplomate Status	2012	Betsy Stringer	Former resident achieves highest level of professional recognition in discipline
ACZM Diplomate Status	2012	Michael Berecz	Recent PhD student achieves highest level of professional recognition in discipline
NIH Presentation Award	2012	Jennifer Hurley-Sanders	NIH Award for Poster Presentation on Freshwater Mussel Metabonomics

Chapter 3.

A. Coastal & Marine Science Faculty

B. Coastal & Marine Science Faculty Narrative

Vision, Mission, & History

Because of increased population densities at the coast, environmental perturbations (such as climate change and sea-level rise) resulting from various anthropogenic activities, as well as increased demands on many of our natural resources, (e.g., seafood or petroleum products), the coastal environments of our state, nation, and world have faced increasing pressures that bring into question society's ability to sustain and utilize the valuable resources at the interface between land and the ocean. The Non-MEAS and Non-CMAST Coastal and Marine Sciences programs and faculty at NC State are an integral part of research, teaching, and outreach activities occurring on state, national, and global levels that address these important issues and environmental problems. NC State has had an organized assemblage of faculty members collaborating on issues pertaining to coastal and marine sciences for over 17 years. On March 24th, 1995, the Provost of NC State approved the Charter of the NCSU Marine Science Council and the NCSU Marine Science Faculty. These programs were established to facilitate the interaction of faculty from a variety of Colleges and Departments on campus, who are researching various issues pertaining to the marine environment. From its original charter both the NCSU Marine Science Council and the Marine Science Faculty consisted of members from the Colleges of Physical and Mathematical Sciences, Agriculture and Life Sciences, and Engineering. In later years, the College of Veterinary Medicine also would contribute faculty and expertise to these marine science organizations. The names of the NC State marine science organizations were broadened in 2009 to the NCSU Coastal and Marine Sciences Council and the NCSU Coastal and Marine Science Faculty.

Over the past decade, interdisciplinary research among the sciences and social sciences has become an essential approach in addressing coastal and marine science issues at the state, national, and global levels. In response to this change in approach, the NCSU Marine Science Faculty, which always included faculty from the Physical and Biological Sciences; Wildlife Ecology; Natural Resource Management; Food Science; and Coastal Engineering, expanded to include faculty from Economics; Parks, Recreation and Tourism; Soil Science; History; Public and International Affairs; Science Education; and Population Health and Pathobiology. Thus, the research interests of the Coastal and Marine Sciences Faculty at NC State is extensive, comprehensive, and diverse. The Coastal and Marine Science Faculty meet at least once a year to maintain channels of communication among the faculty. In addition, national and state requests for proposals relating to coastal and marine environments are distributed among the NCSU Coastal and Marine Science Faculty in an effort to initiate collaboration among NC State scientists on multi-faceted and complex environmental issues.

This chapter of the UNC-GA Coastal and Marine Science Assessment focuses on the activities of Non-MEAS, Non-CMAST faculty at NC State who are active in fields ranging from coastal engineering to the basic sciences to the humanities and social sciences. There are a total of 31 faculty in this category (see Table 3-C1 below). The largest number of faculty (7) comes from the Department of Biology, which historically has been in the College of Agriculture and Life Sciences (CALS). NC State is modifying its college structure by combining the College of Physical and Mathematical Sciences with much of the Department of Biology to form the College of Sciences (effective July 1, 2013). Some of the Department of Biology faculty with research interests in coastal and marine science will remain in the College of Agriculture and Life Sciences, (i.e., **H. Daniels, J. Hightower, R. Hodson, J. Miller, J. Rice, and C. Sullivan**), whereas others (e.g., **D. Shea**) will be part of the new College of Sciences. Two other faculty from CALS discussed in this section come from the Department of Botany and from the Center for Applied Aquatic Ecology (**J. Burkholder and R. Reed**). The Department of Soil Science (also in CALS) has two faculty members interested in coastal and marine science (**C. Crozier and S. Broome**). The three remaining faculty from the College of Agriculture and Life Sciences that

are discussed in this section come from the Department of Food, Bioprocessing and Nutrition Sciences (**L. Jaykus, T. Lanier, and K. Swartzel**).

The College of Natural Resources has several faculty discussed in this section, primarily from the Dept. of Parks, Recreation and Tourism (**C. Barbieri, G. Bothers, Y. Leung, E. Seekamp, and C. Siderelis**) and from the Department of Forestry and Environmental Resources (**H. Cheshire and J. Gregory**). Other faculty whose research, teaching and outreach are described in this section come from the College of Veterinary Medicine (**J. Levine, M. Levy, and G. Lewbart**) as well as from the College of Engineering (**B. Edge and M. Overton** in Civil Engineering). The remaining faculty discussed in the section come from the College of Education (**M. Blanchard** in Science Education), the College of Humanities and Social Sciences (**M. Booker** in History), the School of Public and International Affairs (**T. Birkland and M. Cobb**) and from Sea Grant (**S. Rebach**).

Unique, competitive, compelling, strategic importance

The Coastal and Marine Sciences Faculty discussed in this section (Non-MEAS and Non-CMAST scientists) comprise a significant assemblage of faculty that are active in research, teaching, and outreach across a wide variety of scientific and social science disciplines. This group not only covers much of the basic and fundamental biological sciences, but also performs activities in many applied marine programs, such as in fisheries and wildlife management, coastal engineering, recreation and tourism, as well as veterinary science. North Carolina State University is the Land Grant University for the state of North Carolina and these more applied areas of activity are a natural and unique offshoot of this important mission of our university. Examples of these activities include the Aquaculture efforts of **H. Daniels and C. Sullivan**, who currently have more the \$1.4 million in research funding (see Table D1). In addition, North Carolina State University has several academic/research programs that are unique to the state of North Carolina such as its College of Engineering, its College of Veterinary Medicine, as well as the sole academic program in Atmospheric Sciences. Consequently, coastal and marine science research that pertains to coastal engineering, the health of coastal fauna, or coastal weather (such as hurricanes) naturally originates at our institution. Examples of these unique efforts at North Carolina State University include the Renewable Ocean Energy Research Program (> \$6 million of research generated since 2010 by **B. Edge**, see Table D1) and the monitoring of the Oregon Inlet Terminal Groin (> \$350K in research funding since 2008 by **M. Overton**). Two other examples of the unique research conducted by NC State faculty described in this section include the study of RNMS Statistical Methods for Atmospheric and Ocean Sciences (\$2.8 million dollars of research, lead PI **M. Fuentes** in the NC State Statistics Dept. with Co-PI **D. Shea**, F. Semazzi, and L. Xie from the NC State CMS group) and the Southeast Climate Center (\$1.5 million with **D. Shea** as the lead PI and F. Semazzi and L. Xie as Co-PIs). The latter two examples of unique research activities at NC State illustrate interdisciplinary efforts that combine atmospheric science and the coastal and marine sciences.

Impacts on research, education, and society

Probably the best gauge to judge the impact of the faculty in this section of the self-study is the overall research funds raised since 2008. The Non-MEAS and Non-CMAST CMS faculty at NC State have received nearly \$27 million of support for their research related to coastal and marine sciences. As mentioned above, this research originates from many different facets of coastal and marine sciences including basic scientific research, applied research, science education, and social science studies. A good example of interdisciplinary cooperation among NC State faculty comes from the Southeast Climate Science Center (\$1.5 million program funded through the U.S. Geological Survey). **D. Shea** (from the Biology Dept.) is the lead PI on the grant, but Co-PIs include three faculty from MEAS (**R. Boyles** - the state climatologist, **D. Eggleston**, and **F. Semazzi**), two faculty from CMAST (**S. Kennedy-Stoskopf** and **M. Stoskopf**), and one from Engineering (**M. Overton**). This interdisciplinary effort at NC State illustrates the productive interaction of faculty from different disciplines at the University (supporting one of the primary goals of the NCSU Coastal and Marine Sciences Faculty organization).

By combining research efforts using an interdisciplinary approach, NC State is able to address complex issues affecting society such as climate change and sea-level rise.

The Non-MEAS, Non-CMAST, Coastal and Marine Science Faculty at NC State also impact the field of marine science through numerous peer-reviewed publications. Since 2008, these faculty have published a total of 231 papers (see listing of the 20 most-cited articles below under publications). There have been a total of 1362 citations of these published works over the 5-year period from 2008-2012. This is a considerable accomplishment because of other faculty responsibilities in teaching and extension.

As part of their academic responsibilities and overall impact on education and society, many of the Coastal and Marine Science faculty teach undergraduate and graduate classes (see Table 3-D2) in addition to conducting active research programs. Highlighting this effort, **G. Lewbart** recently received the William Medway Award for Excellence in Teaching, which was given by the International Association for Aquatic Animal Medicine. The faculty listed in this section of the UNC-GA Assessment also make considerable impact through their public outreach. For example, **J. Burkholder and R. Reed** have developed a “floating classroom” that has served and educated nearly 10,000 middle and high school students, as well as 800 K-12 teachers, exploring areas such as estuarine ecology and water quality. **J. Rice** is involved in organizing 4-H fisheries programs, and **G. Lewbart** provides NC Aquarium support. Our Coastal and Marine Science Faculty also make an important impact through their professional service activities. For example, **J. Burkholder** is a member of the NC Marine Fisheries Commission as well as the NC Coastal Futures Committee. **B. Edge** has organized two Symposia (2011 and 2012) on Renewable Ocean Energy for the State of North Carolina. **J. Rice** often has provided professional advice to the NC Marine Fisheries Commission. In addition, **M. Overton** serves on the Governor’s Scientific Advisory Panel on Offshore Energy as well as on the NC Science Panel on Coastal Hazards. Our Coastal and Marine Science Faculty have received several awards for their scientific efforts, which is a confirmation of their impact on science as well as society. For example, **J. Burkholder** received the J. Compton River Lifetime Achievement award for leadership and advancement of water quality protection. In 2011, **J. Hightower** received the Governor’s conservation achievement award as the NC Conservationist of the Year.

Upcoming Challenges

Two of the main challenges facing Coastal and Marine Science Faculty at NC State over the next 1-5 years will be access to specialized instrumentation and access to faculty with research expertise in areas complementing their own scientific interests. Scientific instrumentation is becoming so expensive and specialized that even major research institutions like NC State do not have the resources to purchase all the necessary analytical equipment or sampling devices. Thus, there will be a need to pool scientific resources and share instruments as part of regional or national equipment centers. Similarly, CMS faculty will be interacting more and more directly with scientists from other universities and other countries as they try to address specialized research topics in new and cutting-edge areas of study. The latter need requires enhanced facilities for electronic communication among universities and research institutes. An example of this recent phenomenon is the increased number of graduate student committees that have one or more of its members participate in a final thesis or dissertation defense via SKYPE.

Interdisciplinary collaboration among scientists is only in its infancy and is already reshaping the research and funding realms. In addition, public outreach is increasingly emphasized by federal and state funding agencies, requiring additional expertise in science education as well as social science, (i.e., understanding the impact of science on humanity). The amount and quality of research space also may become an important issue over the next five years. In many of the Coastal and Marine Science programs across the state, buildings and research labs are out of date with regard to electronic connectivity, adequate air conditioning, clean laboratory facilities, and space overall. There is a push

from University administration to have faculty obtain more research funding and greater numbers of graduate students, however, the space allocated for these efforts often remains constant or even diminishes over time.

When the Chancellor decided to restructure the Biology Program and reorganize the College structure at NC State (by transitioning from a College of Physical and Mathematical Sciences to a College of Sciences), a promise was made to add additional faculty to the Biology program, such that NC State could compete with nationally renowned universities in this important field of science. As faculty are added in the biological sciences, it will be essential to have the new “cutting-edge” expertise complement and expand the strong, existing research effort in coastal and marine biological sciences. The Department of Marine, Earth and Atmospheric Sciences at NC State recently hired Dr. Astrid Schnetzer, who specializes in phytoplankton and zooplankton ecology, molecular diversity, biogeochemical cycling, and food web dynamics. This hire is a good example of adding faculty in new and exciting research areas in the marine sciences that cut across the various fields of oceanography and basic physical sciences.

Future Directions

NC State is well-positioned in the Coastal and Marine Sciences to take advantage of new directions in field and laboratory research. The faculty are highly productive and come from diverse backgrounds in the fundamental sciences as well as in the applied sciences and social sciences. The new College of Sciences (effective July 2013) combines many of the Biological areas of expertise with the basic physical and mathematical sciences in PAMS to create a dynamic and diverse assemblage of scientists that can address many of the issues facing society and an evolving coastal environment. Climate change will continue to be a major focus of research for the scientific community well into the 21st century. With its expertise in Atmospheric Science, Coastal and Marine Science, Coastal Engineering, and Veterinary Science, NC State will continue to provide unique leadership in key research issues in the future as they require both a basic science and an applied science approach to address the complex environmental issues created by our society. Land-grant universities, such as NC State, are well-situated to fulfill this role in the research community and in society overall.

C. Coastal & Marine Science Faculty Resources

1. Personnel

CMS faculty and key personnel are listed below in Table 3-C1.

Table 3-C1. Personnel

Name	Title and Department/College	Role
Barbieri, Carla	Assistant Professor; Parks Recreation and Tourist Management/CNR	Faculty Member
Birkland, Thomas	Professor and Assoc. Dean; Public Administration/CHASS	Assoc. Dean of Research, CHASS
Blanchard, Margaret	Assistant Professor; Science Education/COEd; Science House/PAMS	Faculty Member
Booker, Matthew	Assistant Professor; History/CHASS	Faculty Member
Broome, Stephen	Professor; Soil Science/CALS	Faculty Member
Brothers, Gene	Associate Professor; Parks Recreation and Tourist Management/CNR	Faculty Member
Burkholder, JoAnn	William Reynolds Distinguished Professor; Botany/CALS	Director for the Center for Applied Aquatic Ecology
Cheshire, Heather	Associate Professor; Forestry/CNR	Faculty Member
Cobb, Michael	Associate Professor; Public and International Affairs/CHASS	Faculty Member

Name	Title and Department/College	Role
Crozier, Carl	Associate Professor; Soil Science/CALS	Extension Specialist
Daniels, Harry	Professor; Biology/CALS	Faculty Member
Edge, Billy	Professor; Civil, Construction and Environmental Engineering/COEng	NC State Faculty Member at CSI (Manteo)
Gregory, James	Professor Emeritus; Forestry/CNR	Professor Emeritus
Hightower, Joseph	Professor; Biology/CALS	Faculty Member in Cooperative Fish and Wildlife Research Unit
Hodson, Ron	Researcher ; Biology/CALS	Aquaculture Specialist
Jaykus, Lee-Ann	Associate Professor; Food, Bioprocessing and Nutrition Sciences/CALS	Faculty Member
Lanier, Tyre	Professor; Food, Bioprocessing and Nutrition Sciences/CALS	Faculty Member
Leung, Yu-Fai	Professor; Parks Recreation and Tourist Management/CNR	Faculty Member
Levine, Jay	Associate Professor; Population Health and Pathobiology/CVM	Faculty Member
Levy, Michael	Professor; Population Health and Pathobiology/CVM	Faculty Member
Lewbart, Gregory	Professor; Clinical Sciences/CVM	Professor of Aquatic Animal Medicine
Miller, John	Professor; Biology/CALS	Faculty Member
Overton, Margery	Professor; Civil Engineering/COEng	Faculty Member
Rebach, Steve	Associate Director of NC Sea Grant; NC Sea Grant	Research Administration
Reed, Robert	Researcher in Oceanography; Center for Applied Aquatic Ecology/CALS	Director of CAAE Field Programs
Rice, James	Professor; Biology/CALS	Faculty Member
Seekamp, Erin	Assistant Professor; Parks Recreation and Tourist Management/CNR	Faculty Member
Shea, Damian	Professor; Biology/CALS	Faculty Member
Siderelis, Chris	Professor; Parks Recreation and Tourist Management/CNR	Faculty Member
Sullivan, Craig	Professor; Biology/CALS	Faculty Member
Swartzel, Ken	William Reynolds Distinguished Professor; Food, Bioprocessing and Nutrition Sciences/CALS	Faculty Member

b.) Student Numbers

In this section of Non-MEAS, Non-CMAST Coastal and Marine Science Faculty activities, it is difficult to assess the number of undergraduate majors associated with the Coastal and Marine Sciences. No degree or program is 100% Coastal and Marine Sciences oriented. There is a Fish, Wildlife, and Conservation Biology B.S. degree in the Department of Forestry and Environmental Resources which has 175 majors currently. We have assumed that 50% (88) of these majors are associated with Coastal and Marine Sciences activities. For other Departments at North Carolina State University we have assumed the following proportions of undergraduate majors associated with activities in Coastal and Marine Sciences: **30%** (Biology and Zoology majors, 565 of 1883 total), **10%** (Botany majors – 4 of 41 total; Civil Engineering – 49 of 485 total; Food Science – 33 of 328 total; Park, Recreation and Tourism – 25 of 252 total; Soil Science – 2 of 15 total), and **2%** (School

of Public and International Affairs – 11 of 527; History – 3 of 170). Based on these assumptions, **our estimate for the total number of undergraduate majors in Non-MEAS and Non-CMAST programs that are associated with Coastal and Marine Sciences at NC State is 780.**

Number of graduate students associated with Coastal and Marine Sciences

Similar to the undergraduate programs, there are no graduate degrees awarded at NC State for non-MEAS and non-CMAST programs that are 100% associated with activities in Coastal and Marine Sciences. There are graduate degrees (M.S., M.R., or Ph.D.) offered in Fish, Wildlife and Conservation Biology through the Biology Department, the Vet School, and the Department of Forestry and Environmental Resources, with a total enrollment currently of 41 graduate students. We have assumed that 50% (21) of these graduate students have their graduate research in areas associated with Coastal and Marine Sciences. For other departments at NC State, we have assumed the following proportions of graduate students have their graduate research associated with activities in Coastal and Marine Sciences: **30%** (Zoology graduate students, 26 of 86 total), **10%** (Botany graduate students – 3 of 29 total; Civil Engineering graduate students – 24 of 241 total; Food Science graduate students – 10 of 104 total; Park, Recreation and Tourism graduate students – 8 of 79 total; Soil Science graduate students – 4 of 38 total), and **2%** (School of Public and International Affairs graduate students – 4 of 176; History – 4 of 202). Based on these assumptions, **our estimate for the total number of graduate students in Non-MEAS and non-CMAST programs that are conducting their research in areas associated with Coastal and Marine Sciences at NC State is 124.**

Our estimate for the number of Post Docs in Non-MEAS, non-CMAST programs associated with the Coastal and Marine Sciences is 4.

2. Funding

This chapter describes the activities of faculty from a broad range of disciplines and lack a formal administrative, (i.e., accounting) structure. There is no logical way to delineate revenue generated exclusively from these coastal and marine science activities, so no Table C2 is provided for this group. Table 3-C3 represents only the proportion of their coastal and marine science related salary expenses and does not include other expense categories, such as physical infrastructure or equipment.

Table 3-C3: CMS-related Personnel Expenses

Name	Department	NC State Salary	% Effort in CMS	Salary (\$) in Support of CMS Effort
Barbieri, Carla	Parks Recreation and Tourist Management	92,232	10	9,223
Birkland, Thomas	Public Administration	162,896	10	16,290
Blanchard, Margaret	Science Education/Science House	69,128	20	13,826
Booker, Matthew	History	63,000	10	6,300
Broome, Stephen	Soil Science	105,023	70	73,516
Brothers, Gene	Parks Recreation and Tourist Management	70,785	5	3,539
Burkholder, JoAnn	Biology	166,980	70	116,886
Cheshire, Heather	Forestry	86,196	10	8,620
Cobb, Michael	Public and International Affairs	71,469	15	10,720
Crozier, Carl	Soil Science	94,984	10	9,498

Name	Department	NC State Salary	% Effort in CMS	Salary (\$) in Support of CMS Effort
Daniels, Harry	Biology	142,150	100	142,150
Edge, Billy	Civil, Construction and Environmental Engineering	83,490	100	83,490
Gregory, James	Forestry	No Data	10	No Data
Hightower, Joseph	Biology	No Data	75	No Data
Hodson, Ron	Biology	No Data	100	No Data
Jaykus, Lee-Ann	Food, Bioprocessing and Nutrition Sciences	156,680	10	15,668
Lanier, Tyre	Food, Bioprocessing and Nutrition Sciences	101,630	10	10,163
Leung, Yu-Fai	Parks Recreation and Tourist Management	91,553	50	45,777
Levine, Jay	Population Health and Pathobiology	130,675	10	13,068
Levy, Michael	Population Health and Pathobiology	130,614	10	13,061
Lewbart, Gregory	Clinical Sciences	121,982	10	12,198
Miller, John	Biology (Emeritus)	0	75	0
Overton, Margery	Civil Engineering	114,138	100	114,138
Rebach, Steve	NC Sea Grant	79,438	100	79,438
Reed, Robert	Center for Applied Aquatic Ecology	69,880	70	48,916
Rice, James	Biology	122,134	15	18,320
Seekamp, Erin	Parks Recreation and Tourist Management	87,100	10	8,710
Shea, Damian	Biology	162,426	50	81,213
Siderelis, Chris	Parks Recreation and Tourist Management	106,527	30	31,958
Sullivan, Craig	Biology	142,175	100	142,175
Swartzel, Ken	Food, Bioprocessing and Nutrition Sciences	91,799	10	9,180
Total Salary in Support of CMS Activities				\$1,148,954

3. Physical infrastructure

CMSF research, teaching, and service at NC State benefits greatly from the wealth of resources and methods applied by those from other disciplines and organization. These resources and benefits are highlighted below.

a) NC State Center for Applied Aquatic Ecology (CAAE) - The NC State CAAE's mission is to provide water quality research information needed by policy makers, at national as well as state and local levels, to augment regulatory and non-regulatory programs aimed at optimizing management and conservation of water resources from the perspective of protecting fish and human health. This mission, together with the CAAE's combination of major areas of focus in research, teaching, and outreach education, are unique among centers in the UNC system. The CAAE is the only research

center that emphasizes the importance of long-term datasets on water quality and algal assemblages, including harmful taxa, in assessment and protection of estuaries, rivers, and potable water supply reservoirs. Accordingly, it is the only center throughout the UNC system that is acquiring high-frequency, long-term water quality datasets, for 20 years ongoing, on the mesohaline Neuse Estuary in “hot spots” for algal blooms, fish kills, and oxygen deficits. It is the only center that is state-certified to provide the service of nutrient, chlorophyll *a*, and suspended solids water quality analyses spanning the salinity gradient.

Table 3-C4. Personnel at CAAE under the Direction of Dr. JoAnn Burkholder

Name	Title and Department/College	Role
Elle Allen	Research Associate / NC State CAAE / Plant Biology / CALS	Supervises algal identification, culturing and research for the NC State CAAE; also supervises all microscopy (light and confocal microscopy, and scanning and transmission electron microscopy)
Phil Bowie	Boat Captain / NC State CAAE / Plant Biology / CALS	Captain of the RV Humphries (50-foot former Coast Guard auxiliary vessel, now the CAAE’s boat) for all research and education outreach activities
Ben Bunn	Boat Captain / NC State CAAE / Plant Biology / CALS	Captain of the RV Humphries when Mr. Bowie is not available; Mr. Bunn is a retired US Navy officer and aviator
David Bunn [no relation to Ben Bunn]	Field Research Technician / NC State CAAE / Plant Biology / CALS	Assists in all field research and monitoring, including calibration and maintenance of the automated platform networks for real-time data collection; also assists in the CAAE’s environmental education program
Edward Fetzer	Field Research Technician / NC State CAAE / Plant Biology / CALS	Assists in field research and monitoring on the Neuse Estuary, and boat maintenance
Jenny James	Water Quality Analytical Specialist / NC State CAAE / Plant Biology / CALS	Co-manager of the NC State CAAE’s state-certified Water Quality Analytical Laboratory
Carol Kinder	Research Associate, NC State CAAE / Plant Biology / CALS	Data Manager, Statistician, Website Design and Manager, Field Liaison, Network Administrator and Systems Manager
Linda Mackenzie	Water Quality Analytical Specialist / NC State CAAE / Plant Biology / CALS	Co-manager of the NC State CAAE’s state-certified Water Quality Analytical Laboratory
Terri Mann	Water Quality Technician and Education Outreach Specialist / NC State CAAE / Plant Biology / CALS	Assists in water quality analyses and also serves as the coordinator for the CAAE’s education outreach programs

Ships:

- RV Humphries - 50-ft former U.S. Coast Guard auxiliary vessel, the NC State CAAE's boat for research and education outreach activities; this boat is also used to assist in graduate marine science classes at NC State in MEAS. This boat was the first in the UNC system that was U.S. Coast Guard-certified for oceanographic research; it is now one of two such boats, with the second being at ECU.

Specialized Equipment at CAAE:

- Various high-tech equipment - LiCor dataloggers with 4π spherical sensors; boat-mounted acoustic Doppler current profiler (ADCP - RD Instruments 1200KHz) to monitor estuarine flow; a tow body instrument array (Sea Sciences Acrobat - salinometer, pH, chlorophyll, temperature, light, DO, etc.) to monitor water-column vertical and horizontal structure. These instruments are made available, as research permits, for collaborative use by other scientists at NC State, e.g., Dr. D. DeMaster (MEAS).
- The CAAE's real-time remote monitoring network in the Neuse Estuary also includes substantial equipment. The CAAE's profiler is an automated real-time remote monitoring system (RTRM) built around a computer-driven winch and water quality probes. It is expandable to include various biological and chemical probes, meteorological sensors, and different forms of real-time communication equipment such as satellite, radio, and cellular modems. Data are retrieved via cellular telemetry to a base computer that is used to process the data, visualize it into graphical displays, post it to the CAAE website in near-real time (after ~30 minutes of quality control/quality assurance checks), and alert project managers when parameters are out of acceptable ranges. Meteorological and hydrological data are posted in real time to the website for public use as well.
- Each RTRM system operated by the CAAE is equipped with an array of sensors for hydrological (water temperature, pH, redox potential, DO, conductivity, turbidity) and meteorological variables. The CAAE system collects meteorological data as follows: Wind speed/direction obtained with a R.M. Young 05103 marine wind sensor; air temperature and relative humidity acquired with a Vaisala HMP45C sensor; barometric pressure obtained with a Vaisala PTB101B barometer; precipitation assessed using a Young model 52202 tipping-bucket rain gauge; incident solar radiation sensed by a LICOR LI200XL pyranometer. The hydrological sensors are bundled (YSI 6600EDS sonde, YSI Env.) and deployed via specially designed automated winch-driven profilers (NC State U.S. patent), enabling casts of the entire water column. The system is adaptable for additional sensors. The reservoir stations are also outfitted with probes for chlorophyll a relative fluorescence and phycocyanin relative fluorescence (YSI, Inc.).
- Residence monitoring software for all instruments is housed in a Campbell Scientific CR10X datalogger on-site (Campbell Scientific). This datalogger has served as an industry standard for over 25 years and provides reliable instrument logging and control in harsh conditions. The acquisition programs have been custom-modified for the proposed instrument package by CAAE scientists using Campbell Scientific Loggernet software. Communication to platforms is accomplished via cellular telephone and radio modems (e.g. Freewave), the latter providing greater reliability and speed. The present version of the platform software is highly flexible and can be reprogrammed from any site that has cellular telephone service; in addition, sample rate can be re-programmed to initiate at any time period. After acquisition by the datalogger, the data are transmitted by a Sierra Wireless Raven XT EVDO cellular data modem to the CAAE's data acquisition computer (DAC).
- The comprehensive plans for the structure and construction methods (barge with pile-driving crane; tripod or dolphin structure, class-B-treated pilings, length 35-40 ft; 6 ft; 2 platforms 10 ft

above mean sea level) were reviewed by several local CAMA offices, ten other state agency entities, and four federal agencies prior to issuance of the permit.

b) The Program for Sustainable Coastal Engineering (SCE) and Ocean Energy (OE) at the Coastal Studies Institute at Manteo, NC (Dr. Billy Edge – Leader)

The Program for Sustainable Coastal Engineering (SCE) and Ocean Energy (OE) began in 2009 and since then it has grown into a viable and integrated part of CSI. The mission of the Program in support of the overall mission of CSI is to conduct research while providing support to local communities and the State through an integration of applied and basic research in coastal engineering and ocean energy. Support to the communities is planned to be through an extension type service. Research is featured on several fronts from local problems to State, national and even international problems. Additionally, SCE provides a mechanism for educational opportunities for undergraduate and graduate engineering students at North Carolina State University. The SCE is not limited to traditional coastal engineering but includes sustainable transportation - marine and surface, port facilities, coastal hazard mitigation and ocean energy.

Renewable Ocean Energy has been a major part of this program since the State Legislature authorized funding in 2010 for an ocean energy program with annual funding of \$2,000,000. The legislation directed the Coastal Studies Institute to lead the program and to be partnered with the colleges of engineering at NC State, UNC Charlotte, and North Carolina A&T State University. Funding appropriated by this act is to be used by university engineers and scientists to conceptualize, design, construct, operate, and market new and innovative technologies designed to harness and maximize the energy of the ocean to provide substantial power generation for the State. The governance of this program is through an Advisory Board made up of the engineering Deans of the Universities, the Director of the Coastal Studies Institute, and representatives of the UNC System. The technical and scientific direction for the program comes from a Technical Advisory Committee (TAC).

Table 3-C5. Personnel at the Program for Sustainable Coastal Engineering (SCE) and Ocean Energy (OE) under the Direction of Dr. Billy Edge

Name	Title and Department/College	Role
Billy L. Edge	Professor/Department of Civil, Construction and Environmental Engineering, COEng, NC State	Program Head Sustainable Coastal Engineering and Ocean Energy
Lindsay Dubbs	Assistant Research Professor, UNC-CH	Assistant Director of Ocean Energy Program
Kevin Gamiel	Research Associate/UNC Renaissance Computing Institute	Numerical Modeling, Instrumentation
Mike Muglia	Research Associate/PhD Student/UNC CH	Field Operations/Ocean Observing

c) Physical Infrastructure of Dr. James A. Rice Research Program

- 20’ Privateer outboard boat with 115-hp 4-stroke motor, and trailer
- 19’ Carolina Skiff outboard boat with 70-hp 4-stroke motor, and trailer
- 2 YSI 6600 V2 programmable data sondes capable of recording depth, temperature, dissolved oxygen concentration and conductivity, while remotely deployed.
- 4 YSI 600XLM-M programmable data sondes capable of recording depth, temperature, dissolved oxygen concentration and conductivity, while remotely deployed.

- Parr Semi-micro Bomb Calorimeter (for measuring energy content of tissue samples)

Table 3-C6. Personnel of Dr. James A. Rice Research Program

Research Group Participants	Title and Department/College	Role
Peter Lazaro	Research Specialist, Biology/CALS	Lab and Field Program Manager
Xin-Rui Xia	Research Associate Professor, Biology/CALS	Research
Anna Kong	Research Associate, Biology/CALS	Research

d) Physical Infrastructure of Dr. Damian Shea Research Program

- ThermoFinnigan Triple Quadrupole Discovery MAX LC/MS
- ThermoFinnigan LTQ Ion Trap LC/MS
- Agilent 5973/6800 GC/MS (two)
- Agilent 7000/7800 Triple Quadrupole GC/MS

Table 3-C7. Personnel of Dr. Damian Shea Research Program

Name of Personnel	Title and Department/College	Role
Kent Passingham	Aquatic Medicine Research Technician; CVM; Clinical Sciences	Support for CMAST and other coastal CVM activities when Raleigh-based endeavors and resources are required

D. Coastal & Marine Science Faculty Research, Teaching, Public and Professional Service

1. Research

Currently funded research projects (extramural and intramural) of CMSF are listed below in Table 3-D1.

Table 3-D1. CMSF Research

Project Title	PI/Co-PIs	Sponsor	Award Amount (\$)	Project Dates
DRRC: Dynamics Between Local and Foreign Actors: Influence on Capabilities in Post-earthquake Rural Haiti and	Birkland, Thomas	National Science Foundation	22,600	9/15/2011 - 8/31/2013
Enabling the Next Generation of Hazards and Disasters Researchers	Birkland, Thomas	National Science Foundation	248,683	6/1/2008 - 5/31/2013
Burroughs Wellcome Fund Scholars Program	Simmons, Patricia; Bellamy, Mary Louise; Moore, Kathryn M.; Penick, John E.; Blanchard, Margaret R.	UNC - General Administration	470,000	3/19/2008 - 6/30/2013

Project Title	PI/Co-PIs	Sponsor	Award Amount (\$)	Project Dates
Strategies-STEM Teams: Promoting Science, Technology, Engineering, and Mathematics Skills, Knowledge, Interest, and Career Awareness Through Strategic Teaming	Blanchard, Margaret R.; Williams, Braska; Alsbury, Thomas L.; Osborne, Jason W.	National Science Foundation	1,197,669	9/1/2010 - 8/31/2013
STEM Teams Student Scholar Camp: Promoting Science, Technology, Engineering, and Mathematics (STEM) Career Interest, Skills, and Knowledge	Williams, Braska; Blanchard, Margaret R.	BelleJAR Foundation	50,000	12/15/2010 - 12/15/2012
Multi-scale Analysis of Mechanisms and Impact of Phosphorus Mobilization in Wetland Soils Created from Drained Agricultural Fields	Vepraskas, Michael J.; White, Jeffrey G.; Hesterberg, Dean L.; Huffman, Rodney L.; Broome, Stephen W.	US Dept. of Agriculture (USDA)	399,043	9/1/2009 - 8/31/2013
Carbon Sequestration and Greenhouse Gas Emissions in Restored Salt Marshes	Burchell, Michael R.; Birgand, Francois Philippe; Broome, Stephen W.	US Geological Survey (USGS)	60,000	8/1/2011 - 7/31/2013
Visitor Satisfaction Survey ~ Outer Banks, North Carolina	Gene Brothers	Outer Banks Visitors Bureau	6,900	8/1/2010 – 3/31/2012
Inventorying Non-Consumptive Utilitarian Uses of Coastal Resources	Morais, Duarte B.; Brothers, Gene L.; Leung, Yu-Fai; Rozier, Samantha J.	NC State Sea Grant Program	5,000	2/1/2012 - 1/31/2013
North Carolina Floating Classroom Program	Burkholder, JoAnn M.; Reed, Robert E.	Burroughs Wellcome Fund	175,305	3/1/2011 - 2/28/2014
Natural Resource Condition Assessments for Ten Southeast Coast Network Parks	Burkholder, JoAnn M.	US National Park Service	274,566	8/26/2009 - 5/31/2013
Integration of Novel Technologies for Safeguarding Potable Water Supplies	PI Rublee (UNC-G); CoPIs J. Burkholder, (NC State CAAE), Henrich (UNC-G)	UNC GA Research Competitive-ness Fund	140,000	12/01/07 - 06/30/08
Long-term Impacts of Changing Land Use Practices on Neuse Estuary Water Quality	J. Burkholder	NC Sea Grant	46,675	02/01/08 - 01/31/10

Project Title	PI/Co-PIs	Sponsor	Award Amount (\$)	Project Dates
Harnessing Novel Saltwater Microalgae as a Renewable Biofuel Source	J. Burkholder	NC Sea Grant	8,000	11/08/10 - 03/31/11
International Networks Application - Placing Marine Mixotrophs in Context: Modelling Mixotrophy in a Changing World	J. Burkholder , CoPI with Glibert (U MD) and PIs from several nations	The Lever-Hulme Trust	7,850	06/01/11 - 5/31/2012
Scientific Assistance to Riverkeepers and Waterkeeper Alliance	J. Burkholder	Moore Charitable Trust	25,000	04/01/12 - 07/31/12
EFRI-HyBi Preliminary Proposal: Algal Oils to 'Drop-in' Replacements For Petroleum Transportation Fuels	Roberts, William L.; Burkholder, JoAnn M. ; Sederoff, Heike W.; Stikeleather, Larry F.; Lamb, Henry	National Science Foundation	1,999,172	8/1/2009 - 7/31/2013
Rapid Assessment of Soil Carbon Assistance for the Coastal Plain and Piedmont Soil Survey Region	Crozier, Carl R. ; Lindbo, David L.; Hardy, David	US Dept. of Agriculture (USDA)	31,837	7/1/2010 - 6/30/2013
Improved Cost Effectiveness and Sustainability of Aquaculture in the Philippines and Indonesia	Borski, Russell J.; Ferket, Peter R.; Stark, Charles R.; Hatch, Luther; Daniels, Harry V.	US Agency for International Development (AID)	1,204,730	10/25/2007 - 1/31/2013
Optimizing All-Female Southern Flounder Culture in Low Saline Waters	Borski, Russell J.; Daniels, Harry V.	NC State Sea Grant Program	166,442	2/1/2010 - 1/31/2013
Publication, Videos and Computer Software-Year 16 (previous title: Nutritional Aspects of Seafood - Hybrid Striped Bass)	Daniels, Harry V.	US Dept. of Agriculture (USDA) - National Institute of Food and Agriculture	1,000	5/1/2011 - 10/31/2012
Year-round Indoor Production of Hybrid Striped Bass Fingerlings	Daniels, Harry V. ; Borski, Russell J.	NC State Sea Grant Program	93,608	5/1/2011 - 6/30/2013
Optimization of Ions For Low Salinity Culture of Southern Flounder and Black Sea Bass With Emphasis on Reduction of Sodium Chloride in Recirculating Aquaculture Systems.	Daniels, Harry V. ; Borski, Russell J.	NC State Sea Grant Program	51,369	2/1/2012 - 1/31/2013

Project Title	PI/Co-PIs	Sponsor	Award Amount (\$)	Project Dates
Renewable Ocean Energy Research	Edge, Billy B. Edge is an NC State faculty member who is leading the Renewable Ocean Energy Program at CSI (Manteo). His research funds are administered through the coastal facility (CSI), but his appointment is at NC State.	State of North Carolina	2,000,000	7/1/2010 - 6/30/2011
Renewable Ocean Energy Research	Edge, Billy (see above)	State of North Carolina	2,200,000	7/1/2011 - 6/30/2012
Renewable Ocean Energy Research	Edge, Billy (see above)	State of North Carolina	2,000,000	7/1/2012 - 6/30/2013
Effects of Habitat Alteration and Biotic Interactions on Survival of Juvenile Estuarine Fish	Buckel, J.A., Hightower, Joseph E.	NC State Sea Grant Program	(\$167,191 – see Buckel under CMAST grant listing)	2/1/2010 - 1/31/2013
A Multi-stage Survey Protocol for Shortnose Sturgeon	Hightower, Joseph E.	US Geological Survey (USGS)	216,709	9/1/2008 - 8/31/2013
Factors influencing escapement of red drum in North Carolina: a conventional tag and telemetry approach	PI Buckel, CoPIs J. Hightower, Pollock	Sea Grant	(\$166,668 - see Buckel in CMAST grant listing)	2006-2008
Assessing benefits to migratory fishes of habitat restored by dam removal	J. Hightower	US Fish and Wildlife Service	187,081	2006-2010
Spawning activity of anadromous fishes in the Cape Fear River, North Carolina	J. Hightower	U. S. Army Corps of Engineers	140,121	2007-2009
Hydroacoustic monitoring of anadromous fishes in the Roanoke River	J. Hightower	NC Wildlife Resources Commission; Dominion	242,689	2007-2013

Project Title	PI/Co-PIs	Sponsor	Award Amount (\$)	Project Dates
Migratory behavior of diadromous fishes in the Roanoke River, North Carolina	J. Hightower	US Fish and Wildlife Service	45,283	2007-2011
Feasibility of using mobile hydroacoustic surveys for estimating spawning stock size of blueback herring	coPIs Mitchell (NOAA), Taylor (NOAA), J. Buckel, J. Hightower	Sea Grant	142,916	2008-2009
The feasibility of conducting a long-term conventional tagging and telemetry study on spotted seatrout (<i>Cynoscion nebulosus</i>) in North Carolina	PI Buckel, CoPIs J. Hightower , Pollock	Sea Grant	(\$62,061 - see Buckel in CMAST grant listing)	2008-2009
Does density-dependent mortality in an estuarine fish limit recruitment?	PI Buckel (NC State), CoPIs J. Hightower , Scharf (UNCW), Pollock (NC State)	Sea Grant	(\$155,000 - see Buckel in CMAST grant listing)	2008-2010
Movement and mortality of spotted seatrout in North Carolina: a combined conventional tag and telemetry approach.	PI Buckel (NC State), coPIs J. Hightower , Pollock (NC State), Burns (NC Division of Marine Fisheries)	NC Coastal Recreational Fishing License Fund	(\$299,563 - see Buckel CMAST grant listing)	2009-2012
Research and Management of Endangered and Threatened Species in the Southeast: Riverine Movements of Shortnose and Atlantic sturgeon	J. Hightower	NOAA	176,553	2010-2013
Characterizing habitat suitability for American Shad in the Yadkin-Pee Dee River	Co-PIs Raabe (NC State), J. Hightower	NOAA	18,360	2011-2013
Assessing Mortality, Tag Reporting Rate, and Movement patterns of Albemarle Sound-Roanoke River (AR) Striped Bass Using Conventional, Passive Integrated Transponder (PIT), and Telemetry Tagging Techniques.	Co-PIs Harris (NC State) and J. Hightower	NC Department of Environment & Natural Resources (DENR)	365,108	6/15/2010 - 6/30/2013
Riverine Movements of Shortnose and Atlantic Sturgeon	Hightower, Joseph E.	National Oceanic & Atmospheric Administration (NOAA)	123,477	7/1/2010 - 5/15/2013

Project Title	PI/Co-PIs	Sponsor	Award Amount (\$)	Project Dates
Are Fish Productivity Metrics Related to Anthropogenic Alterations of Habitat?	Buckel, Jeffrey A.; Hightower, Joseph E.	NC State Sea Grant Program	(\$69,903 - see Buckel in CMAST grant listing)	2/1/2012 - 1/31/2013
Evaluation of Fish Passage Following Installation of a Rock Arch Rapids at Lock and Dam #1, Cape Fear River, North Carolina	Hightower, Joseph E.	US Dept. of Interior (DOI)	213,037	5/11/2012 - 9/30/2014
Characterizing habitat suitability for American Shad in the Yadkin-Pee Dee River	Hightower, Joseph E.	US Fish & Wildlife Service	23,585	9/9/2011 - 12/31/2013
Master UNC Collaborating Entities SEA-COOS	Hodson, Ronald G.	UNC - General Administration	1	1/1/2002 - 12/31/2012
Blue Crab Funding 7/1/2003-6/30/2010 (5-38177)	N.C. Sea Grant Program Voiland, Michael P.; Hodson, Ronald G.	NC State Sea Grant Program	(\$3,244,046 - see separate submission for NC Sea Grant Program)	4/1/2003 - 6/30/2013
N.C. Fishery Resource Grant Program (FRG)	N.C. Sea Grant Program Voiland, Michael P.; Hodson, Ronald G.	NC State Sea Grant Program	(\$5,201,760- See separate submission from NC Sea Grant Program)	1/31/2003 - 6/30/2013
A Comprehensive Action Plan for Restructuring North Carolina's Licensing and Permit Systems	Peterson, Nils, Leung, Yu-Fai	NC Wildlife Resources Commission	141,588	9/1/2010 - 12/31/2012
Aquarium Health Management	Stoskopf MK (PI); CoPI's: Harms CA, Kennedy-Stoskopf S, Lewbart GA.	DENR	(\$356,476 - See under M.K. Stoskopf in CMAST grant listing)	10/1/09 - 9/30/12
Shoreline Monitoring at Oregon Inlet Terminal Groin	M.F. Overton	NC DOT	114,914	8/16/2011-8/15/2012
Shoreline Monitoring at Oregon Inlet Terminal Groin	M.F. Overton	NC DOT	93,495	8/16/2010-8/15/2011

Project Title	PI/Co-PIs	Sponsor	Award Amount (\$)	Project Dates
Shoreline Monitoring at Oregon Inlet Terminal Groin	M.F. Overton	NC DOT	80,747	10/16/2009 -8/15/2010
Shoreline Monitoring at Oregon Inlet Terminal Groin	M.F. Overton	NC DOT	93,113	7/1/2008-8/15/2009 (note: funded continuously since 1989)
Visualization of Terrain Evolution: from Animations to Space-Time Cube	Tateosian, H. Mitasova, M.F. Overton	RENCI	(\$12,000 - See H. Mitasova grant listing in MEAS Chapter)	1/1/2011-12/31/2011
Multi-Temporal, Three Dimensional Coastal State Indicators	M.F. Overton , H. Mitasova	NC State Sea Grant Program	91,734	2/1/2008-8/15/2010
Engineering the Civil Infrastructure For Enhanced Resilience of the Built and Natural Environments	Overton, Margery F.; Gabr, Mohammed A.; List, George F.; Seracino, Rudolf; Baugh, John W.; Ranjithan, Sanmugavadivel; Brill, Earl D.	US Dept. of Homeland Security (DHS)	1,961,875	7/1/2008 - 6/30/2013
DHS Homeland Security HS-STEM Career Development Grants (CDG)	Ranjithan, Sanmugavadivel; Brill, Earl D.; Gabr, Mohammed A.; Overton, Margery F.; Seracino, Rudolf; Baugh, John W.; List, George F.; Demers, Alixandra	Demers, Alixandra	390,000	9/30/2009 - 9/30/2013
Shoreline Monitoring at Oregon Inlet Terminal Groin	Overton, Margery F.	NC Department of Transportation	117,851	8/16/2012 - 8/15/2013

Project Title	PI/Co-PIs	Sponsor	Award Amount (\$)	Project Dates
Development of a Research Plan for the Mid-Atlantic Region	N.C. Sea Grant Program Steve Rebach	US Dept. of Commerce (DOC)	(\$20,000 - see separate submission for NC Sea Grant Program)	6/1/2008 - 12/31/2012
Marine Mammal Bycatch Reduction and Related Research in Cooperation with North Carolina Sea Grant	N.C. Sea Grant Program Steve Rebach	National Oceanic & Atmospheric Administration (NOAA)	(\$125,000 - see separate submission for NC Sea Grant Program)	7/1/2010 - 6/30/2014
A Comprehensive Examination of Endocrine Disrupting Compounds and Intersex Fish in North Carolina Water Bodies	Aday, David Derek; Kullman, Seth W.; Cope, William G.; Kwak, Thomas J.; Rice, James A. ; Law, Jerry M.	NC Wildlife Resources Commission	489,788	7/1/2011 - 12/31/2016
Coastal Largemouth Bass Responses to Seasonal and Episodic Habitat Constraints and Tournament Displacement	Rice, James A. , Aday, David Derek	NC Wildlife Resources Commission	189,708	7/1/2011 - 12/31/2014
Linking changes in hypoxia to effects on fish growth using three short-term growth indicators.	J. Rice , Russell J. Borski	UNC Sea Grant	140,005	02/01/2008 - 01/31/2011
Effects of hypoxia-induced habitat compression on juvenile fish cohort dynamics: field and model investigations.	J. Rice , J. Kevin Craig	UNC Sea Grant	135,677	02/01/2006 - 01/31/2008
Increasing Engagement in Science through Authentic Practice K-20	Shea, Damian ; Ferzli, Miriam G.; Schulze, Sharon Kay	Howard Hughes Medical Institute	1,500,000	9/1/2010 - 8/31/2014
Species and Strain Differences in the Toxicity of Caribbean Gambierdiscus Species: Implications For Ciguatera Fish Poisoning in the Caribbean	Shea, Damian	National Oceanic & Atmospheric Administration (NOAA)	39,245	9/1/2011 - 8/31/2013
Assessment of Terrestrial and Aquatic Monitoring Programs in the Southeastern United States	Shea, Damian	US Geological Survey (USGS)	24,794	9/20/2012 - 9/19/2014

Project Title	PI/Co-PIs	Sponsor	Award Amount (\$)	Project Dates
Collaborative Research: RNMS Statistical Methods for Atmospheric and Oceanic Sciences	Fuentes, Montserrat; Reich, Brian James; Shea, Damian ; Semazzi, F.; Xie, L.	National Science Foundation	2,837,003	10/1/2011 - 9/30/2013
Student Participation in Climate Change Impact Studies	Damian Shea, PI	USGS	21,000	09/11-09/13
Southeast Climate Science Center	Shea, Damian , PI; PIs: Boyles, Ryan; Dunn, Robert R.; Eggleston, David B.; Haddad, Nicholas M.; Gilliam, James F.; Kennedy-Stoskopf, Suzanne; Moorman, Christopher E.; Overton, Margery F. ; Semazzi, Fredrick H.; Stoskopf, Michael K.; Fitzpatrick, Scott M.; Robison, Daniel	USGS	1,470,847	08/10-09/15
Measuring Chronic Exposure to and Bioavailability of Organic Chemicals and their Metabolites in Water and Sediment with a Novel Universal Passive Sampling Device (uPSD)	Damian Shea , PI	NIEHS	1,493,515	04/11-05/16
Innovative Biotechnologies for Environmentally Sustainable and Economically Competitive Aquaculture across North Carolina	Sullivan, Craig V. ; Borski, Russell J.; Daniels, Harry V. ; Hinshaw, Jeffrey M.; Losordo, Thomas M.	US Dept. of Agriculture (USDA)	211,262	6/15/2010 - 6/14/2013
Managing Reproductive Failure In Fisheries and On Fish Farms:A Joint NC/SC Sea Grant Project	Sullivan, Craig V.	NC State Sea Grant Program	73,267	2/1/2012 - 1/31/2013

Project Title	PI/Co-PIs	Sponsor	Award Amount (\$)	Project Dates
Domesticated Broodstock for Hybrid Striped Bass Farming: Pioneering Industry Implementation	Sullivan, Craig V.	NC State Sea Grant Program	19,947	8/1/2011 - 6/30/2013
Total			\$26,511,744	

2. Teaching and Instruction (if applicable)

a.) Degree credit instruction that directly relates to coastal and marine science are listed below in Table 3-D2.

Table 3-D2. Teaching and Instruction for Degree Credit

Course Title/Number	Dates Offered	Instructors	Brief Description of Course	Enrollment Figures - Total (On Site/Dist. Ed.)
Environmental Issues in Aquatic Ecology - PB 595W; Graduate level	2008 fall, 2010 fall, 2011 fall	J. Burkholder (NC State CAAE)	Science, policy, and politics of major issues affecting the state's and the nation's water resources (fresh to marine)	9 graduate students (2008, 2010); 5 graduate students (2011); No Dist. Ed.
Phycology - PB/MB 774; Graduate level	2008 spring; 2010 spring	J. Burkholder (NC State CAAE)	The study of algae across the salinity gradient (fresh to marine)	8 graduate students (2008); 5 graduate students (2010); No Dist. Ed.
Aquatic Plant Ecology - PB 595A; Graduate level	2008 fall	J. Burkholder (NC State CAAE)	The ecology of primary producers (algae, angiosperms) across the salinity gradient (fresh to marine)	7 graduate students; No Dist. Ed.
STEM Education Seminar: Environmental Issues in Estuarine Ecology and Pedagogical Applications -	2010 spring	Simmons and Clark (STEM, NC State), and J. Burkholder (NC State CAAE)	Pedagogical applications of environmental issues in estuarine ecology, focusing on the mesohaline Neuse Estuary	7 graduate students; No Dist. Ed.

Course Title/Number	Dates Offered	Instructors	Brief Description of Course	Enrollment Figures - Total (On Site/Dist. Ed.)
EMS 496/622/822 or TDE 490/610; Graduate level				
Special Topics in Coastal Modeling; CE 596; Graduate Level	Spring 2010	Billy Edge – NC State	Use of numerical models for studying storm surges, tides and water quality in coastal bays and estuaries	12 No Dist. Ed.
CE 596/CE496	F2011	M.J. Overton	Coastal Structures	7 G, 2 UG No Dist. Ed.
CE 583	F2010	M.J. Overton	Engineering Aspects of Coastal Processes	8 G No Dist. Ed.
CE 596	F2009	B. Edge and M.J. Overton	Coastal Modeling	10 G No Dist. Ed.
CE 487/596	S2009	M.J. Overton	Introduction to Coastal Engineering	33 UG, 6 G No Dist. Ed.
CE487/583	S2008	M.J. Overton	Introduction to Coastal and Ocean Engineering/Engineering Aspects of Coastal Processes	27 UG, 6 G No Dist. Ed.
CE487	2009,2010,2011,2012, 2013	E. Sciaudone, Asst. Teaching Professor in Civil Engineering	Teaching Introduction to Coastal and Ocean Engineering	Variable No Dist. Ed.
Resort Development and Management; PRT 420; Senior Level	Annually, Spr	G. Brothers	The goal of this course is to provide the student with an exposure to destination and resort planning, development and management from a theoretical and applied perspective.	38/semester No Dist. Ed.

Course Title/Number	Dates Offered	Instructors	Brief Description of Course	Enrollment Figures - Total (On Site/Dist. Ed.)
VMC-991; Advanced Fish Medicine	Fall Semester each year.	Drs. Michael Stoskopf, Craig Harms, Jeff Yoder, Lysa Posner, Craig Sullivan, Mac Law, Cliff Swanson, Gregory Lewbart	The important aspects of fish medicine and surgery are covered in this 1-week Selective course for DVM students.	Approx. 20 Graduate Students; No Dist. Ed.
VMC-991-E-019; Invertebrate Medicine	Spring Semester each year	Drs. Michael Stoskopf, Craig Harms, Dan Dombrowski, Ryan DeVoe, Gregory Lewbart	A review of invertebrate zoology and medicine. This is a 1-credit, 1-week Selective course.	Approx. 20 Graduate Students; No Dist. Ed.

b.) Workshops, continuing education, and other non-credit bearing instruction activities are listed below in Table 3-D3.

Table 3-D3: Non-Degree Credit Instruction

Workshop/Instruction Title	Dates Offered	Instructors	Brief Description of Instruction	Enrollment Figures - Total (On Site/Distance Ed)
Workshop on Dredging Engineering at Texas A&M University	1/11-15/2010	B. Edge - NC State	Presented one hour lecture on Beach Nourishment	48 (48/0)
Workshop on Dredging Engineering at Texas A&M University	1/10-14/2011	B. Edge - NC State	Presented one hour lecture on Beach Nourishment	56 (56/0)
Workshop on Dredging Engineering at Texas A&M University	1/8-13/2012	B. Edge - NC State	Presented one hour lecture on Beach Nourishment	68 (68/0)

c.) Public Service, Outreach and Community Engagement

Faculty outreach and community engagement that directly relate to coastal and marine science are listed below in Table 3-D4.

Table 3-D4. Public Service, Outreach and Community Engagement

Public Service Program	Dates	Personnel Involved	Participants in Program (e.g., K-12 teachers)	Number of Participants
NC Floating Classroom Program (grants from the Burroughs Wellcome Fund, GlaxoSmithKline, etc.)	2008 to present	J. Burkholder, R. Reed, and 5 NC State CAAE staff and graduate students (Morris, Mann, Bunn, Mixson)	8 th and 9 th graders and their teachers from Wayne Co. and Craven Co., focusing on schools in economically depressed areas	More than 5,200 students and 840 teachers
CAAE website - www.ncsu.edu/wq - access to long-term data summaries, real-time data on the mesohaline Neuse Estuary, information and virtual teaching exercises about various topics in aquatic research, etc.	2008-present	R. Reed, C. Kinder, J. Burkholder (NC State CAAE)	General NC citizenry (local/state/federal government agency personnel, state and federal legislators, K-12 and college teachers and their students, fishermen, sailing recreationists, etc.	Well over 100,000: for example, in spring 2011, the CAAE website averaged 3,500-3,800 hits per day
Presentations about water quality issues in North Carolina's estuaries and marine coastal waters	2008-present	J. Burkholder (NC State CAAE)	General citizenry - secondary and high school students and teachers (workshops), college-level students, etc.	~3,800
Service - the CAAE's state-certified Analytical Water Quality Laboratory (low-level nutrients, suspended solids, chlorophyll <i>a</i> , etc.)	2008-present	J. Burkholder, James, Mackenzie, Mann, C. Alexander, B. Alexander, Mixson, Rothenberger (NC State CAAE)	Professors and graduate students in the UNC system, 3 small businesses	~40
Service - the CAAE's Algal Research Laboratory	2008-present	J. Burkholder, Allen, B. Alexander, Mixson, Skelton (NC State CAAE)	NC Ag Extension, various professors and students in the UNC system,	~60

Public Service Program	Dates	Personnel Involved	Participants in Program (e.g., K-12 teachers)	Number of Participants
NC State Park Student Organization	2011	Billy L. Edge – NC State	Freshmen	45
UNC-CSI Field School	10/2/2012	Billy L. Edge – NC State	Seniors	13
Oversee the 4-H Fisheries & Aquatic Resources program and its State Presentations competition	Annually, 1986-present	James A. Rice , NC State	4-H members, ages 9-18	310
Coordinated volunteers from the Student Fisheries Society to address various K-12 classes on aquatic biology and careers in fisheries, judge science fairs, help run the 2011 Blue Heron Ocean Sciences Bowl, and conduct other educational events.	Various	J.A. Rice , Graduate and undergraduate student members of the NC State Student Fisheries Society	K-12 students and teachers, general public	400
Faculty sponsor for the annual NC State Saltwater Sportfishing School at Cape Hatteras	Annually	James A. Rice	Adults from NC and multiple other states	120
Presented an overview of the NC Red Drum Fisheries Management Plan to fishing club members.	2008	James A. Rice	Adult anglers	47
Visitor Satisfaction Survey ~ Outer Banks, North Carolina	6/26/2012	G. Brothers	Community business owners OBX	25
Beaufort County tourism assessment	2/10 – 2/12/2012	G. Brothers and Morais	Community Business owners	20
Nanotechnology Ethics, North Carolina School for Science and Math	10/1/2012	M. Cobb , Jurr (NC State)	High school seniors	40
Durham Science Museum, Science Café: Transgenic Mosquitoes & Society	5/8/2012	M. Cobb , Fred Gould	Community members	70

Public Service Program	Dates	Personnel Involved	Participants in Program (e.g., K-12 teachers)	Number of Participants
Presentations to the Coastal Resource Commission	As invited, generally representing the Science Panel on Coastal Hazards	M.J. Overton	Coastal Resource Commission	Depends on number of members from the public attending the CRC mtgs
NC Aquariums Support	Ongoing	G. Lewbart	See details provided by Dr. Craig Harms in CMAST section	
NMFS Support	Ongoing	G. Lewbart	See details provided by Dr. Craig Harms in CMAST section	
KBSTRRC Support	Ongoing	G. Lewbart	See details provided by Dr. Craig Harms in CMAST section	

d.) Professional Service

Advisory, regulatory and other professional service that CMSF have provided to North Carolina and at the regional / national / international level are listed below in Table 3-D5.

Table 3-D5. CMSF Professional Service

Board or Group Name	Dates	Activity Member Name/Affiliation	Service Provided
NC Marine Fisheries Commission	1992-1997	J. Burkholder (NC State CAAE) - Member-at-large; Chair of the Habitat and Water Quality Committee	Scientific expertise on habitat and water quality issues affecting NC's commercially important marine fisheries
NC Coastal Futures Committee	1993-1994	J. Burkholder (NC State CAAE)	The only scientist on this policy board - provided scientific expertise on various issues affecting coastal aquatic resources

Board or Group Name	Dates	Activity Member Name/Affiliation	Service Provided
Partnership for the Sounds	1993-1995	J. Burkholder (NC State CAAE), Member of the Board of Directors	Expertise on environmental education about coastal resources
Congressional Hearing on Harmful Algae and Human Health - U.S. House of Representatives Committee on Government Reform and Oversight	1997	J. Burkholder (NC State CAAE)	Invited testimony as an expert witness
Congressional Hearing on Fisheries Conservation, Wildlife and Oceans - U.S. House of Representatives Committee on Resources	1997	J. Burkholder (NC State CAAE)	Invited testimony as an expert witness
Congressional Hearing on the Value of Estuaries - U.S. Senate Environment and Public Works Committee	1998	J. Burkholder (NC State CAAE)	Invited testimony as an expert witness
Congressional Hearing on Harmful Algal Blooms - U.S. Senate Committee on Commerce, Science and Transportation	1998	J. Burkholder (NC State CAAE)	Invited testimony as an expert witness
Albemarle-Pamlico National Estuary Program's Science Advisory Committee (STAC)	2008-2009	R. Reed (NC State CAAE) - Water Resources Monitoring Team Leader in 2009	Provided scientific expertise on water resource management issues
American Society of Civil Engineers	10/1/12 - 9/31/15	Billy L. Edge – NC State	Board of Direction - Technical Region Director, Committee on Technical Activities, Vice-chair Coastal Engineering Research Council, Coastal Structures Committee, Task Committee on Flood Safety Protection and Policy
TC 114	5/11 - present	Billy L. Edge – NC State	Develop standards for ocean energy devices
1 st Annual Symposium on Renewable Ocean Energy for North Carolina	5/1/2011	Billy L. Edge – NC State; Nancy M. White – ECU and many other CSI	Two day Symposium with international participation;

Board or Group Name	Dates	Activity Member Name/Affiliation	Service Provided
2 nd Annual Symposium on Renewable Ocean Energy for North Carolina	6/1/2012	Billy L. Edge – NC State; Nancy M. White – ECU and many other CSI	Researchers and international participation (2 day Symposium)
GPUSPH Developers workshop for better numerical tools for designing ocean energy devices	6/1/2012	Billy L. Edge – NC State; Kevin Gamiel – RENCI; Robert A. Dalrymple – Johns Hopkins University	5 day workshop for defining problem statements and coding
International Journal of Ocean Engineering	2008 – continuing	Billy L. Edge – NC State	Associate Editor
Academy of Coastal, Ocean, Port and Navigation Engineers	2008 – 2012	Billy L. Edge – NC State	President and Past President of the Academy
Inland Regional Advisory Committee	1999-2012	James A. Rice , NC State	Advised the NC Marine Fisheries Commission regarding management plans and other fisheries issues.
Northern Advisory Committee	2012 - present	James A. Rice , NC State	Advised the NC Marine Fisheries Commission regarding management plans and other fisheries issues.
Invited participant in the NC Sea-level Rise Risk Management Workshop convened by the NC Division of Emergency Management, , Research Triangle Park, NC	April 2-3, 2009	James A. Rice , NC State	Advise NC Division of Emergency Management on sea-level rise impacts on coastal fisheries and fisheries habitat.
NC State representative on the Science Coordinating Committee for the Coastal Studies Institute in Manteo, NC	2008-2010	James A. Rice , NC State University	Advise CSI Director re science program development.
Member, North Carolina Fish Consumption Advisory Ad Hoc Working Group, NC Division of Public Health	2010 - present	James A. Rice , NC State University	Advise the NC Division of Public Health regarding potential revisions of NC mercury consumption advisories
Governor's Scientific Advisory Panel on Offshore Energy	2011-2012	M.J. Overton	Panel member

Board or Group Name	Dates	Activity Member Name/Affiliation	Service Provided
NC Science Panel on Coastal Hazards	Member 1997 - ongoing; Chair 2005-ongoing	M.J. Overton	Member and Chair
UNC Coastal Studies Institute Board of Directors	2012-ongoing	M.J. Overton	Ex-officio member

E. Coastal & Marine Science Outputs and Impacts

1. Publications

a.) Selected CMSF refereed publications for the period January 1, 2008 – present are listed below.

1. Eutrophication and harmful algal blooms: A scientific consensus. 2008. Heisler, J.; Glibert, P. M.; **Burkholder, J. M.**; Anderson, D. M.; Cochlan, W.; Dennison, W. C.; Dortch, Q.; Gobler, C. J.; Heil, C. A.; Humphries, E.; Lewitus, A.; Magnien, R.; Marshall, H. G.; Sellner, K.; Stockwell, D. A.; Stoecker, D. K.; Suddleson, M., *HARMFUL ALGAE*, v.8, pp. 3-13. DOI 10.1016/j.hal.2008.08.006
2. Mixotrophy, a major mode of nutrition for harmful algal species in eutrophic waters. 2008. **Burkholder, Joann M.**; Glibert, Patricia M.; Skelton, Hayley M., *HARMFUL ALGAE*, v. 8, pp. 77-93. DOI 10.1016/j.hal.2008.08.010
3. An Empirical Model to Estimate the Impact of Overwash. 2011. Park, Young H. and **Billy L. Edge**. *Journal of Coastal Research*, Vol. 26, No. 6, pp. 1049-1059.
4. Harmful algal blooms and eutrophication: Examining linkages from selected coastal regions of the United States. 2008. Anderson, Donald M.; **Burkholder, Joann M.**; Cochlan, William P.; Glibert, Patricia M.; Gobler, Christopher J.; Heil, Cynthia A.; Kudela, Raphael M.; Parsons, Michael L.; Rensel, J. E. Jack; Townsend, David W.; Trainer, Vera L.; Vargo, Gabriel A., *HARMFUL ALGAE* v. 8, pp. 39-53. DOI 10.1016/j.hal.2008.08.017
5. Climate change and food safety: A review. 2010. Tirado, M. C.; Clarke, R.; **Jaykus, L. A.**; McQuatters-Gollop, A.; Franke, J. M., *FOOD RESEARCH INTERNATIONAL*, v. 43, pp.1745-1765. DOI 10.1016/j.foodres.2010.07.003
6. Determination of molecular phylogenetics of *Vibrio parahaemolyticus* strains by multilocus sequence typing. 2008. Gonzalez-Escalona, Narjol; Martinez-Urtaza, Jaime; Romero, Jaime; Espejo, Romilio T.; **Jaykus, Lee-Ann**; DePaola, Angelo, *JOURNAL OF BACTERIOLOGY*, v. 190, pp.2831-2840. DOI 10.1128/JB.01808-07
7. Selection, characterization, and application of DNA aptamers for the capture and detection of *Salmonella enterica* serovars. 2009. Joshi, Raghavendra; Janagama, Harish; Dwivedi, Hari P.; Kumar, T. M. A. Senthil; **Jaykus, Lee-Ann**; Schefers, Jeremy; Sreevatsan, Srinand, *MOLECULAR AND CELLULAR PROBES*, v. 23, pp. 20-28. DOI 10.1016/j.mcp.2008.10.006
8. Gender-specific expression of multiple estrogen receptors, growth hormone receptors, insulin-like growth factors and vitellogenins, and effects of 17 beta-estradiol in the male tilapia (*Oreochromis mossambicus*). 2008. Davis, Lori K.; Pierce, Andrew L.; Hiramatsu, Naoshi; **Sullivan, Craig V.**; Hirano, Tetsuya; Grau, E. Gordon, *GENERAL AND COMPARATIVE ENDOCRINOLOGY*, v. 156, pp. 544-551. DOI 10.1016/j.ygcen.2008.03.002

9. Detection of pathogens in foods: the current state-of-the-art and future directions. 2011. Dwivedi, Hari P.; **Jaykus, Lee-Ann**, *CRITICAL REVIEWS IN MICROBIOLOGY*, v. 37, pp. 40-63. DOI 10.1186/1471-2164-9-345
10. Sex determination in flatfishes: Mechanisms and environmental influences. 2009. Luckenbach, J. Adam; Borski, Russell J.; **Daniels, Harry V.**; Godwin, John, *SEMINARS IN CELL & DEVELOPMENTAL BIOLOGY*, v. 20, pp. 256-263. DOI 10.1016/j.semcd.2008.12.002
11. Potential transport of harmful algae via relocation of bivalve molluscs. 2008. Hegaret, Helene; Shumway, Sandra E.; Wikfors, Gary H.; Pate, Susan; **Burkholder, Joann M.**, *MARINE ECOLOGY-PROGRESS SERIES*, v. 361, pp. 169-179. DOI 10.3354/meps07375
12. Nitrogen limitation increases brevetoxins in *Karenia brevis* (dinophyceae): implications for bloom toxicity. 2012. Hardison, D. R., Sunda, W. G., Litaker, R. W., **Shea, D.**, & Tester, P. A., *JOURNAL OF PHYCOLOGY*, v. 48, pp. 844-858.
13. Grazing by *Karenia brevis* on *Synechococcus* enhances its growth rate and may help to sustain blooms. 2009. Glibert, Patricia M.; **Burkholder, JoAnn M.**; Kana, Todd M.; Alexander, Jeffrey; Skelton, Hayley; Shilling, Carol , *AQUATIC MICROBIAL ECOLOGY*, v. 55, pp. 17-30. DOI 10.3354/ame01279
14. Detection of spring viraemia of carp virus (SVCV) by loop-mediated isothermal amplification (LAMP) in koi carp, *Cyprinus carpio*. 2008. Shivappa, R. B.; Savan, R.; Kono, T.; Sakai, M.; Emmenegger, E.; Kurath, G.; **Levine, J. F.**, *JOURNAL OF FISH DISEASES*, v. 31, pp. 249-258. DOI 10.1111/j.1365-2761.2007.00894.x
15. Rapid and sensitive detection of hepatitis A virus in representative food matrices. 2008. Papafragkou, Efstathia; Plante, Michelle; Mattison, Kirsten; Bidawid, Sabah; Karthikeyan, Kalavethi; Farber, Jeffrey M.; **Jaykus, Lee-Ann**, *JOURNAL OF VIROLOGICAL METHODS*, v. 147, pp. 177-187. DOI 10.1016/j.jviromet.2007.08.024
16. Sustaining Visitor Use in Protected Areas: Future Opportunities in Recreation Ecology Research Based on the USA Experience, 2010. Monz, Christopher A.; Cole, David N.; **Leung, Yu-Fai**; Marion, Jeffrey L., *ENVIRONMENTAL MANAGEMENT*, v. 45, pp. 551-562. DOI 10.1007/s00267-009-9406-5
17. Detection of Gram-Negative Histamine-Producing Bacteria in Fish: A Comparative Study, 2009. Bjornsdottir, Kristin; Bolton, Gregory E.; McClellan-Green, Patricia D.; **Jaykus, Lee-Ann**; Green, David P., *JOURNAL OF FOOD PROTECTION*, v. 72, pp. 1987-1991.
18. Ecological Stoichiometry, Biogeochemical Cycling, Invasive Species, and Aquatic Food Webs: San Francisco Estuary and Comparative Systems, 2011. Glibert, Patricia M.; Fullerton, David; **Burkholder, Joann M.**; Cornwell, Jeffrey C.; Kana, Todd M., *REVIEWS IN FISHERIES SCIENCE*, v. 19, pp. 358-417. DOI 10.1080/10641262.2011.611916
19. Nutrient enrichment and fisheries exploitation: interactive effects on estuarine living resources and their management. 2009. Breitbart, D. L.; Craig, J. K.; Fulford, R. S.; Rose, K. A.; Boynton, W. R.; Brady, D. C.; Ciotti, B. J.; Diaz, R. J.; Friedland, K. D.; Hagy, J. D., III; Hart, D. R.; Hines, A. H.; Houde, E. D.; Kolesar, S. E.; Nixon, S. W.; **Rice, J. A.**; Secor, D. H.; Targett, T. E., *HYDROBIOLOGIA*, v. 629, pp. 31-47. DOI 10.1007/s10750-009-9762-4
20. The effects of interdune vegetation changes on eolian dune field evolution: a numerical-modeling case study at Jockey's Ridge, North Carolina, USA. 2009. Pelletier, Jon D.; **Mitasova, Helena**; Harmon, Russell S.; **Overton, Margery**, *EARTH SURFACE PROCESSES AND LANDFORMS*, v. 34, pp. 1245-1254. DOI 10.1002/esp.1809

b.) Selected CMSF non-refereed publications for the period January 1, 2008 – present are listed below.

1. United States Department of Environmental Protection (U.S. EPA) (2011) Efficacy of Ballast Water Treatment Systems: A Report by the EPA Science Advisory Board (SAB). U.S. EPA SAB Ecological Processes and Effects Committee Augmented for the Ballast Water Advisory. Report #EPA-SAB-11-009. U.S. EPA, Washington, DC, ~150 pp. **J. Burkholder** was an Augmented Panel Member and a coauthor of this report.
2. **Burkholder J**, Glasgow H, Deamer N, Melia G, Litzenberger T (2003) Response of *Pfiesteria piscicida*, Microbial Predators and Prey, and Fish to Common Dithiocarbamate Fungicides and Heavy Metals. Final Report to the U.S. EPA, Research Triangle Park, NC, 26 pp. + appendix.
3. **Burkholder JM**, Glasgow HB, Rublee PA, Shumway SE (2001) The Toxic Dinoflagellate, *Pfiesteria*, as a Potential Biosensor of Estuarine Stress. Final Report to the U.S. EPA, Washington, DC, 108 pp.
4. van der Schalie WH, Shedd T, Widder M, Kane AS, Reimschuessel R, Sarabun J, **Burkholder J**, Glasgow H (2001) Real-Time Monitoring for Toxicity Caused by Harmful Algal Blooms and Other Water Quality Perturbations. Report EPA/600/R-01/103, U.S. EPA, Washington, DC.
5. **Burkholder JM**, Glasgow HB (1999) Neuse Estuary Biomonitoring Study, with Additional Information on Overall Nutrient Loading to the Mesohaline Estuary. Final Report to the U.S. Marine Air Station – Cherry Point. Department of Botany, NCSU, Raleigh, 134 pp.
6. Van Ledden, M., J. Lansen, H. De Ridder, **B. Edge**, Reconnaissance level study Mississippi storm surge barrier, *Proceedings of the International Conference on Coastal Engineering*, (33), Santander, 2012.
7. **Edge, B.L.**, Overton, M. F., , R. A. Dalrymple, A. Hérault, G. Bilotta, M. Onur Kurum, Application of GPU smooth particle hydrodynamics: wave run-up and overtopping on composite slopes, *Proceedings of the International Conference on Coastal Engineering*, (33), Santander, 2012.
8. M.O. Kurum, H. Mitsova, **B. L. Edge**, and M.F. Overton. Effects of coastal landform changes on storm surge along the Hatteras island breach area. *Proceedings of the International Conference on Coastal Engineering*, (32), 2010.
9. **Billy L Edge**, Lesley Ewing, Robert G Dean, James M Kaihatu, Margery F Overton, Spencer M Rogers, Paul A Work, Immediate Impacts of Hurricane Ike on the Texas Coast, *Proceedings of the International Conference on Coastal Engineering*, (32), 2010.
10. **Edge, B.L.** and P.J. Lynett, “Mitigation for Storm Surge and Tsunami Impacts in the United States,” *Proceedings of the 6th International Workshop on Coastal Disaster Prevention*,” Bangkok, 2009.
11. **Edge, B.L.**, R. McPherson and O. Cruz-Castro, “Experimental Study of Wave Forces on Bridge Decks,” *Proceedings 31st International Conference on Coastal Engineering*, Hamburg, World Scientific, 2008.
12. Magoon, O.T., D.D. Treadwell, **B.L. Edge**, “Lost Jetty of California’s Russian River,” *Proceedings 31st International Conference on Coastal Engineering*, Hamburg, World Scientific, 2008. Irish, J.L., A. Frey, M.E. Mousavi, F. Olivera, B.L. Edge, J. Kaihatu, “Predicting the Influence of Climate Change on Hurricane Flooding,” *Proceedings 31st International Conference on Coastal Engineering*, Hamburg, World Scientific, 2008.
13. Cruz-Castro, O., **B.L. Edge**, and L. Romijnders, “Active Absorption of Waves in a 3D Basin “, *Proceedings of Deepwater Offshore technology Symposium*, Shanghai, China, Nov. 2008.

14. **Cobb, Michael D.** 2013. "Deliberative Fears: Citizen Deliberation about Science in a National Consensus Conference." In Kieran O'Doherty and Edna Einsiedel (Eds.), *Thinking through technology with publics*. University of British Columbia Press.
15. **Cobb, Michael D.** and Mark T. Nance. 2011. "The Consequences of Measuring Non-Attitudes about Foreign Trade Preferences." *Survey Practice*, December: www.surveypractice.org.
16. Toumey, C., J. Besley, M. Blanchard, M. Brown, **M. Cobb**, E.H. Ecklund, M. Glass, T.M. Guterbock, A.E. Kelly, & B. Lewenstein. 2010. "Science in the Service of Citizens & Consumers: The NSF Workshop on Public Knowledge of Science." Report to NSF, 4 November 2010. Last retrieved at <http://nano.sc.edu/resources/publications.aspx>
17. Kurum, M. O., Mitsova, H. and **M. Overton**, 2011. Geospatial techniques to derive short term dynamics of coastal morphology, Coastal Sediments '11, Miami, Florida.
18. Kurum, M. O., H. Mitsova, **M. Overton** 2012. "The influence of antecedent conditions and geologic framework on post-storm coastal morphology", 33rd International Conference on Coastal Engineering, Santander, Spain.
19. **Overton, M.**, B. Edge, R. A. Dalrymple, A. Herault, G. Bilotta and M. O. Kurum, 2012. "Application of GPU Smooth Particle Hydrodynamics: Wave Runup and Overtopping on Composite Slopes", 33rd International Conference on Coastal Engineering, Santander, Spain.
20. **Lewbart GA.** (ed.). *Invertebrate Medicine*, 2nd Ed., Oxford, UK: Wiley-Blackwell Publishing, 2012, 488 pp.

2. Technical Outputs

Technical outputs of CMSF activities, (e.g., CDs, software programs, databases, algorithms, and measurement instruments) are listed below.

Automated platforms: NC State CAAE scientists partnered with CCC (Morehead City, NC) and the South Carolina Algal Ecology Lab (AEL – photos at right) at Kiawah Island. The AEL represents a multi-institutional collaboration of the SC Department of Health and Environmental Control, SC Sea Grant Consortium, NOAA, USC, the USDA Forest Service, the College of Charleston, and the Medical University of South Carolina. The AEL has provided statewide information on harmful algal blooms, including background environmental conditions from by the real-time remote monitoring platform (RTRM) that the CAAE installed for the AEL. **J. Burkholder and R. Reed researchers.**

Fish sentinels as water quality biomonitors - The Legacy Project was a partnership between the U.S. Army Center for Environmental Health Research and the CAAE, wherein the CAAE designed and tested a prototype automated fish biomonitor system for early warning of toxic hazards in surface waters used by the military for potable supplies. The "fish sentinels" respond to a broad spectrum of contaminants, and the biomonitor system evaluates changing water quality conditions using fish physiological responses. Computer-monitored endpoints include fish movement, ventilatory rate and depth, and cough rate, together with water quality parameters (DO, pH, temperature, conductivity/salinity, redox, and water level). Once the prototype design, deployment, and testing were completed by the CAAE in the Neuse Estuary, the Army constructed additional biomonitoring systems for strategic placement to provide unique continuous, real-time fish behavioral toxicity data for tracking pollutant spills and contaminant dispersal. This technology can also be used more generally in surface waters wherever there are concerns about toxic pollutants. **J. Burkholder and R. Reed researchers.**

UNC-CSI is a partner in the development of smooth particle hydrodynamics code (**Dr. Billy Edge** oversees the effort) that operates on the fast and economical graphical processor units (GPU's) available on most high end workstations. The code is developed on CSI's behalf to provide better design tools for renewable ocean energy devices. The international group working with CSI includes:

- **Alexis Hérault**, Istituto de Nazionale di Geofisica e Vulcanologia, Sezione di Catania, Catania, Italy and National des Arts et Métiers, Paris, France - Original C++ and GPU programming
- **Giuseppe Bilotta**, Dipartimento di Matematica e Informatica, Università degli Studi di Catania - Original C++ and GPU programming
- **Robert A. Dalrymple**, Department of Civil Engineering, Johns Hopkins University, Baltimore, MD - Applications

3. *Commercialization and Technology Transfer*

Examples of commercialization and technology transfer to private or governmental entities are listed below.

- U.S. Patent #7,040,157. “Variable depth automated dynamic water profiler,” **R. Reed (CAAE)**, H. Glasgow, **J. Burkholder (CAAE)**, F. Toms, May 2006.

This invention enables automated water quality monitoring systems to take profiles of conditions throughout an entire water column, 24/7. The invention has provided the university with income and national/international recognition for innovation in water resource protection. The license for this technology was sold to YSI, Inc., the leading environmental equipment manufacturer in the U.S., and is currently commercially available (see Appendix A - letter from Mr. R. Ellison). The reservoir profiler systems have generated recurring funds for services from the Cities of Raleigh and High Point, and provide water treatment plant personnel with the information in near-real time that enables them to make daily decisions about water treatment processes, which in turn gives savings in operational costs.

- Dr. Jonathan Bird, a UNCC researcher working under the direction of Dr. Billy Edge on the Ocean Energy Program has prepared and submitted two patents:
 - Bird J., Flux Focusing Magnetic Gear, Application number 61/542,335, Filing date 10/03/2011.
 - Bird J., A Continuously Variable Magnetic Gear, Application number unknown.

4. *Awards and Honors*

Awards and honors conferred to faculty, staff, and students as a result of their participation in the coastal and marine science activities are listed below in Table 3-E1.

Table 3-E1. CMSF Awards and Honors

Name of Award or Honor	Date	Personnel Receiving the Award	Brief Description
J. Compton River Achievement Award (from River Network)	2008	J. Burkholder (NC State CAAE)	Lifetime achievement for leadership to advance water quality protection, based on work in the Neuse Estuary
William Neal Reynolds Distinguished Professor	2008	J. Burkholder (NC State CAAE)	Endowed professorship honoring excellence in research on estuarine microorganisms

Name of Award or Honor	Date	Personnel Receiving the Award	Brief Description
Project Manager, Advanced Energy and NC Sustainable Building Design Competition	2008	Dixon (NC State CAAE student research intern)	Innovative expertise in “green” building design
Best Ph.D. Dissertation of the Year (from the NC State Graduate School)	2008	Rothenberger (NC State CAAE)	For her dissertation entitled, “Long-Term Impacts of Changing Land Use Practices on Water Quality and Phytoplankton Assemblages in the Neuse Estuary Ecosystem, North Carolina”
Hollings Scholarship for Undergraduate Study (from NOAA)	2008	Williams (NC State CAAE undergraduate)	In recognition of scholastic achievement
Member, Golden Key Honor Society	2009	Bunn (NC State CAAE undergraduate)	For scholastic achievement
Borlaug Joint Award for Service to the Environment and Society (from the College of Agriculture and Life Sciences, and the College of Natural Resources at NC State)	2009	J. Burkholder (NC State CAAE)	For efforts to protect and conserve estuaries and marine coastal resources
Grant from the Lindburgh Foundation	2010	Mixson (doctoral candidate, NC State CAAE)	For dissertation research on use of marine microalgae for sustainable biofuel
Featured in the NC State CALS’ “Perspective On Line”	2010	San Miguel (NC State CAAE undergraduate research intern)	“In His Words: CALS student Bobby San Miguel Making Tracks Toward Career in Research and Teaching”
Selected participant in the National Student Exchange at Oregon State University	2011	San Miguel (")	Took advanced courses in marine sciences as part of this program
Member, NC State Honors Program	2008-2011	San Miguel (")	For scholastic achievement
Member, CALS Honors Program	2010-2011	San Miguel (")	For scholastic achievement

Name of Award or Honor	Date	Personnel Receiving the Award	Brief Description
Environmental Scholarship Award (from the Alliance of Hazardous Materials Professionals)	2011	Forbes (NC State CAAE undergraduate)	For scholastic achievement
Distinguished Member of ASCE	10/9/2012	Billy L. Edge - NC State	Highest level of distinction awarded to less than 5 % of 140,000 civil engineering
CALS Kenneth Keller Award for Excellence in Doctoral Dissertation Research.	2009	James Morris (PhD student co-advised by James A. Rice , NC State, and Jeff Govoni, NOAA Center for Coastal Fisheries and Habitat Research	Award recognizing the most outstanding dissertation in the NC State College of Agriculture and Life Sciences, presented to James Morris for his dissertation entitled “The Biology and Ecology of the Invasive Indo-Pacific Lionfish”
National Ocean Service Employee of the year	2010	James Morris (PhD student co-advised by James A. Rice , NC State, and Jeff Govoni, NOAA Center for Coastal Fisheries and Habitat Research	Presented in recognition of the impact of his dissertation research on invasive lionfish.
GAANN Biotechnology Graduate Fellowship	2008-2010	Lindsay Glass (PhD student advised by James A. Rice , NC State)	Competitive national fellowship (Graduate Assistance in Areas of National Need) presented for biotechnology research, as part of her dissertation work on effects of hypoxia on growth of juvenile estuary-dependent fishes.
Governor’s Conservation Achievement Award, Water Conservationist of the Year	2011	Joseph Hightower	

Name of Award or Honor	Date	Personnel Receiving the Award	Brief Description
William Medway Award for Excellence in Teaching	April, 2012	Gregory A. Lewbart	Awarded by the International Association for Aquatic Animal Medicine

F. Coastal & Marine Science Faculty – Supplemental Information

It is important to recognize that the **Sustainable Coastal Engineering and Ocean Energy Program (Dr. Billy Edge of NC State, Leader)** directly supports the UNC-CSI mission. Below is a description of how the UNC mission is being met:

1. *Provide facility support for research and educational efforts in the NE;*
 - a. Through the Ocean Energy program we have been able to add support to the facilities at CSI including oceanographic instruments, computing facilities, and oceanographic access to the pier.
 - b. Access to the pier for research also allows access for education – both academic and for the public through displays and special programs.
 - c. Support is also being provided to support growth of the intellectual capacity of the CSI staff via conferences, meetings and networking.
2. *Provide a facility and administrative construct to support inter-institutional and inter disciplinary research, education, and public service programming;*
 - a. Through the ocean energy program, we are directly providing inter-institutional and interdisciplinary activities in research, education and public service programming.
 - b. Fortunately the ocean energy program provides an excellent opportunity for CSI to reach across university campuses and disciplines.
 - c. For example of public service, we create and publish video from topics as varied as coastal processes to harvesting energy from the ocean.
3. *Serve as a portal for the public to access university assets + to facilitate and conduct place-based research + educational programming;*
4. *Develop academic programming in the areas of coastal processes, engineering, estuarine ecology and human health, maritime heritage, and public policy in partnership with NC State, ECU, UNC CH, ECSU, and UNCW.*
 - a. Initially we have worked with the coastal engineering academic infrastructure at NC State in the Civil Engineering program. This provided the students a classroom setting at NC State and a field opportunity at CSI with its faculty and its facilities.
 - b. We are continuing to develop academic programming via distance and on-site for coastal engineering, sustainability and ocean energy related curricula.
5. *Partner with and serve as a resource to state / federal/ local agencies/ governments / communities.*
 - a. Development of the wave atlas off the coast of North Carolina using the 20-year hindcast provided the opportunity to partner with RENCi and the US Army Corps of Engineers. This has been a rewarding partnership with products that will be especially helpful to those involved with coastal processes, wave analysis, offshore wind farms and marine hydrokinetic energy.
 - b. We are also partnering with other marine facilities including NOAA, Sea Grant and the US Geologic Survey. For example this partnership has led to the deployment of numerous wave and storm surge gages along the outer banks by CSI personnel for each hurricane that appeared imminent during the three previous hurricane seasons.