



East Carolina University

Coastal Activities

ECU Self-Study
Submitted to Dr. Chris Brown
VP for Research and Graduate Studies
University of North Carolina
November 1, 2012

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I. Overview of ECU's Coastal Activities

East Carolina University has been focused on disciplinary and interdisciplinary coastal research since the 1960s. Our emphasis always has been on the coasts as the interface between land and ocean. We have long considered research, engagement, and creative activities focused on the Inner and Outer Banks as an opportunity and a responsibility. North Carolina's human population increased by 18 percent from 2000 to 2010, and growth in the 20 coastal counties has kept pace with 10 percent of the state's resident population, and greatly exceeding that percentage during every summer season. Humans are drawn to the coast, and ECU's commitment to strong social and natural sciences has been in place since ECU established the Institute for Coastal and Marine Resources (ICMR) in 1973. Other examples of strong coastal commitments include the Department of History's Program in Maritime Studies, established in 1981, and the long line of excellent faculty committed to understanding coasts, wetlands, and the atmosphere within the Departments of Biology, Geological Sciences, and Geography. To help forge stronger connections, ECU founded a Coastal Maritime Council (CMC) in 2004 to serve as a venue to synergistically combine Departmental and Institute/Center activities.

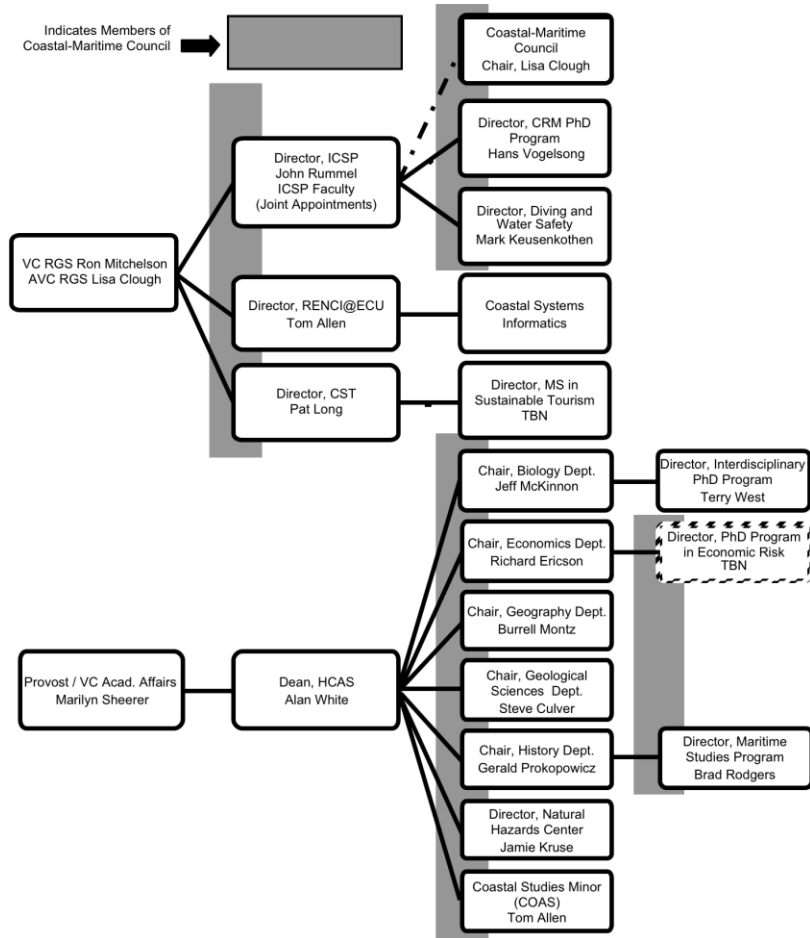
East Carolina has offered training in the coastal sciences at the MA and MS levels for many years. The primary coastal PhD program at ECU, the Coastal Resources Management (CRM) PhD, welcomed its first class in 1999 with tracks in Coastal Ecology, Coastal Geology, Coastal Social Sciences, and Maritime History. Each CRM student takes classwork in multiple subjects, completes an internship, and produces a dissertation with interdisciplinary and/or applied implications, remaining true to ECU's commitment to interdisciplinary coastal research. Broadening ICMR's scope of work was necessary to support the CRM degree, and a plan to grow ICMR into a larger Institute was put forth. The Institute for Coastal Science and Policy (ICSP) was officially established in 2006 to include ICMR, the CRM PhD, and the Office of Diving and Water Safety. The scope of ICSP has continued to grow, and it now includes faculty with expertise in coastal geological sciences, geography, recreation and leisure studies, engineering, and economics, in addition to the original ICMR strengths in ecology and the social science.

The three current ECU programs dedicated to coastal activities have been correctly identified in the UNC-GA Coastal and Marine review (ICSP, the CRM PhD, and the Maritime Studies MA), and we are happy to present an inventory of their activities in the subsequent sections. In addition, several other Centers, Programs, and Departments at ECU have significant coastal components, and we have chosen to include two additional chapters with a subset of the requested information: 1) related Centers and Programs and 2) related Departments. The Centers and Programs chapter includes: A. the proposed PhD Program in Economic Risk housed within the Department of Economics that has strong ties to the Center for Natural Hazards Research; B. the RENCI@ECU program that is currently winding down, but its affiliated faculty will continue to have strong coastal ties; and C. components of the Center for Sustainable Tourism. The Departments chapter includes: A. Geological Sciences, B. Biology, and C. Geography and the coastal studies (COAS) minor. Please note that additional departments across campus have faculty with expertise in coastal research, and we feel the review committee will get a flavor for some of this activity as you review the CRM PhD Program and the contributions of its graduate faculty. Synergistic partnerships between CRM, ICSP, the other interdisciplinary centers, and

the departments, have catalyzed both disciplinary and interdisciplinary coastal research across both ECU campuses (Main and Health Sciences).

East Carolina University's comprehensive mission statement is "**To serve as a national model for public service and regional transformation** by: 1) Preparing our students to compete and succeed in the global economy and multicultural society; 2) Distinguishing ourselves by the ability to train and prepare leaders; 3) Creating a strong, sustainable future for eastern North Carolina through education, research, innovation, investment, and outreach; 4) Saving lives, curing diseases, and positively transforming health and health care; and 5) Providing cultural enrichment and powerful inspiration as we work to sustain and improve quality of life." ECU views the coast, particularly the northeastern Outer and Inner Banks (OBX and IBX) as part of the "Pirate Nation", and we are committed to engaging with the OBX and IBX areas in many different ways. While traditional coastal research emerges most clearly in "...sustainable future for eastern NC through education, research...", our interdisciplinary tradition includes a role for coastal research in every one of the processes called out in the statement. Our NC coasts are certainly multicultural, and ECU researchers are conducting engaged research in many of our coastal counties; our leadership training is offered across all departments and programs including coastal constituencies; we see the coastal ties to health increasing via Public Health and outreach clinics that can serve as locations for place-based research not yet explored. In sum, we see partnering with our coastal communities as a local source of cultural enrichment and powerful inspiration for the University community to learn from and to give back to. Given our history and capacity, we look forward to partnering with the coastal communities, especially those in Northeastern North Carolina, in many different ways for years to come.

The organizational chart that follows will look different next year as a result of internal ECU restructuring. The Program Prioritization Committee (PPC) recommended in April 2012 that all Centers and Institutes be moved out of the Division of Research and Graduate Studies (RGS) after an appropriate incubation period. Thus ICSP, CRM, CST, and RENCI@ECU will soon have new administrative homes. The range of options is wide. Perhaps the units will retain their current structure, but report to Colleges, or perhaps all the coastal units will be combined into a single School. A recommendation from a faculty committee on the future of ECU's coastal entities, a first step in the process, is due by mid-December, so we will be able to provide an update on our plans during the site visit. Regardless of the outcome, ECU is committed to elevating coastal instruction, research, and outreach for years to come. As an example, a team of ECU geological scientists has recently published a book entitled "*The Battle for North Carolina's Coast: Evolutionary History, Present Crisis, and Vision for the Future*". Such a vision requires continued disciplinary, interdisciplinary, and engaged research for regional success. ECU faculty and community partners see the vision as a blueprint for future research. The North Carolina coast is already an amazingly dynamic region, and the propensity for change will only accelerate because of climate change and human adaptation to that change. The State needs the interdisciplinary knowledge base found in its University faculty, and the foresight needed to pair its faculty with local populations to enable a sustainable future for NC in this time of extraordinary change. ECU's commitment to interdisciplinary, coastal, and engaged research has positioned us to be a key player in meeting the future needs of North Carolina, both in terms of responding directly, and in terms of producing the future workforce needed. The maxima of sea-level rise projections are on the order of one meter by 2100. While this is a disconcerting number, it is also a call to arms for coastal researchers. ECU will respond to that challenge.



ECU's coastal activities currently fall under two different Divisions, Academic Affairs and Research and Graduate Studies. As mentioned, we expect all activities to be housed within Academic Affairs by the 13/14 academic year, thus moving the reporting lines for the Directors (ICSP, CST, RENCi@ECU) to the Provost. The other acronym within the Org Chart is CMC, which is the Coastal Maritime Council. The CMC is an internal advisory group charged with 1) serving as a venue for coastal information to be shared across campus and 2) providing advice to the ICSP Director. CMC includes nine *ad hoc* members, plus the chairs, directors, or their representatives from eight Departments within Arts and Sciences, four Departments housed within other Colleges (Brody School of

Medicine, Health and Human Performance, Technology and Computer Science, and Business), and from affiliated Centers already mentioned (Hazards, RENCi@ECU, Maritime, and the Center for Sustainable Tourism).

Missing relationships not represented within our organizational chart include strong ties to the UNC Coastal Studies Institute (CSI) and the Duke UNC Oceanographic Consortium (DUNCOC). ECU has four faculty serving as program heads for CSI: Andy Keeler heads the Sustainability Program, and his position is funded by both CSI and ECU; Nathan Richards is the program head for Maritime Studies; and Reide Corbett and JP Walsh are currently sharing the interim program head position in Coastal Processes, with funding for their position currently from ECU. ECU is also designated as the lead institution for support of CSI, including running most administrative and operational tasks through ECU. We look forward to the CSI/ECU collaboration continuing to thrive over the years, especially as the new facilities come on line. DUNCOC is a much broader collaboration that was originally formed with very close ties to the R/V CAPE HATTERAS. It has evolved over the years to include annual meetings, advisory and executive boards, and a very valuable (but informal) venue enabling oceanographers across the state to get to know one another. ECU typically has had strong representation at the annual meetings, and has always had at least two faculty/administrators on the DUNCOC boards. With our internal ECU emphasis on interdisciplinary coastal activities, DUNCOC has served as a critical venue for ECU faculty to network with our more oceanographically-focused colleagues.

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A1. Institute for Coastal Science and Policy (ICSP)

B1. ICSP Narrative

The ICSP Mission and History

The Institute for Coastal Science and Policy (ICSP) was founded to achieve and maintain a regional, national, and international reputation for excellence in interdisciplinary and multidisciplinary coastal research and education, providing for the integration of natural and social sciences, innovations in theory and application, and contributions to economic development, human health, safety, and welfare. ICSP was established in 2006-2007 by combining the previous Institute for Coastal and Marine Resources (ICMR; founded in 1973) with the Coastal Resources Management PhD Program (CRM; founded in 1999) and ECU's Diving and Water Safety Office (DWS; founded in 2000). In the view of its founders, who included the members of ECU's Coastal Maritime Council (CMC; founded in 2004), ICSP is intended, in part, to conduct interdisciplinary research to enhance understanding of the complex interactions between human behavior and the marine environment and its resources, and to draw on that understanding to develop and influence sound public policy options. Through the CRM PhD program, ICSP trains and prepares tomorrow's leaders—but strives to engender economic prosperity, today, by working to create a strong and sustainable future for eastern North Carolina through education, innovation, investment, and outreach. The Institute shares faculty with academic departments at ECU, providing support for inter- and multidisciplinary research projects and educational programs across the university and in cooperation with other UNC campuses and institutions.

Coastal Systems, Complex Science—The Need for an Interdisciplinary Approach

Scientific and policy issues regarding coastal systems are complex. More and more of the US population is moving closer to the coasts, contributing stressors that affect these systems from both the biophysical and social perspectives. The impacts of natural disasters such as hurricanes and floods result from the interplay of human decisions and physical phenomena. Similarly, anthropogenic disasters, such as oil spills, coastal land use, shoreline modification, and the overuse of available water resources, can be profoundly shaped by the interplay of powerful physical and social forces. Understanding and managing these issues requires objectivity and openness with strong science guiding management decisions.

Obstacles to understanding and adapting to these coastal changes are pervasive. Specific information about the climate and the oceans' responses to anthropogenic effects have become politically charged, leading to misinformation and confusion as to the role of humans in these processes (e.g., the recent Frontline program: <http://www.pbs.org/wgbh/pages/frontline/climate-of-doubt/>). Overall, adaptation to ongoing coastal processes (e.g., sea-level rise, erosion, flooding) is as much about human interactions as it is about the specific physical process dynamics. For example, dramatic sea-level rise is seen when using an extremely long baseline (~18,000 years since the peak of the last major ice age), but until recently the public's perception is that the rise is, and will continue to be, gradual over time. Because of the economic and cultural implications of a now accelerating rise in sea-level, there is considerable pressure to resist any policy that incorporates the "new normal". Accordingly, denial of the scale and inevitability of sea-level rise projections continues to be an issue for North Carolina [and other coastal states]. Elsewhere, other major changes are taking place in the ocean realm. For

example, the opening of the ice-free zone of the Arctic Ocean during the extended summer season is unprecedented in human history, with implications for trade, resource development, and economic development, as well as having great military significance.

Significant impact(s) of the program on research, education, and/or society (including direct contributions to policy or management decisions) since January 1, 2008.

The Institute has seen significant growth in recent years. In January 2008, the Institute had a total of 10 faculty representing four departments—and only two were social scientists. The Institute is now comprised of 20 faculty, 12 faculty whose primary expertise is in the natural sciences, and 8 faculty with primary expertise in the social sciences. These faculty represent eight different departments from three different colleges at ECU: the Harriot College of Arts and Sciences; the College of Health and Human Performance; and the College of Technology and Computer Sciences; as well as contributing to ECU's new Honors College. Along with the Coastal Maritime Council, these partnerships have strengthened the ties among the various coastal activities at ECU, and have engendered cooperative activities across the entire gamut of academic disciplines within the university.

The Institute has had good success with return-on-investment, with active faculty winning research grants individually and in partnerships across ECU and campuses worldwide. Currently, the ICSP grant portfolio for awards active on November 1, 2012 totals over \$6.6M, yielding a mean annual value of external grants awarded to ICSP investigators of approximately \$100,000/investigator. Future efforts will be focused on increasing this multiplier, and generating broader collaborations within ICSP and between ICSP and other ECU faculty.

Interdisciplinary research can play a major role in reshaping ideas of how humans live along the coast. For example, several of the CRM student projects described in the CRM section combine the social and natural sciences, including several with policy implications. Within the faculty, a team of natural and social scientists from ICSP (and Biology) have had two large projects that combined both traditional and scientific ecological knowledge (TEK and SEK respectively) in Core Sound, North Carolina and Kotzebue, Alaska. In each case the team worked extensively with local stakeholders (NC DMF and the Native Village of Kotzebue) to identify and then research problems of practical and academic interest. In both cases, multiple graduate students were included, and significant community outreach was provided, including a Sea Grant published book in the case of the Alaska project. For the Alaska project we were able to determine that the possibly decadal changes that occurred in the mid 1990's (assessed using SEK) were different from any previous changes using the knowledge of local experts (assessed using TEK; manuscript just submitted to Nature Climate Change). Finally, in both projects, our results suggest both TEK and SEK are needed to reconstruct food webs accurately and comprehensively.

The most significant challenges that will be faced by ICSP in the next year, and in the next five years

With lean economic times in North Carolina, funding for both academic and state agencies has been cut, meaning the investment in the management and use of coastal environments has been reduced by the state. Nevertheless, this is a critical time along our coasts. New inlets have opened while others have shoaled into dire straits. Tourism is affected by disruptions of the

transportation system with each major storm. Public and private property and infrastructure is consumed by the sea. Oyster and other fisheries are on life support, requiring significant human intervention such as hatchery rearing to keep populations at viable levels. In ICSP, ECU is fortunate to have built a strong combination of natural and social science expertise, which, coupled with our strong interdisciplinary PhD program, allows ECU to make important contributions in the area of coastal sustainability.

The specific ECU challenges include:

- Streamlining campus organization and increasing synergy within related research, education, and service activities at ECU, without significant new state funding
- Providing a wide variety of audiences both within the State and more widely, with an understanding of the questions being addressed, the results gained, and a vision for the future.

Future directions and sustainability of ICSP in the next year and in the next five years

The ICSP Future—Continuing a Research Focus

It is essential that social and natural scientists frame questions together. ICSP will focus on making that happen, either within its own framework or as a key part of a new School of the Coasts that ECU may form. In addition to recruiting project-specific coordinators for large activities with grant and foundation funding, ICSP will seek to hire modelers if funds for new faculty lines become available, helping to improve ICSP's predictive capabilities about the responses of coastal systems to endogenous and exogenous changes.

For the next five years, the priorities for the ICSP research portfolio will be implemented as follows:

- 1) Continue single-investigator and small-group research projects (\$50-300K/year) as practicable to ensure the continuation of research opportunities for graduate students and to ensure long-term datasets are available;
- 2) Develop medium scale opportunities (\$300-500K/year) that can be scaled up from small-group efforts or funded as-proposed based on the ideas and teaming prospects presented by the current ICSP faculty and cooperating investigators on- and off-campus.
- 3) Define, develop, and execute one or two large-scale research projects (>\$500K/year) that can bring to bear the full range of expertise available to the Institute in an interdisciplinary and multidisciplinary context. Several ICSP faculty are working on a Coupled Natural and Human Systems proposal to NSF currently, and several others are involved in separate NSF Coastal SEES proposals. Such projects often require multiple-university efforts, connecting ECU to a network of other universities around the state, the country, and the world. Success in this area will draw on a substantial history of ICSP collaboration with researchers from other institutions.

The ICSP Future—Enhancing ICSP's Educational Program

See the CRM Chapter

The ICSP Future—Improving Public Service; Establishing a Policy Presence

One of the goals of the Institute is to draw on scholarly understanding to support the development of sound public policy and environmental decision-making. While this goal can be partially addressed by the regular publication of insightful and well-targeted papers, other

strategies should complement thoughtful publications in academic journals. Policy making, and politics of all sorts, is a business built on relationships—familiarity among the parties is one of the most important aspects of the policy process. ICSP will continue to develop appropriate relationships with decision-makers both to provide them with answers to their questions and to work with them to develop questions and identify areas needing attention.

In addition to national-level policies that ICSP/ECU will work on with the help of organizations such as the Consortium for Ocean Leadership and the National Association of Marine Laboratories, ICSP will continue to work with on-campus academic leaders who have their own relationships with State and local leaders, and will seek to extend, strengthen, and diversify those relationships into other areas of expertise. ICSP should also have a chance to provide service to State decision makers with a revived UNC Coastal and Marine Research Council, which will potentially be able to speak with a strong voice on a variety of coastal and maritime issues.

As a focused effort to develop a relationship with, and to further develop the specifics of public policy relating to the coasts and oceans, ICSP will propose an ECU Chair in Coastal and Marine Policy, which will be awarded for a 1-2 year term to enable senior government or academic policy leaders to bring their expertise to ECU/ICSP and to the CRM Program. This will strengthen campus-wide understanding of the policy process, and the Institute's capacity to engage effectively in decision processes at various levels, including private, public and non-profit sectors.

The ICSP Future—Communicating to the Press, Public, and Beyond

ICSP continues to encourage its investigators to provide public and school presentations about the Institute's work whenever they are solicited, and/or whenever they can be arranged, and will provide support to make those presentations possible and well-attended. In addition, faculty and staff support to informal educational activities such as science centers, aquaria, and similar facilities, can be used to help enhance the public's knowledge of ICSP's work, and give them a greater ability to deal with complex environmental information and to make informed decisions about their place in the environment.

The ICSP Future—Developing and Expanding Partnerships:

ICSP has a role within ECU as a catalyst for interdisciplinary research for its own joint faculty and among the various departments and colleges. The Coastal-Maritime Council provides one productive forum for such partnerships. As ECU's focal point for coastal studies and as a leading advocate for coastal research and education, ICSP will continually look for new and continued partnership opportunities. One specific opportunity will be focused on improvements in science, technology, engineering, and mathematics education through the use of coastal and maritime themes in education, thus providing a general benefit in STEM education while providing opportunities to promulgate coastal and maritime information more widely. ICSP and the Department of Math, Science, and Instructional Technology Education (MSITE), also located in the Flanagan Building, have the potential to continue and expand existing partnerships in this area.

Another on-campus partner with which ICSP should have a much more structured and productive relationship is the ECU Foundation. To be successful, that relationship will need to

have the attention of both parties to engender a partnership that is not just focused on responding to grant opportunities and announcements, but one that is focused on building productive and mutually beneficial relationships as part of an overall engagement strategy for ICSP and ECU, together. Coupled with expanded efforts in communications by the Institute itself, or in collaboration with other ECU Centers, such efforts could fundamentally reshape the landscape in which ICSP now finds itself, and could allow for a greater capability for self-determination in choosing productive research and educational activities.

Beyond the ECU campus, there are continuing opportunities for productive collaboration and partnership with the University of North Carolina Coastal Studies Institute (CSI). CSI’s location on Roanoke Island will provide an important facility on the northeast NC coast for ECU faculty to access, via partnerships, and will be a focal point for research, training, and service activities conducted jointly. Two ICSP faculty currently act as the Program Heads for CSI in the area of coastal processes, joining the maritime heritage Program Head and the CSI Public Policy and Coastal Sustainability Program Head, who are both ECU faculty members on joint appointments. Currently, ICSP also provides the oversight for CSI boating and diving safety programs. The partnership with CSI represents an exciting opportunity that has been, and we expect will continue to be, extremely productive for all concerned, and can be built and further formalized over the next decade, and beyond.

Elsewhere in North Carolina ICSP is maintaining and will seek to increase cooperation with the other coastal and maritime organizations within the UNC System and with Duke University’s Nicholas School of the Environment. The Duke/University of North Carolina Oceanographic Consortium (DUNCOC) is a consortium of Duke, ECU, North Carolina State University, the Universities of North Carolina at Chapel Hill, Greensboro, and Wilmington, and the UNC Coastal Studies Institute, focused on the operations and maintenance of the R/V *Cape Hatteras*, a UNOLS regional class research vessel. ICSP will work with DUNCOC to ensure the near-term replacement of this valuable research asset for North Carolina.

In the international arena, ICSP is continuing excellent opportunities already in hand. An ongoing collaboration with the University of Malaysia, Terengganu is the focus of a collaboration that includes ICSP faculty and the Department of Geological Sciences at ECU. We have also agreed to a number of facets of cooperation with the Wimereux Marine Station of the Université of Lille, to include student and faculty exchanges for research and instruction. ICSP continues to attract international students to the CRM program, and will pursue additional opportunities overseas that have the potential to broaden and reshape the conduct of ICSP research and educational programs in the future.

C1. ICSP Resources

1. Personnel

- a.) The faculty (most of them joint with academic departments) and key staff involved with the Institute for Coastal Science and Policy are listed, below:

Table C1. Personnel

Name	Departmental Rank	Joint Appointment Department	ICSP Role
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John Rummel	Professor	Institute for Coastal Science and Policy	Director
Reide Corbett	Professor	Geological Sciences	Joint Faculty
David Griffith	Professor	Anthropology	Joint Faculty
Jeff Johnson	Professor	Sociology	Joint Faculty
Rick Miller	Professor	Geological Sciences	Joint Faculty
Roger Rulifson	Professor	Biology	Joint Faculty
Tim Runyan	Professor	Institute for Coastal Science and Policy	Joint Faculty
Craig Landry	Assoc. Professor	Economics	Joint Faculty
David Loomis	Assoc. Professor	Recreation and Leisure Studies	Joint Faculty
Joe Luczkovich	Assoc. Professor	Biology	Joint Faculty
Michael O'Driscoll	Assoc. Professor	Geological Sciences	Interim Dep. Director, CWRC
Enrique Reyes	Assoc. Professor	Biology	Joint Faculty
Richard Spruill	Assoc. Professor	Geological Sciences	Director, CWRC
Hans Vogelsong	Assoc. Professor	Recreation and Leisure Studies	Director, CRM Program
JP Walsh	Assoc. Professor	Geological Sciences	Joint Faculty
Eban Bean	Asst. Professor	Engineering	Joint Faculty
Jennifer Brewer	Asst. Professor	Geography	Joint Faculty
David Kimmel	Asst. Professor	Biology	Joint Faculty
Alex Manda	Asst. Professor	Geological Sciences	Joint Faculty
Tracy Van Holt	Asst. Professor	Geography	Joint Faculty
Kimberly Null	Postdoctoral Scholar	Institute for Coastal Science and Policy	Postdoctoral Researcher
Chris Cooper	Research Assistant	Institute for Coastal Science and Policy	Social Science Research Support
Laura McKenna	Research Technician	Institute for Coastal Science and Policy	Biological Project Support
Mark Keusenkothen	Director, DWS	Diving and Water Safety	Director, Diving and Water Safety
Jason Nunn	Diving Safety Officer	Diving and Water Safety	Diving Safety Officer
Eric Diaddorio	Boat Captain	Diving and Water Safety	Research Vessel Captain
Mike Baker	Dockmaster	Diving and Water Safety	Research Vessel Support Technician
Cindy Harper	Financial Manager	Institute for Coastal Science and Policy	Financial Manager
Kay Evans	Executive Assistant	Institute for Coastal Science and Policy	Executive Assistant
Gwen Bibbs	Administrative Assistant	Diving and Water Safety	Administrative Assistant

Sara Mirabilio	Research Associate	NC Sea Grant	Sea Grant Fisheries Specialist
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b.) Undergraduates: 17
Masters Students: 30
Doctoral Students (includes 24 ICSP faculty-mentored CRM students): 26
Postdoctoral Scholars: 1

All of these are involved with research projects through the Institute for Coastal Science and Policy, and through its faculty.

Graduate students taking the scientific diving course offered by the Diving and Water Safety Office: 23

2. Funding

The following financial information was provided by the ECU Office of Sponsored Programs and Grants and Contracts, capturing the previous three fiscal years of revenues and expenses, as well as the current fiscal year. Projections for FY14 are calculated as an extrapolation of those numbers, given the lack of overlap between the many different grant budgets and the university/state “fiscal year.”

Table C2a: Revenue (non-Institutional)

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Federal	1,759,434	715,133	1,094,135	287,729	1,301,000
State (not including university)	275,378	376,126	435,951	159,731	516,240
Institution (e.g. University)	-	-	-	-	-
Foundation (Gift)	-	-	5,000	-	- 1,000
Other*	2,235	7,576	21,930	507	8,000
Total	2,037,047	1,098,835	1,557,016	447,967	1,826,240

This table gives the non-Institutional funding received or projected. Institutional funding is delineated, below:

Table C2b: Revenue (Institutional – University State Funds)

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
ICSP	986,127	965,974	873,549	942,991	940,000
Coastal Maritime Council	20,090	20,510	10,000	10,000	10,000
Diving and Water Safety	341,740	871,122	393,219	361,542	350,000

Subtotal:	1,347,957	1,857,606	1,276,768	1,314,533	1,300,000
CRM Program	416,447	610,965	533,582	508,545	500,000
Total	1,764,404	2,468,571	1,810,350	1,823,078	1,800,000

Institutional funding is assumed to be flat for FY14. FY11 funding for Diving and Water Safety includes \$500,000 for the purchase of the R/V *Stanley R. Riggs*.

Table C3a: Expenses (non-Institutional)

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Personnel	883,833	1,105,950	1,038,559	289,460	1,125,000
Programmatic	278,816	326,754	291,827	105,311	300,000
Physical infrastructure	-	-	-	-	
Maintenance and operation	5,568	5,964	4,232	1,495	6,000
Equipment (>\$5,000)	(62,998)	-	42,743	7,955	50,000
Other Direct Costs*	7,085	11,104	21,241	819	24,000
Indirect Costs	136,386	209,262	270,261	70,762	320,000
Total	1,248,690	1,659,034	1,668,863	475,802	1,825,000

Represents ongoing grant expenditures. FY10 numbers include an after-the-fact reimbursement for equipment purchased in a prior year. Projections for FY14 are calculated as an extrapolation of those numbers, given the lack of overlap between the many different grant budgets and the university/state “fiscal year.”

Table C3b: Expenses (Institutional – University State Funds)

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Personnel	1,395,613	1,495,749	1,553,031	366,422	1,580,000
Programmatic	88,026	125,186	75,030	11,298	80,000
Physical infrastructure	16,848	574,301	88,602	16,818	85,000
Maintenance and operation	696	1,638	1,758	595	12,000
Equipment (>\$5,000)	16,171	30,851	8,252	0	20,000
Total	1,517,354	2,227,725	1,726,673	395,133	1,777,000

This table includes expenditures of CRM funds, totaling \$392,285 for FY10; \$346,257 for FY11; \$477,658 for FY12; and \$103,379 for FY13 Current expenditures.

Physical infrastructure

ICSP has ~5,450 sq. ft. of office and meeting space assigned, directly, and indirectly has office and laboratory space for 3 faculty members in their “home” departments (Corbett, Reyes, Walsh).

ICSP is currently assigned over 6,500 sq. ft. of laboratory and research support space on ECU’s East Campus, and another 4,800 sq. ft. of research vessel support space on the West Research Campus, as well as boat storage accommodation in the lot near the Belk Building on the ECU athletic (East) campus.

Further, a small storage building (150 sq. ft.) is located on the Mattamuskeet National Wildlife Refuge in Swan Quarter, NC.

ICSP Research Vessels:

Vessel Name	Length (ft)	Power	Pax	Special features
<i>Jaws</i>	14	Outboard	6	Tiller
<i>Alumacraft</i>	16		6	Steering Console
<i>Little Skimmer</i>	16	Outboard	6	Tiller, rigged for plankton sampling
<i>Roughneck</i>	16	Outboard	6	Tiller
NN Parker	18	Outboard	6	Rigged for water sampling (project vessel)
<i>Electric Eel</i>	18	Outboard	6	Steering console, electroshock rig
<i>Pinfish</i>	19	Outboard	6	Steering console, rigged for plankton sampling
<i>Seeker</i>	21	Outboard	10	Enclosed cabin
<i>Flounder</i>	24	Outboard	10	Steering console, side scan sonar system
<i>Tom Cat</i>	25	Dual Outboards	10	Enclosed cabin, ocean use
<i>Sound Bite</i>	25	Outboard	12	Steering console, live well
<i>Beeliner</i>	27	Dual Outboards	12	Enclosed cabin, multibeam sonar mount
<i>Work Barge</i>	28	Dual Outboards	12	Steering console, dive benches, dive ladder
<i>Cutting Edge</i>	30	Diesel Inboard	20	Cabin, ocean use, dive capable
<i>Stanley R. Riggs</i>	34	Diesel Inboard/ Outboard	15	Enclosed cabin, A-frame, 3 hydraulic winches, dive platform, bow ramp

Contracted vessels for research (project charters):

F/V Tarbaby, 42-foot fiberglass commercial fishing vessel
(Captain Dewey Hemilright)

F/V Bouttime, 45-foot fiberglass commercial fishing vessel
(Captain Chris Hickman)

Diving and Water Safety Facilities:

West Campus Research Vessel Workshop – 4,800 sq. ft.

The Boat Workshop is equipped with:

- 1 stick welder
- 1 aluminum/stainless TIG welding machine
- 2 drill presses
- 1 metal shear
- 1 metal brake
- 1 upright belt sander
- 1 cabinet bead blaster
- 1 engine hoist
- 1 table saw
- 1 plasmak cutting machine
- 1 ice machine
- 3 phase power

Dive Locker – 1,545 sq. ft. in Bldg 43 on ECU East Campus

The dive locker is equipped with:

- 1 stationary 9ft³/minute Bauer compressor capable of mixing nitrox
- 1 mobile 9ft³/minute Bauer compressor capable of mixing nitrox
- 10 bank cylinders
- 1 Haskell booster pump
- 117 scuba cylinders of varying capacities
- 4 Inspiration rebreathers with vision electronics
- 46 sets of regulators
- 14 Drysuits
- 16 Buoyancy compensators
- 27 dive computers
- 5 Oxygen administration kits
- 3 video camera systems with underwater housings
- 3 still camera systems with underwater housings
- 2 Dive-X scooters
- 1 flowbench for regulator repair
- 1 pressure pot for pressure testing
- 1 visual plus 3 eddy current inspection tool

ICSP Diving and Water Safety Office has three pickup trucks assigned for research vessel and diving support:

- 2011 Ford F350 – C101: 4-door, non-dually
- 2008 Ford F350 – C91: four-wheel drive, 4-door, non-dually
- 2003 Ford F350 – C100: 4-door, dually

ICSP Vehicles:

1999 Ford F-250, 4-door, 6 passengers, non-dually
 2001 Dodge Ram, 2-door, 3 passengers, non-dually
 2007 Coachman travel trailer

Specialized equipment, core facilities, land:

Olympus teaching compound microscope with Optimus software and camera
 CTD instrument
 Laser Optical Plankton Counter
 In situ fluorometer (shared with ECU Biology Department)
 Biology Core Imaging Facility
 Biology Core Genomics Facility
 Biology High Performance Computer Core.
 Downhole borehole equipment (heat pulse flow meter, caliper, optical televiewer, temperature and resistivity, downhole video, and winch assembly)
 Geoprobe and OhmMapper (shared with ECU Geological Sciences Department)
 ICP-OES (Shared with Geological Sciences)
 Share of ECU lease of Pocosin Arts Folk School “Scuppernong Riverside Lodge” in Columbia, NC (six month field site support)
 Potential field site at the Palmetto Peartree Preserve, Columbia, NC (investigating operations with The Conservation Fund and NC DOT)

D1. Research, Teaching, Public and Professional Service

1. Research

Table D1. Research

Project title	PI/CoPIs –	Sponsor	Amount	Dates Begin	End
Is Cape Cod a Natural Delineation for Migratory Patterns in US and Canada	Rulifson, Roger East Carolina University	Commercial Fisheries Research Foundation	\$140,348	8/1/10	12/31/12
Maturation, Fecundity, and Spawning Frequency of the Albermale/Roanoke Striped Bass	Rulifson, Roger East Carolina University	N.C. Division of Marine Fisheries	\$205,750	6/15/10	12/31/12
Origin of Central Southern Management Area Striped Bass Using Otolith Chemistry, and Recommendations	Rulifson, Roger East Carolina University	N.C. Division of Marine Fisheries	\$153,313	7/1/11	12/31/12

for Fishery Management					
Sea Grant Extension Program at East Carolina University	Rummel, John East Carolina U.	North Carolina Sea Grant	\$143,670	2/1/10	1/31/13
Identifying nursery habitats for coastal sharks within Pamlico Sound, NC	Rulifson, R. East Carolina University	North Carolina Sea Grant	\$4,451	5/30/12	5/31/13
Regional Engagement Center for Coastal Systems Informatics and Modeling (C-SIM)	Allen, T., Walsh, J.P., Corbett, D. R. (ECU) and others	RENCI, State of NC	\$ 200,000	7/2011	6/2013
Preserving the Resource Base and Developing a Sustainable Coastal Economy for North Carolina's Coastal System in the 21st Century	Riggs, Stanley R.; Culver, Stephen; and Rummel, John, East Carolina U.	Kenan Institute	\$65,000	7/1/11	6/30/13
Identification of Juvenile Spiny Dogfish Habitats in North Carolina Coastal Waters	Rulifson, Roger East Carolina University	North Carolina Sea Grant	\$106,683	11/1/11	6/30/13
Initiating a New Collaboration between East Carolina University and Universiti Malaysia Terengganu: Post-Glacial Variations in the East Asian Monsoon	Culver; Stephen Corbett; D. Reide, Curtis, Walter; Leorri Eduardo Soriano; Mallinson; David. Mitra, Siddhartha, Walsh, John East Carolina U.	National Science Foundation	\$49,974	1/2012	6/2013
RAPID: Collaborative	Walsh, John, Corbett, D.	National Science Foundation	\$58,498	7/18/11	6/30/13

Research: Signature of the 2011 Flooding on the Mississippi Subaqueous Delta	Reide Mitra, Sid East Carolina U.				
Is Anadromy Responsible for High Strontium Levels in the Primordium of Some Striped Bass Otoliths?	Rulifson, R. East Carolina University	NC Sea Grant, Fishery Resource Grant 12-EP-03	\$19,787	9/1/12	6/30/13
Continuing the Hatteras Acoustic Array to Detect Presence of Acoustically Tagged Species (continuation)	Rulifson, R. East Carolina University	U.S. Fish and Wildlife Service.	\$7,500	10/1/12	06/30/13
Evacuation and Daily Ration of Atlantic Spiny Dogfish (<i>Squalus acanthias</i>)	Rulifson, R. East Carolina University	NC Sea Grant, Fishery Resource Grant 12-EP-02	\$18,561	11/1/12	6/30/13
Assessing & Developing Best Practices in Seafood Marketing and Consumption: A R	Griffith, David East Carolina U. Sara Mirabilio NC Sea Grant (ECU)	National Oceanic and Atmospheric Administration	\$134,263	8/1/10	7/31/13
RAPID collaborative research: Historic freshwater input and hypoxia effects on zooplankton populations of the northern Gulf of Mexico	Kimmel, David, East Carolina U.; Roman, Pierson, Boicourt, UMd	National Science Foundation	\$85,191	7/1/11	7/31/13
Advanced Regional and Decadal Predictions of Coastal Inundation for the U.S.	Corbett, D. Reide, East Carolina U. Others,	University of Pennsylvania	\$78,936	9/1/11	7/31/13

Atlantic and Gulf Coasts	U. of Pennsylvania				
A Collaborative Proposal: Formation and Preservation of Fluvial and Marine Depositional Events, Waipaoa River Margin, New Zealand	Walsh, John, Corbett, D. Reide East Carolina U.	National Science Foundation	\$ 384,874	8/1/09	7/31/13
Vulnerability Assessment for Coastal Counties and Developed Islands	Corbett, D. Reide, Walsh, J. P. East Carolina U. Others, Skidaway Institute of Oceanography	Skidaway Institute of Oceanography	\$73,479	8/1/11	7/31/13
Cooperative Winter Tagging Cruise, 2013-2015, for Atlantic Striped Bass and Affiliated Species	Rulifson, Roger East Carolina U.	Division of Marine Fisheries (DMF)	\$238,836	7/1/12	8/15/13
Collaborative Research: The Estuarine Chlorophyll a Maximum as an Ecosystem Integrator	Kimmel, David, East Carolina U.; Paerl (UNC-IMS); Wetz (TAMCC)	National Science Foundation	\$134,849	9/1/10	8/31/13
CESU: Commercial Fishing Hang Data as a Proxy for Locating Shipwreck Sites off the Mid-Atlantic Coast	Runyan, Timothy East Carolina U.	Department of the Interior (DOI)	\$250,000	9/22/11	8/31/13
Summer Institute for Research Design on Cultural Anthropology	Johnson, Jeffrey East Carolina U.	National Science Foundation	\$354,550	9/1/95	8/31/13
Reprocessing, Analysis and	Miller PI East Carolina	NASA	\$30,257	Nov 2012	Oct 2013

Synthesis of IOP Measurements Acquired during the GEO-CAPE Chesapeake Bay Field Campaign July 2011	U.				
BREACH III: Evaluating and Predicting 'Restoration Thresholds' in Evolving Freshwater-Tidal Marshes.	Reyes, Enrique (ECU); C. Simestad (University of Washington).	CESU/USFWS	\$122,000	1/01/10	12/31/13
Economic Values of Coastal Erosion Management	Whitehead, John, Appalachian State Landry, Craig East Carolina U.	NC Sea Grant	\$129,035, \$77,448 from sponsor, \$59,778 to ECU	Jan 2012	Dec 2013t
Welfare Economics of Beach Nourishment Projects Using OCS Sand Resources	Landry, Craig East Carolina U.	US Army Corps of Engineers and Bureau of Ocean Energy Management	\$215,000, \$150,000 to ECU	Jan 2012	Dec 2013
Non-intrusive geophysical characterization of wastewater plumes in coastal North Carolina.	Humphrey, C., O'Driscoll, M., and Mallinson, D. (ECU)	North Carolina Water Resources Research Institute.	\$30,000	2012	2013
On-site wastewater and centralized sewer system nutrient loadings to surface waters in Pitt County, NC . \$83,473.	Humphrey, C., O'Driscoll, M., and Manda, A (ECU)	North Carolina Department of Environment and Natural Resources 2010	\$83,473	2010	2013
Examining the Transport, Transformation and Fate of Materials Impacting North	Miller, Richard (ECU). PI; McKee, UNC Chapel Hill	North Carolina Sea Grant	\$149,683	2/1/12	1/31/14

Carolina Coastal Waters					
Managed Migration and the Value of Labor	Griffith, David Contreras, Ricardo East Carolina U; Preibisch, Kerry U. of Guelph; Cerdi, Elizabeth Jarez Colegio Michoacan	National Science Foundation (NSF)	\$186,425	6/1/12	5/31/14
Ethnographic Overview of Guilford Courthouse National Military Park	David Griffith East Carolina U.	National Park Service	\$56,648	8/1/12	6/30/14
Beam Me Up Scotty (NC Space Grant)	Rummel, John East Carolina U.	North Carolina Space Grant Consortium	\$55,000	7/1/10	6/30/14
Integrating Sustainability into Agricultural Education: Water resources and Global Climate Change Challenges	Reyes, Enrique PI East Carolina U.I	Southern University U.S. Department of Agriculture	\$35,041	9/01/11	08/31/14
Restoring access to diadromous fish habitat and linkages to forage-fish biomass in the North Atlantic Large Marine Ecosystem: GIS Analysis and Population Response Estimates	Rulifson, R. Walsh, J.P. (ECU)	NOAA NMFS (NFAPO-2012-2003133).	\$40,030	10/1/12	9/30/14.

Synthesis of High and Low Marsh Habitat Mapping, Vulnerability and Responses to Sea-Level Rise in the South Atlantic Region	T. Allen, J.P. Walsh, East Carolina U.	Southeast Atlantic Landscape Conservation Cooperative	\$271,861	10/12	9/2014
A Structural Approach to the Incorporation Cultural Knowledge in Adaptive Adversary Models	Johnson, Jeffrey, PI Van Holt, Tracy, Co-PI East Carolina U.	ONR / Carnegie Mellon University	1,016,119	9/17/08	12/31/14
Collaborative Research: Submarine Groundwater and Freshwater Inputs Along the Western Antarctic Peninsula	Corbett, D. Reide East Carolina U.	National Science Foundation	\$344,037	8/2012	7/31/15
The BioExcellence Scholarship Program.	M. Farwell, M, Sutton, L, Stellwag, E. Reyes, E. East Carolina U.	National Science Foundation S-STEM program.	\$599,945	1/15/12	12/31/16

2. Teaching and Instruction (if applicable)

- a.) The CRM portion of this report will delineate appropriate course and instructors related to that PhD program.
- b.) The Coastal Water Resources Center is proposing to develop instruction in field methods in hydrology for later implementation.

Table D3: Non-Degree Credit Instruction

Workshop/Instruction title	Dates offered	Instructor(s) and Affiliation(s)	Brief description of instruction (1 sentence)	Enrollment Figures
No non-degree credit instruction was performed by ICSP in the period of this study.				

Public Service, Outreach and Community Engagement

Given below are 20 examples of faculty outreach and community engagement that directly relate to the activities of the Institute for Coastal Science and Policy:

Table D4. Public Service, Outreach and Community Engagement

Public Service / Outreach/Engagement	Dates	Personnel Involved	Participants in program	Number of participants
Emergency Managers Hurricane Conference (Co-organizer)	May 2010 May 2011 May 2012	Craig Landry, Jamie Kruse, Tom Allen, Donna Kain (ECU)	Managers, State Government, Media	100 150 200
Co-Coordinator, Science and Policy Committee, Northwest Atlantic Marine Alliance, Gloucester, Massachusetts.	2010-Present	Jennifer Brewer East Carolina U.	Scientific colleagues in academic, government, and NGO positions	10
Invited workshop participant, Fisheries Licensing for the Future, Penobscot East Resource Center and Maine Sea Grant, Freeport, Maine.	2012	Jennifer Brewer East Carolina U.	State and federal agency personnel, scientists, NGO staff, business owners	40
Resource Team member, Saltwater Connections, Hatteras Island and down east, North Carolina.	2011	Jennifer Brewer East Carolina U.	Academic scientists, NGO staff, state agency personnel, business owners, local residents	100
Latino Leadership Conference	April 2010	David Griffith, Ricardo Contreras East Carolina U.	Latino Leaders	50
Day at the Docks Outreach	Oct 2012	David Griffith, East Carolina U.; Sara Mirabilio, NC Sea Grant	Public	1,500
NCSU international PhD coastal field trip - Geological Background and Coastal Hazards of the Outer Banks		Reide Corbett	PhD Students	25

UNC CH/ECSU IDEA Summer Science Institute program – field-based presentation/programming; Geological Background and Coastal Hazards of the Outer Banks		Reide Corbett	High school students	20
Blue Heron Bowl - A "College Bowl"-like competition for high school students focused on Oceanography.	Feb 2011 March 2012	Kay Evans Coordinator; ICSP Staff and Faculty, plus Others from East Carolina U. and the community	High school students	150
Blounts Creek Public Forum: Public informational meeting of potential impacts of surface mining and discharge to receiving waters.	June 12, 2012	Eban Bean, Joe Luczkovich, Dave Kimmel, Roger Rullifson, Scott Lecce; East Carolina U.	General public, Coastal Federation, Tar-Pamlico River Foundation	100
Greenville Stormwater Tour	October 24, 2012	Mike O’Driscoll, Eban Bean (ECU) Heather Jacobs-Deck (PTRF), City of Greenville Public Works	City Commissioners and other officials	10
Radio Interview for Summit Daily Times (Colorado) Radio Interview for Voice of Russia Radio Radio Interview for NPR Down East Journal Radio Interview for International Business Times Television Interview with Henry Hinton “Talk of the Town” Television interview for WNCT	2012	David Kimmel, Sid Mitra (ECU)	General public	3
Pitt County Teen Leadership Institute	2011	David Kimmel (ECU)	High School students interested in a career in Marine	50

			Biology	
Climate Change Potential Impacts to the Virginia Coastal Reserve. The Nature Conservancy. Climate Change Workshop.	Feb. 11, 2009.	Enrique Reyes (ECU)	TNC managers	25
ECU Open House: Participated in event showcase department to admitted students, prospective students and parents	2010 and 2011	Alex Manda East Carolina U.	Admitted college students, prospective college students and parents	4000-4500
NE Region Science and Engineering Fair	2010	Alex Manda, Sharon Schleigh East Carolina U.	K-12	>100
SEABASS Summer School in Bioacoustics, Penn State University, State College, PA http://www.arl.psu.edu/education_seabass.php	17-22 June 2012	Joe Luczkovich East Carolina U.	Graduate students from around the county and world	46
BOEM Underwater Noise Workshop, San Diego, CA, USA http://www.boemsoundworks.com/	March 2012	Joe Luczkovich East Carolina U.	Various researchers from NOAA, BOEM, universities	150
National Youth Science camp	July 2012	Rick Miller East Carolina U.	23	120
NC COastal HAZards Decision Portal	2008-present	J.P. Walsh, East Carolina U.	Dissemination of information to public	>60,000 hits

Professional Service

Given below are examples of advisory, regulatory or other professional service that ICSP faculty have provided to North Carolina or at the regional / national / international level:

Table D5. Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service provided
Albemarle-Pamlico National Estuary Program – Science & Technical Advisory Council	2008-present Chair, 2012-present	Reide Corbett David Kimmel Craig Landry Joe Luczkovich, ECU Reide Corbett, ECU	Scientific expertise Organize/lead quarterly meetings

Div of Marine Fisheries, Strategic Habitat Area Advisory Committee – Region 2	2011	Reide Corbett, ECU	Provide expertise on Pamlico River/Sound, and Neuse River Estuaries
NC CRC, Hazard Committee - Sea Level Rise	2010	Reide Corbett, ECU	Provide up-to-date scientific information on NC sea level rise
Duke, University of NC Oceanographic Consortium (DUNCOC)	2001-present	Reide Corbett, J. P. Walsh, ECU	Advisory group for R/V Cape Hatteras
Member, NC Blue Crab Advisory Committee	2008	David Kimmel, ECU	Advise state of NC on Blue Crab issues
The Nature Conservancy's Climate Change Adaptation Project	Aug. 18, 2009 – present	Enrique Reyes, ECU	Member Scientific Advisory Committee
Partnership for the Sounds	1996-present	Roger Rulifson	Board member representing coastal ecology
Marine Fisheries Section, American Fisheries Society	2008-12	Roger Rulifson	President-Elect, President, and Past President
Chair, National Maritime Alliance. Trustee, National Maritime Historical Society.	2008-12 2011-12	T. Runyan East Carolina University	Lead person in national effort to secure federal funding of \$4M for maritime heritage grant program. Organizer, Maritime Heritage Conference, 2014. International conference.
Pamlico Tar River Foundation (NC)	2010-Present	Alex Manda East Carolina University	Advisory Board Member
NC Division of Marine Fisheries Inland Advisory Board	2005-2008	Hans Vogel song East Carolina U	Advisory Board
Piedmont South Atlantic Coast	2005-2012	Hans Vogel song East Carolina U	Technical representative

Cooperative EcoSystem Unit			
Human Dimensions for Global Change Specialty Group, American Association of Geographers	2010-2012	Tracy Van Holt, ECU	Secretary/Treasurer
President Elect, Anthropology and the Environment	11/1/2012	Jeffrey C Johnson ECU	Officer, Professional Society
Southern Association of Marine Laboratories	2012-Present	John D. Rummel, ICSP	Executive Committee Member (At Large)
Advisory Board, North Carolina Coastal Resources Law, Planning and Policy Center	2010-Present	John D. Rummel, ICSP	Board Member
Leadership: <i>The Coastal Society's 23rd</i> Conference	2012	Craig Landry David Loomis Hans Vogel song East Carolina U	Co-Chairs and Organizing Committee
New England Fishery Management Council Research Steering Committee, Newburyport, Massachusetts.	2011	Jennifer Brewer East Carolina U.	Testimony on collaborative research findings
National Science Foundation; NASA; NOAA; Research Council of Norway	2008-Present	David Griffith David Kimmel Craig Landry Rick Miller John Rummel Tracy Van Holt East Carolina U	Senior Program Reviews; Review Panelists for Scientific Proposals
Journal Editor, <i>Various Journals</i>	2008-Present	David Griffith Jeffrey C Johnson Craig Landry Joe Luczkovich Alex Manda Enrique Reyes John Rummel Tim Runyan Hans Vogel song, East Carolina U.	Peer review of manuscripts

E1. Outputs and Impacts

1. Publications

a.) Refereed publications

- Brewer, Jennifer F. 2011. Paper Fish and Policy Conflict: Catch Shares and Ecosystem-Based Management in Maine's Groundfishery. *Ecology and Society* 16(1):15 [online]: <http://www.ecologyandsociety.org/vol16/iss1/art15/>
- Corbett, D.R., 2010. Resuspension and Estuarine Nutrient Cycling: Insights from the Neuse River Estuary. *Biogeosciences*, 7, 3289-3300.
- Dell'Apa, L. Schiavinato, and R.A. Rulifson. 2012. The Magnuson–Stevens act (1976) and its reauthorizations: Failure or success for the implementation of fishery sustainability and management in the US? *Journal of Marine Policy* 36(3):673-680.
- Griffith, David. 2012. Labor Recruitment and Immigration in the Eastern North Carolina Food Industry. *International Journal of the Sociology of Agriculture and Food*, 19 (1), 1-17.
- Johnson, J. C., J. J. Luczkovich, et al. (2009). Using social network analysis tools in ecology: Markov process transition models applied to the seasonal trophic network dynamics of the Chesapeake Bay. *Ecological Modelling* 220(22): 3133-3140.
- Johnson, Jeffrey C. and David Griffith. 2010. Finding Common Ground in the Commons: Intracultural Variation in Users' Conceptions of Coastal Fisheries Issues. *Society and Natural Resources* 12(9): 837-855.
- Kimmel, D. G. & Hameed, S. (2008). An update on the relationship between the North Atlantic Oscillation and *Calanus finmarchicus*. *Marine Ecology Progress Series*, 366, 111-117.
- Landry, Craig E.. 2011. Coastal Erosion as a Natural Resource Management Problem: An Economic Perspective. *Coastal Management* 39(3): 259-78.
- Luczkovich, J. J., D. A. Mann, R. Rountree. (2008). Passive acoustics as a tool in fisheries: an introduction to the American fisheries society symposium. *Transactions of the American Fisheries Society* 137(2008): 533-541.
- McLeod, E., B. Poulter, J. Hinkel, E. Reyes, R. Salm. 2010. Sea level rise impact models and environmental conservation: A review of models and their applications. *Ocean and Coastal Management*. 53: 507-517.
- Miller, R.L., C-C. Liu, C.J. Buonassissi and A-M. Wu. 2011. A Multi-sensor Approach to Examining the Dynamics of Total Suspended Matter (TSM) in the Albemarle-Pamlico Estuarine System, NC USA. *Remote Sensing*, 3, 962-975; doi:10.3390/rs3050962.
- Mitra, S., Kimmel, D. G., Snyder, J., Scalise, K., McGlaughon, B. D. , Roman MR, Jahn GL, Pierson JJ, Brandt SB, Montoya JP, Rosenbauer RJ, Lorenson TD, Wong FL, Campbell PL, (2012). Macondo-1 well oil-derived polycyclic aromatic hydrocarbons in mesozooplankton from the northern Gulf of Mexico. *Geophysical Research Letters*, 39 (L01605).
- Mohan, J.E., R.A. Rulifson, D.R. Corbett, and N.M. Halden. 2012. Validation of oligohaline elemental otolith signatures of striped bass using in situ caging experiments and water chemistry. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science*. 4(1):57-70.
- Poulter, B., R.L. Feldman, M. Brinson, B. Horton, M. Orbach, S. Pearsall, E. Reyes, S. Riggs, J. Whitehead. 2009. Managing coastal systems for sea level rise: Coastal policy and research progress in North Carolina, USA. *Ocean and Coastal Management*. 52: 147-153

- Riggs, S.R., Ames, D.V., Culver, S.J., Mallinson, D.J., Corbett, D.R., and Walsh, J.P. 2009. Eye of a human hurricane: Pea Island, Oregon Inlet, and Bodie Island, northern Outer Banks, North Carolina; In *Identifying America's Most Vulnerable Oceanfront Communities: A Geological Perspective*, eds., J.T. Kelley, R.S. Young, and O.H. Pilkey. Geological Society of America, Special Publication.
- Rulifson, R. A, and T. M. Moore. 2009. Population estimates of spiny dogfish aggregations overwintering south of Cape Hatteras, North Carolina, using an area density method. Pages 133–138 in V. F. Gallucci, G. A. McFarlane, and G. G. Bargmann, editors. *Biology and Management of Dogfish Sharks*. American Fisheries Society, Bethesda, Maryland.
- Rulifson, R.A., S.A. McKenna, and M.J. Dadswell. 2008. Intertidal habitat use, population characteristics, movement and exploitation of striped bass in the Inner Bay of Fundy, Canada. *Transactions of the American Fisheries Society* 137 (1): 23-32.
- Van Holt, T. 2012. Landscape influences on fisher success: adaptation strategies in closed and open access fisheries in southern Chile. *Ecology and Society* 17(1): 28. <http://dx.doi.org/10.5751/ES-04608-170128>
- Van Holt, T., Moreno, C.A., Binford, M., Portier, K, Mulsow, S, Frazer, T. Influence of landscape change nearshore fisheries in southern Chile. 2012. *Global Change Biology*. 18(7): 2147-2160. <http://dx.doi.org/10.1111/j.1365-2486.2012.02674.x>
- Walsh, J.P. and C.A. Nittrouer. 2009. Towards an Understanding of Fine-grained River-Sediment Dispersal on Continental Margins. *Marine Geology*, 263: 34-45.

b.) Non-refereed publications

- Bin, Okmyung., Jennifer Brewer, Robert Christian, D. Reide Corbett, Stephen Culver, Scott Curtis, Bob Edwards, Lauriston King, Patrick Long, David J. Mallinson, Lloyd Novick, Michael O'Driscoll, Stanley R. Riggs, and John Rummel. 2008. *Global Warming and Coastal North Carolina*. Report to North Carolina State Senate President Marc Basnight, East Carolina University, Greenville, North Carolina.
- Boesch, D. F., Coles, V. J., Kimmel, D. G. , & Miller, W. D. 2010. Chapter 23: Climate change: coastal dead zones, *Life Science Ethics* (pp. 423-434). Dordrecht, The Netherlands: Springer.
- Cahoon, D.R., D.J. Reed, A.S. Kolker, M.M. Brinson, J.C. Stevenson, S. Riggs, R. Christian, E. Reyes, C. Voss, and D. Kunz. 2009. Coastal wetland sustainability. In: *Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region*. A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. [J.G. Titus (coordinating lead author), K.E. Anderson, D.R. Cahoon, D.B. Gesch, S.K. Gill, B.T. Gutierrez, E.R. Thieler, and S.J. Williams (lead authors)]. U.S. Environmental Protection Agency, Washington DC, pp. 57-72.
- Corbett, D.R., Walsh, J.P., Cowart, L., Riggs, S.R., Ames, D.V., and Culver, S.J. 2008. *Shoreline Change within the Albemarle-Pamlico Estuarine System, North Carolina*. White Paper published by East Carolina University, 10 p.
- Corbett, S.J., Walsh, J.P., Cowart, L., Mallinson, D., and Culver, S.J., 2008. Evaluating sediment processes and accumulation patterns, Setiu Wetlands, Terengganu, Malaysia. Conference on the Current State of Knowledge of the Setiu Wetlands. Institute of Oceanography, Universiti Malaysia Terengganu, December 2007, 21p.
- Johnson, J. C. and D. Griffith. 2010. Linking Human and Natural Systems: Social Networks, Environment and Ecology. In "Environmental Social Sciences: Methods and Research

- Design” (eds. I. Vaccaro, E.A. Smith and S. Aswani). Cambridge University Press: Cambridge.
- Kimmel, D. G. 2012. Chapter 6.05 - Plankton Consumer Groups: Copepods, Trophic Structure of Estuaries and Coasts (Eds. Luczkovich JJ, Wilson J) in *Treatise on Estuarine and Coastal Science* (Eds. Wolanski E, McLusky D) (pp. 95-126). Elsevier.
- Kimmel, D. G., Townsend, H., Carruthers, T. J. B., & Fertig, B. 2010. Chapter 8: environmental statistics: balancing simplicity and explanatory power, In BJ Longstaff, TJB Carruthers, WC Dennison, TR Lookingbill, JM Hawkey, JE Thomas, EC Wicks, J Woerner (Ed.), *Integrating and applying science: A handbook for effective coastal ecosystem management* (pp. 113-132). Cambridge, Maryland: IAN Press.
- Krahforst, C. S., J. P. Walsh, M. W. Sprague, D. O. Eulie, D. R. Corbett & J. J. Luczkovich. 2012. Influence of turbidity on the incidence of sounds production in Atlantic croaker (*Micropogonias undulatus*) in Pamlico Sound, North Carolina. In *The Effects of Noise on Aquatic Life*, eds. A. N. Popper & A. D. Hawkins, 169-171. New York: Springer.
- Luczkovich, J. J., M. W. Sprague, et al. 2011. Acoustic Behavior. *Encyclopedia of Fish Physiology: From Genome to Environment*. F. A.P. San Diego, Academic Press. 1: 311–320.
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2. *Technical Outputs*

There are no technical outputs such as CDs, software programs, databases, algorithms, and/or measurement instruments to report.

3. *Commercialization and Technology Transfer*

There are no commercialization or technology transfer opportunities to report.

4. *Awards and Honors*

Awards and honors conferred to faculty, staff, and students as a result of their participation in ICSP are listed here. Student-only awards are listed in the CRM Chapter.

Table E1. Awards and Honors

Award or Honor	Date	Name	Brief Description
Five-Year Achievement for Excellence in Research and Creative Activity Award	2012	Craig Landry East Carolina University	Five-Year Achievement for Excellence in Research and Creative Activity Award
Engagement and Outreach Scholars Academy, ECU	2009-2010	Jennifer Brewer East Carolina University	Training in community engagement and service through outreach.
Outstanding Scientific Achievement Award for 2007-2008, Southern Division, AFS	March 2008	Roger Rulifson East Carolina University	The Southern Division is the largest of the divisions in terms of membership. The award is given to an AFS member contributing major scientific advancement in that year. It is not awarded each year.
Meritorious Service Award, American Fisheries Society, for 2007-2008	Fall 2007	Roger Rulifson East Carolina University	Annual awardee is nominated by peers for dedication to and advancement of the fisheries profession and the American Fisheries Society. This award is international.
Scholar-Teacher Award, ECU, 2011	Fall 2010	Roger Rulifson East Carolina University	Teacher-Scholar Award is a University-wide honor given to up to 10 faculty each year, who demonstrate substantial research activity and incorporate that into their courses and lectures.
Outstanding service	2010	T. Runyan East Carolina University	Outstanding service in organizing the 2010 Maritime Heritage Conference,

			Baltimore, MD
Marianne Schmink Award	2010	Tracy Van Holt East Carolina University	Outstanding Dissertation in Tropical Conservation and Development
2010 Thomas Harriot College of Arts and Sciences Distinguished Professor	August 2010	Jeffrey C Johnson ECU	The Thomas Harriot College of Arts and Sciences Distinguished Professorship is one of the most prestigious at ECU and is conferred upon a professor whose career exemplifies a commitment to and a love for knowledge and academic life, as demonstrated by outstanding teaching and advising, research and creative productivity, and professional service.
Key note address entitled: Simplifying Complexity: Interactive Network Visualization of Social and Ecological Systems	May, 2009	Jeffrey C Johnson ECU	Visualisierung sozialer Netzwerke Conference, Frühjahrstagung der AG „Netzwerkforschung“ in der Deutschen Gesellschaft für Soziologie, in Zusammenarbeit mit dem Sfb 536 „Reflexive Modernisierung“, 1./2. Mai 2009, Ludwig-Maximilians-Universität, Leopoldstraße 13, München-Schwabing.
Distinguished Lecture, Modeling Traditional Ecological Among the Inupiaq of Arctic Alaska	April 2009	Jeffrey C Johnson ECU	St. Mary's College of Maryland
Named "Friend of the Arts 2012-13"	October 2012	John D. Rummel East Carolina University	North Carolina Art Education Association
Servire Society	2010, 2011, 2012	J. P. Walsh East Carolina University	ECU Award for recognition of public service
Top Ten Most Downloaded Paper	June-September 2009	J. P. Walsh East Carolina University	<i>Marine Geology</i>
Most-Cited Paper Award	2008	J. P. Walsh East Carolina University	From Continental Shelf Research for last 5 years (2003-2007)

A2. Coastal Resources Management Interdisciplinary PhD Program

B2. Narrative

History and Mission

The Coastal Resources Management (CRM) PhD program is a relatively new academic program whose first cohort started in the Fall of 1999. The mission of the program is to meet the need for scientifically trained specialists able to move effectively between the worlds of research, policy, and management as these relate to the world's coastal margins. To do so, it:

- *Emphasizes an integrated, multidisciplinary approach to coastal studies with a focus on science and public policy;*
- *Nurtures skills in the acquisition, interpretation, and synthesis of scientific information on coastal environments and populations;*
- *Fosters pursuit of individual interests in the context of a structured but flexible program of classroom instruction, field research, work and professional development experience, and a doctoral dissertation;*
- *Draws on a supportive, collaborative faculty throughout the University;*
- *Provides the academic basis for students seeking resource management careers in government agencies, private firms, non-profit organizations, and interdisciplinary education programs.*

A strong interdisciplinary and integrated curriculum has been developed and is operationalized through the use of the following primary and secondary concentrations:

- *Coastal and Estuarine Ecology* – focuses on near-shore and estuarine processes important for living marine resources and environmental quality and offers opportunities for specialization in fisheries, coastal plain, wetland, marine and estuarine populations, communities and ecosystems, water quality, and land/water interactions;
- *Coastal Geosciences* – emphasizes coastal and atmospheric processes, geomorphology, and water resources as they affect the use and development of the coastal margin and provides opportunities for specialization in atmospheric science, coastal geology and sedimentary processes, hydrology, and biogeochemistry;
- *Coastal Social Science and Policy* – focuses on the social, economic, and political aspects of environmental resources management and offers opportunities for specialization in marine policy, law, and planning; natural resource and environmental economics; social and institutional behavior as these relate to resource development and management; sustainable tourism; adaptation to climate change and hazards; and maritime cultural heritage.

Students currently choose a primary field, with complementary work in one other. Those who select either coastal and estuarine ecology or coastal geosciences are required to take complementary work in coastal social science and policy; students choosing the social science track are required to take complementary work in either ecology or geosciences.

The CRM program was formally moved to the Institute for Coastal Science and Policy upon ICSP's creation in 2006/2007. Based on self-assessment results, a major curriculum revision was passed and initiated in 2010. Administratively, the program currently is overseen by the Vice Chancellor for Research and Graduate Studies, through the Dean of the Graduate School, the Director of ICSP, and the Director of the CRM Program. Additionally a CRM Advisory

Committee provides input on policy issues such as admission criteria, curriculum revisions, comprehensive examination policies, and dissertation guidelines. This committee consists of Department Chairs from Biology, Economics, Geography, Geological Sciences, Maritime Studies, Political Science, Recreation and Leisure Studies, and Sociology, as well as appointed faculty from a variety of disciplines. With approximately 40 active students, the CRM program is the largest PhD program at ECU. To date, 32 former students have earned their PhDs through the CRM program.

Program Strengths and Uniqueness

The CRM program is unique in coastal and marine science programs throughout the country. While many programs purport to be interdisciplinary, most are actually multi-disciplinary and offer a variety of programs to fit students into. The CRM program at ECU requires students to take coursework in three very different disciplines and to integrate this material into solving problems through interdisciplinary research and policy formation. While this process is difficult, the students graduate with knowledge on a variety of subjects, and are very adaptable in a changing workforce. This approach benefits the university by providing opportunities for faculty from a wide variety of disciplines to recruit and engage with PhD students. Incoming students take core courses on Coastal and Estuarine Ecology, Coastal Geosciences, Human Dimensions of Coastal Resources Management, and Coastal Policy and Law during their first year as PhD students. These courses are meant to provide minimal levels of competency, and foundations for future coursework and research. The remaining curriculum consists of courses in research methods, data analysis, and a number of electives selected by the students and their academic committee members. At all times within the curriculum, emphasis is placed on developing the knowledge, skills, and abilities to not only conduct research, but to make it relevant, and to communicate research results to different audiences. This problem-solving based educational method has proven to be very attractive to potential applicants and provides a diversified pool to recruit from. Additionally, the strong integration of social sciences and policy provides the program with a unique curriculum that is not found elsewhere, and is very consistent with NSF trends that often require proposals to be interdisciplinary.

Another advantage of the interdisciplinary structure of the CRM program is that students are not limited in selecting dissertation chairs and committee members. Students can select the most relevant faculty in the university to work with, regardless of their departmental affiliation. To date, faculty members from 17 different departments at ECU have served on CRM doctoral committees or otherwise significantly participated in the program. The faculty also provide significant support to the students. The CRM program supports more students through external funding than any other graduate program on campus. The commitment of faculty across campus to the program, as well as the high profile coastal research that occurs at ECU have contributed to make the CRM PhD program the flagship graduate program at the university, and it is aligned well with university strategic goals for research. Furthermore, the requirement that dissertation committees must include a qualified member from outside ECU ensures that students will become engaged with researchers at other universities and government agencies.

An additional strength of the program is the demand for its graduates. Of the 32 graduates the program has produced, 31 of these are gainfully employed in their field of choice. Unlike many PhD programs where graduates are limited to working in academia, students who earn the PhD

in CRM often have the choice of taking an academic position, or working for a government agency or non-profit group. Of the most recent nine graduates (May 2010 – August 2012), four are employed in academic positions, two are completing post-docs, and three are employed by federal agencies (National Park Service, US Army Corps of Engineers, and NOAA).

Program Impacts

As mentioned above, the CRM PhD program has a great impact on the research productivity of the university as a whole. Furthermore, due to the nature of the program, the vast majority of dissertations contain applied components that often time lead to management and policy recommendations to improve the coastal resources within NC and beyond. The majority of CRM students have helped produce technical reports and white papers designed to assist coastal resource managers and inform policy making, below are a few recent examples:

- Several CRM students (Chris Ellis, April Evans, Lauren Jordan) were involved with studies at both Cape Hatteras and Cape Lookout National Seashores. The results of these studies were used to inform and develop Off-Road Vehicle and Visitor Management plans.
- Significant involvement from several CRM students on the partnership between the NC Turnpike Authority and ECU produced a series of documents and technical reports that led to the crafting of the Environmental Impact Statement for the Mid-Currituck Bridge Project.
- The dissertation work of recent CRM graduate Charles Humphries has resulted in recommendations to the State to change/modify/revise the permitting regulations for septic tank site locations based on soil types within the NC coastal plain. These recommendations are currently being considered by the NC Division of Natural Resources.
- Knauss Fellow Jennifer Cudney has been working with the National Marine Fisheries Service to develop policy and regulations designed to properly manage the sustainable use of highly migratory fish species on the national level.
- Current CRM student Sarah Watkins Kenney has been engaged with the NC Division of Cultural Resources to develop a decision tree on how to best optimize resources for conserving different underwater cultural resources within the States waters.
- Current CRM Student Sarah Young co-authored a response to the recent National Oceans Policy document that included recommendations to incorporate ecosystems goods and services, provisions for public engagement, and strengthening governance standards as suggested revisions to the policy.
- L.J. Palmer-Maloney has been working with the Department of Defense in developing water resources policy designed to decrease insurgency of local populations in areas that are occupied by US forces across the Middle East and elsewhere.
- Current CRM student Devon Eulie has done extensive field and lab work to map coastal resources and assets that are at risk from coastal erosion and sea-level rise. This work informs the scale and prioritization of adaptation efforts, and may influence the development and improvement of more sophisticated risk management tools.

Challenges

The most immediate challenge facing the program in the coming year will be to maintain the current funding stream to support student compensation packages and research. Although the CRM program is aligned well with graduate school strategic priorities, reallocation and distribution of graduate school funding is under consideration at the university level. While the

program expects to fare well, there will be increased internal competition for these resources. Additional challenges related to adequate funding focus on maintaining external grant and contract funding streams. While CRM faculty and affiliates have been very successful in securing external research funding and using these funds to support CRM students, the nature of these funding streams is cyclic and often unpredictable. This challenge is amplified by the shrinking and uncertain budgets of state, federal, and regional government agencies that have traditionally provided the foundation of support for research at universities.

In addition to the funding issues mentioned above, an additional long-term challenge is the national trend of fewer applicants to ocean/coastal graduate programs. This has been blamed on fewer undergraduate students enrolling in STEM disciplines and thus limiting opportunities to pursue degrees in traditional ocean and coastal science programs. The CRM program may be better equipped to handle this downturn due to the fact that it considers and admits students from diverse backgrounds including those both with and without STEM degrees.

Future Directions and Program Sustainability

In order to insure the future sustainability of the CRM program, efforts will focus on two primary objectives. These are to maintain/increase funding for the program and to maintain demand for the program. Specifically, the following tasks are currently underway or planned:

Maintain/Increase Funding

Submission of an IGERT Grant. The Integrative Graduate Education and Research Traineeship Program (IGERT; NSF 11-533) was (in the words of NSF) “developed to meet the challenges of educating U.S. Ph.D. scientists and engineers with interdisciplinary backgrounds, deep knowledge in chosen disciplines, and technical, professional, and personal skills.” The program is extremely compatible with CRM as a “new models for graduate education and training”. . .”that transcends traditional disciplinary boundaries” and can help faculty “contribute to a world-class, broadly inclusive, and globally engaged science and engineering workforce.” IGERT resources include awards of up to \$400,000 for the first award year, and amounts up to \$600,000 for each of the next four years.

Encourage and reward external funding success. Faculty who are successful in securing external funding to support CRM students need to be recognized and rewarded for their efforts. We plan to subsidize faculty who support CRM students with external funds by providing them an additional student supported through program funds. The CRM students who are assigned to faculty members without external funding will be expected to work with these faculty members on writing grant applications as a portion of their assistantship duties.

Development Efforts. The CRM program can no longer solely depend on university resources and external research funding to support all of its activities. A strategic development plan will be created to identify potential partners, sponsors, and donors who may be in a position to provide funding to the program. This may include the creation of academic and travel scholarships, the endowment of the CRM Director position, or the potential for “naming rights” for a new school or department focused on educating future coastal leaders. In any case, ICSP/CRM will need to be entrepreneurial in pursuing non-traditional funding sources.

Alumni Event. The CRM program now has a critical mass of alumni that is large enough to justify the creation of an alumni event. Not only would such an event potentially raise funds for the development effort outlined above, it could also be used to garner social and professional capital for current program incentives and activities.

Maintain Demand for the Program

Consider Program Name Change. While the Coastal Resources Management name has served the program well, speculation has been voiced that a name change could help increase the number of program applicants within the STEM concentrations. Incorporating the word “science” into the program name may enhance the reputation of the program as one that produces coastal scientists, rather than managers. Current suggestions for name changes include the PhD in Coastal Science and Policy (CSP), and the PhD in Coastal, Human, and Environmental Sciences (CHESS).

Strengthen Brand. Along with considering the above name change, additional efforts will be made to help strengthen the brand of the program beyond the boundaries of NC. Providing leadership and sponsorship efforts to national and international conferences and symposia such as The Coastal Society Conference, Coastal Zone 2013, and 2013 Natural Resource Economics and Policy Symposium will be continued and other events/venues will also be considered. Additionally, students will continue to be encouraged to publish the results of their research in peer reviewed journals and will be assisted to travel to meetings in order to make research presentations. A mechanism for identifying competitive awards at the national and state levels will be implemented and students will be encouraged to apply for them where appropriate.

Constant Curriculum Assessment and Revisions. In order to meet the needs of changing populations of students and to help solve shifting coastal problems, program curricula require constant assessment and periodic revisions. Alumni, current students, and CRM faculty will be surveyed to determine how effective they believe the curriculum is and to gain suggestions for revisions. Efforts will also be made to consider an additional concentration area in Coastal Resource Economics.

Recruiting Under-Represented Populations. Efforts will be made to identify best practices in recruiting and retaining under-represented populations. Once these have been identified, a plan will be developed and implemented in order to increase applications from these populations. Consulting with similar programs at Texas A&M University and the SCRIPPS Institute of Oceanography, both of whom have had recent success in increasing minority applicants, will be a key part of this effort.

Development of Undergraduate and MS feeder Programs. Currently the only specifically coastal degree available at ECU is the CRM PhD program. Lower level degrees in Coastal Science or Coastal Management that are housed within the same administrative unit as the PhD program would not only act as feeder programs for the PhD program, but would also provide PhD students who wish to enter academia with opportunities to gain instructional experience in undergraduate teaching. Any future development of new academic programs will need to consider existing coastal related undergraduate and Masters programs to ensure that the new programs complement the existing degrees rather than compete with them.

A. Resources

3. Personnel

- c.) The following faculty are the CRM Faculty. CRM faculty are defined as all the faculty holding joint positions with ICSP, as well as faculty who have chaired or co-chaired a CRM PhD student within the time frame under study.

Table C1. Personnel

Name	Title and department/college	Role
Allen, Tom	Associate Professor, Geography/HCAS	Instructor & Advisor
Bean, Eban	Assistant Professor, Engineering/CST/ICSP	Instructor & Advisor
Brewer, Jennifer	Assistant Professor, Geography/HCAS/ICSP	Instructor & Advisor
Chalcraft, David	Associate Professor, Biology/HCAS	Instructor & Advisor
Clough, Lisa	Associate Professor, Biology/HCAS/RGS	Instructor & Advisor
Corbett, D. Reide	Associate Professor, Geology/HCAS/ICSP	Instructor & Advisor
Crawford, Tom	Associate Professor, Geography/HCAS	Instructor & Advisor
Edwards, Bob	Associate Professor, Sociology/HCAS	Instructor & Advisor
Griffith, David	Professor, Anthropology/HCAS	Instructor & Advisor
Harris, Lynn	Assistant Professor, History/HCAS	Instructor & Advisor
Johnson, Jeff	Professor, Sociology/HCAS/ICSP	Instructor & Advisor
Kimmel, David	Assistant Professor, Biology/HCAS/ICSP	Instructor & Advisor
Kruse, Jamie	Professor, Economics/HCAS	Instructor & Advisor
Landry, Craig	Associate Professor, Economics/HCAS/ICSP	Instructor & Advisor
Leorri, Eduardo	Assistant Professor, Geology/HCAS	Instructor & Advisor
Loomis, David	Associate Professor, RCLS/HHP/ICSP	Instructor & Advisor
Luczkovich, Joseph J	Associate Professor, Biology/HCAS/ICSP	Instructor & Advisor
Manda, Alex	Assistant Professor, Geology/HCAS/ICSP	Instructor & Advisor
Marcucci, Dan	Assistant Professor, Geography/HCAS	Instructor & Advisor
Miller, Rick	Professor, Geology/HCAS/ICSP	Instructor & Advisor
Mitchelson, Ron	Professor, Geography/HCAS/RGS	Instructor & Advisor
Mitra, Siddhartha	Assistant Professor, Geology/HCAS	Instructor & Advisor
Montz, Burrell	Professor, Geography/HCAS	Instructor & Advisor
O'Driscoll, Micheal	Assistant Professor, Geology/HCAS	Instructor & Advisor
Reyes, Enrique	Associate Professor, Biology/HCAS/ICSP	Instructor & Advisor
Richards, Nathan	Associate Professor, History/HCAS	Instructor & Advisor
Rulifson, Roger	Professor, Biology/HCAS/ICSP	Instructor & Advisor
Rummel, John	Professor, Biology/HCAS/ICSP	Director of ICSP - ADMIN
Suh, Hong-Bing	Associate Professor, Geography/HCAS	Instructor & Advisor

Van Holt, Tracy	Assistant Professor, Geography/HCAS/ICSP	Instructor & Advisor
Vogelsong, Hans	Associate Professor, RCLS/HHP/ICSP	Director of CRM - ADMIN
Walsh, J.P	Associate Professor, Geology/HCAS/ICSP	Instructor & Advisor
Wang, Yong	Associate Professor, Geography/HCAS/ICSP	Instructor & Advisor

d.) Provide current number and general description of undergraduate students, graduate students, and post-docs involved with the Activity.

There are currently 39 PhD students enrolled within the Coastal Resources Management PhD Program. These students come from diverse academic backgrounds and have a primary concentration in one of the three following foci areas:

- *Coastal and Estuarine Ecology* – focuses on near-shore and estuarine processes important for living marine resources and environmental quality and offers opportunities for specialization in fisheries, coastal plain, wetland, marine and estuarine populations, communities and ecosystems, water quality, and land/water interactions;
- *Coastal Geosciences* – emphasizes coastal and atmospheric processes, geomorphology, and water resources as they affect the use and development of the coastal margin and provides opportunities for specialization in atmospheric science, coastal geology and sedimentary processes, hydrology, and biogeochemistry;
- *Coastal Social Science and Policy* – focuses on the social, economic, and political aspects of environmental resources management and offers opportunities for specialization in marine policy, law, and planning; natural resource and environmental economics; social and institutional behavior as these relate to resource development and management; sustainable tourism; adaptation to climate change and hazards; and maritime cultural heritage.

4. Funding

Table C2: Revenue

Source	FY10 (\$)*	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Federal		114,000	104,000	102,000	144,000
State (not including university)		110,000	104,000	110,000	96,000
Institution (e.g.		240,000	288,000	328,000	360,000

University)					
Foundation					
Other*				5,000	
Total		464,000	496,000	545,000	600,000

* No program level data available for Fiscal year 2010

All revenues provided in the above table are for graduate assistantship stipends:

Table C3: Expenses

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Personnel *	371,161	313,225	457,787	100,091	400,000
Programmatic	21,124	33,866	19,869	3,285	26,000
Physical infrastructure					
Maintenance and operation					
Equipment (>\$5,000)					
Other Direct Costs					
Indirect Costs					
Total					

* Includes some graduate assistant stipend funds

5. *Physical infrastructure*

Describe the key physical infrastructure that supports your Activity.

Currently have two faculty offices (Runyan and Vogelsong) Flanagan 379 & 377
 Seven offices for shared graduate student office space Flanagan 159, 161, 161A, 163, 163A, 165, 376
 CRM computer lab Flanagan 378
 CRM library Flanagan 378 A
 CRM Conference room Flanagan 371
 CRM mail and copy room Flanagan 381

D2. Research, Teaching, Public and Professional Service

1. *Research*

Table D1. Research

Project title	PI/CoPIs – include institution	Sponsor	Amount	Dates
Marine Debris	Vogelsong	NOAA	52,112	10/1/10 –

Survey in the Coastal North Carolina Region				10/31/12
CESU: Maps, Marshes, and Management Applications: Ecological Effects of Sea Level Rise in North Carolina	Thomas Allen; Melody Bentz; Michelle Covi	DOC National Oceanic and Atmospheric Administration (NOAA)	\$87,750	7/11-6/13
Modeling Natural Disaster Risk Management: A Stakeholder Perspective	Jamie Kruse; Richard Ericson	University of Delaware	\$125,000	1/10-12/12
A Structural Approach to the Incorporation Cultural Knowledge in Adaptive Adversary Models - 2009	Jeffrey Johnson	Carnegie Mellon University	\$265,114	9/8-9/12
Cooperative Winter Tagging Cruise, 2013-2015, for Atlantic Striped Bass and Affiliated Species	Roger Rulifson	Division of Marine Fisheries (DMF)	\$238,836	
Is Cape Cod a Natural Delineation for Migratory Patterns in US and Canada	Roger Rulifson	Commercial Fisheries Research Foundation	\$140,348	
Identification of Juvenile Spiny Dogfish Habitats in North Carolina Coastal Waters	Roger Rulifson; Cindy Evans	North Carolina Sea Grant	\$106,683	
Maturation, Fecundity, and Spawning Frequency of	Roger Rulifson	N.C. Division of Marine Fisheries	\$105,119	

Albermale/Roanoke Striped B				
Maturation, Fecundity, and Spawning Frequency of the Albermale/Roanoke Striped B	Roger Rulifson	N.C. Division of Marine Fisheries	\$100,631	
Origin of Central Southern Management Area Striped Bass Using Otolith Chemistry, and Recommendations for Fishery Management	Roger Rulifson; Jeffrey Dobbs; Joey Smith	N.C. Division of Marine Fisheries	\$77,351	
Identification of River Herring Spawning & Juvenile Habitat in Albemarle Sound	Roger Rulifson; Cynthia Harper	U.N.C.-Sea Grant Program	\$70,429	
Gillnet Calibration for Spiny Dogfish Abundance Assessment	Roger Rulifson	U.N.C.-Sea Grant Program	\$68,664	
RAPID collaborative research: Historic freshwater input and hypoxia effects on zooplankton populations of the northern Gulf of Mexico	David Kimmel	National Science Foundation	\$85,191	7/31/11-7/31/12
WELFARE ECONOMICS OF BEACH NOURISHMENT PROJECTS USING OCS SAND RESOURCES	Craig Landry	DOD DA Army Corps of Engineers	\$149,998	10/11-10/13
CESU: Commercial Fishing Hang Data as a Proxy for	Timothy Runyan; Joyce Steinmetz	Department of the Interior (DOI)	\$250,000	9/11-8/13

Locating Shipwreck Sites off the Mid-Atlantic Coast				
Regional Engagement Center for Coastal Systems Informatics and Modeling (C-SIM)	Thomas Allen; Libero Bartolotti; Jeffrey Johnson; Jamie Kruse; Ernest Marshburn; Ronald Mitchelson; Lloyd Novick; Enrique Reyes	U.N.C.-Chapel Hill	\$650,000	7/10-9/12
Reducing Recreational Boating Accidents through Advanced Risk Analysis	Ronald Mitchelson; Ernest Marshburn; Yong Wang	United States Power Squadrons	\$76,376	7/11-4/13
Collaborative Research: Measurement and Modeling of Aerodynamic Interactions between Tree-Sway-Motion and Turbulence in and above a Forest Canopy	Hong-Bing Su	National Science Foundation, GEO/ATM – Physical & Dynamic Meteorology Program	\$255,537	02/01/09 – 1/31/13

Grants were only included if a portion of their amount is currently being used to provide support for CRM PhD Students

2. Teaching and Instruction (if applicable)

c.) Identify courses taught for degree credit that are directly related to the Activity.

Table D2. Teaching and Instruction for Degree Credit

Course title, number, and level	Dates offered	Instructor(s) and affiliation(s)	Brief description of course (one sentence)	Enrollment Figures
GEOL 7002. Coastal Geoscience	Every Fall	Walsh GEOL/ICSP	Fundamental concepts of geological and physical oceanographic principles of coastal systems.	8-12
PADM 7004. Marine Policy, Governance, and Law	Every Spring	Schavianoato NC Sea Grant	Processes, politics, laws, and institutions as they affect marine, coastal, and climate policy in the United States	8-12

BIOL 7005. Coastal Ecological Processes	Every Fall	Kimmel BIOL/ICSP	Fundamental concepts of chemistry and biology within the context of the coastal zone with emphasis on local ecosystems	10-20
CRM 7005. Human Dimensions of Coastal Management	Every Fall	Loomis RCLS/ICSP	Concepts, theories, and frameworks of human values, attitudes and behavior related to coastal resources.	8-12
CRM 7006. Seminar in Coastal Issues and Professional Development	Every semester	Vogelsong CRM	Topics include analysis of coastal issues; proposal and dissertation preparation; professional communications; ethics in research.	10-20
CRM 7007. Research Design in Marine and Coastal Studies	Every Spring	Johnson & VanHolt SOCI/GEOG / ICSP	Fundamentals of planning, evaluation, and implementation in marine research.	8-12
CRM 7008. Data Analysis	Every Spring	Luczkovich BIOL/ICSP	Statistical, quantitative, qualitative, and spatial techniques for coastal research.	8-12
CRM 7010. Special Topics in Coastal Science and Policy	As needed	Varies	Readings, presentations, and critical analysis of literature in coastal science and policy.	3-10
CRM 7011. Special Topics in Coastal Research and Methodology	As needed	Varies	Readings, classroom, laboratory and field work on specific research instruments, measurements, and techniques.	3-10
CRM 7012. Directed Study	As needed	Varies	Individual student research under the guidance of a graduate faculty member.	1
CRM 7300 Case Studies of Coastal	As needed	Varies	Teams of students with varying disciplinary backgrounds examine	8-12

Management Issues			application of scientific data to specific coastal issues of concern to coastal management agencies and private sector organizations.	
CRM 9400. Internship.	As needed	Vogelsong CRM	Supervised internship with government agencies, private sector business or organization, or non-profit group that has coastal resources management responsibilities, concerns, or activities.	1-5
CRM 9000. Dissertation	Every semester	varies	Dissertation work	1-20

d.) Public Service, Outreach and Community Engagement

Table D4. Public Service, Outreach and Community Engagement

Public Service / Outreach/Engagement	Dates	Personnel Involved	Participants in program (e.g. K-12 teachers)	Number of participants
Blue Heron Bowl competition of the National Ocean Science Bowl	2011 & 2012	Approximately 15 CRM students participated in a variety of roles	High School Students	200+
Demonstration of fish sound-production, zooplankton analysis, and fish length analysis for the Ocean Adventure Summer Camp	2008 & 2009	Cecilia Krahforst		
Müller’s maritime musicians: Fritz Müller’s letter to Charles Darwin about sound-producing fishes in Brazil. Poster and demonstration given at Darwin Day 200 Biodiversity Celebration. East Carolina University	2009	Cecilia Krahforst		
Middle School Ecology Leader for the North	2009	Cecilia Krahforst	Middle school students	

Carolina Science Olympiad				
Hurricane Floyd Symposium	2009	Tom Allen, Michelle Covi, Stephen Sanchagrin	Public, managers, professionals, researchers,	300+
Dare County Hurricane Evacuation Simulation Exercise (Felix 2010) (organized and facilitated by RENCI@ECU)	2010	Tom Allen, Stephen Sanchagrin, Michelle Covi, Donna Kain, Burrell Montz	Dare County Control Board, NC and VA Emergency Mgt, National Park Service, US Coast Guard, NC State Police	25
Annual NC Hurricane Wkshop	2010-12	Tom Allen, Michelle Covi, Stephen Sanchagrin	Emergency managers, communicators and responders, researchers, meteorologists	100+ annual
Estuarium Kiosk	2012	Tom Allen, Travis Hill, Michelle Covi	General public	
ECU Visualization Challenge	2009-12	Tom Allen, Stephen Sancharin, Michelle Covi	Higher education students	40
Open houses, science festival/fairs, outreach events	2008-2012	Tom Allen, Michelle Covi	k-12 teachers and students, families, general public	100 annual

e.) Professional Service

Table D5. Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service provided
The Coastal Society Conference Organizational Committee	2011-2012	Elizabeth Brown Pickren	Committee member
The Coastal Society Conference Organizational Committee	2011-2012	Michelle Covi	Webmaster
East Carolina	2012	Hillary Huffer	President

University, Graduate and Professional Student Association			
East Carolina University, Graduate and Professional Student Association	2011	Hillary Huffer	Secretary
Organizer of the Symposium titled “Management of elasmobranch fisheries: sustainability, conservation, and regulation of global trade”. 141 st Annual Meeting of the American Fishery Society, September 7, 2011, Seattle, WA	2011	Andrea Dell’Apa	Symposium Organization
UNESCO Colloquium on Factors impacting Underwater cultural Heritage	2011	Sorna Khakzad	Colloquium Coordinator
American Fisheries Society, Annual Meeting Program Committee	2008-2009	Jennifer Cudney	Conference Organization

Service is only included if conducted by CRM Students. Service by CRM faculty will be included in other chapters

B. Outputs and Impacts

5. Publications (students highlighted in yellow)

Title	Journal	Year	Authors
Does vessel noise change the calling rate and intensity of soniferous fishes?	Advances in experimental medicine and biology	2012	Joseph J Luczkovich; Cecilia S Krahforst; Mark W Sprague
Participation in the Community Ratings System of NFIP: An Empirical Analysis of North Carolina Counties	Natural Hazards Review	2012	Craig Landry; Jingyuan Li
A Case for Coastal Theory with Lessons from planning theory	Coastal Management	2012	Dan Marcucci; James Brinkly; Lauren

			Jordan
Influence of turbidity on the incidence of sound production in Atlantic croaker (<i>Micropogonias undulatus</i>) in Pamlico Sound, North Carolina.	Advances in experimental medicine and biology	2012	Cecilia S Krahforst; John P Walsh; Mark W Sprague; Devon O Eulie; D Reide Corbett; Joseph J Luczkovich
Monuments in the Desert: A Maritime Landscape in Namibia	Journal of Maritime Archaeology	2012	Lynn Harris; Jennifer Jones; Kate Schnitzer
Resource attributes that contribute to nonresident diver satisfaction in the Florida Keys, USA	Tourism in Marine Environments	2012	Shona Paterson; Sarah Young; David K. Loomis; William Obenour
Structure of ethnic violence in Sudan: a semi-automated network analysis of online news (2003-2010)	Computational and Mathematical Organization Theory	2012	Tracy Van Holt; Jeffrey C. Johnson; James D. Brinkley; Kathleen M. Carley; Janna Caspersen
The Magnuson-Stevens act (1976) and its reauthorizations: Failure or success for the implementation of fishery sustainability and management in the US?	Marine Policy	2012	Andrea Dell'Apa; Lisa Schiavinato; Roger A. Rulifson
Trends of fish and elasmobranch landings in Italy: Associated management implications	ICES Journal of Marine Science	2012	Andrea Dellapa; David G. Kimmel; Simona Cl
Addressing onsite sampling in recreation site choice models	Journal of Environmental Economics and Management	2011	Paul Hindsley; Craig E. Landry; Brad Gentner
Astronomical tidal regime change as a control on the holocene development of an organic-rich coastal zone, North Carolina, USA	Southeastern Geology	2011	Peter R. Parham; Stanley R. Riggs; Stephen J. Culver; David J. Mallinson; Dorothy Peteet
Cumulative saturation of low chroma soil colors and shallower depths: Implications for on-site wastewater system design	International Journal of Soil Science	2011	C.P. Humphrey Jr.; M.A. O'Driscoll
Evaluation of on-site wastewater system Escherichia coli contributions to shallow groundwater in coastal North Carolina	Water Science and Technology	2011	C.P. Humphrey Jr.; M.A. O'Driscoll; M.A. Zarate
Valuing beach quality with hedonic property models	Land Economics	2011	Craig E. Landry; Paul Hindsley
Review of submarine groundwater discharge (SGD) in coastal zones of the Southeast and Gulf Coast regions of the United States with management	Journal of Environmental Management	2009	C.A. McCoy; D.R. Corbett

implications			
Riparian buffers and hedonic prices: A quasi-experimental analysis of residential property values in the Neuse river basin	American Journal of Agricultural Economics	2009	Okmyung Bin; Craig E. Landry; Gregory F. Meyer
Experimental assessment of trophic impacts from a network model of a seagrass ecosystem: Direct and indirect effects of gulf flounder, spot and pinfish on benthic polychaetes	Journal of Experimental Marine Biology and Ecology	2008	David R. Gloeckner; Joseph J. Luczkovich
Intergovernmental influences on the implementation of coastal zone management in the United States: Public shoreline access in the Southeast	Ocean and Coastal Management	2008	Amy F. Blizzard; William R. Mangun
Writing on the plywood: Toward an analysis of hurricane graffiti	Coastal Management	2008	Derek Alderman; Heather Ward
Water as Nexus: Linking U.S. National Security to Environmental Security	Journal of Military Geography,	2010	Palmer-Moloney, L. J.

Publications were only selected if they were authored by a current students or a recent Alumni (within 2 years of gradation) of the Coastal Resources Management Program

c.) List non-refereed publications such as journal articles, reviews, conference papers, books and book chapters directly related to Activity.

d.)

Title	Venue/Publisher	Year	Authors
If You Know What's Good for You': The Need for 'Social Marketing' to Sell North Carolina Communities on the Ecosystem Benefits of Alternative Estuarine Shoreline Stabilization Methods	The Coastal Society's 23rd International Conference	2012	Deanna Swain
Panel: Wading In – Tackling Sea Level Rise in North Carolina: Risk Assessment, Communication, Adaptation Strategies, and Policy-Making	The Coastal Society's 23rd International Conference	2012	Michelle Covi , East Carolina University, John Dorman, North Carolina Department of Crime, Control and Public Safety, n Tancred Miller, Division of Coastal Management, North Carolina Department of Environment and Natural Resources. n Gavin Smith, University of North Carolina at Chapel Hill, n Dylan Sandler, University of North Carolina at Chapel

			Hill
Analyzing Potential Oil Spill Damages to Wetlands in Galveston Bay: A GIS Centric Approach	The Coastal Society's 23rd International Conference	2012	Hillary Huffer
International Trade in Spiny Dogfish and Fishery Management Aspects	The Coastal Society's 23rd International Conference		Andrea Dell' Apa
Characterizing the Social Landscape and Land Cover of Barrier Island Communities	The Coastal Society's 23rd International Conference		Andrew Bennett
CZMA'S Lone Departure: The Alaska Coastal Management Program	The Coastal Society's 23rd International Conference		Elizabeth Brown-Pickren
A Comparison of Recreational and Commercial Fisherman on Perceptions of Management Measures on Striped Bass <i>Morone saxatilis</i> in the Albemarle Sound/ Roanoke River	The Coastal Society's 23rd International Conference		Coley Hughes
Monitoring changes in high-turbidity submerged aquatic vegetation (SAV) beds in North Carolina's estuaries using single-beam SONAR and low-light video	Coastal Estuarine Research Federation meeting	2011	Krahforst, C.S.; J.J. Luczkovich; R.W. Curran; J.J. Kenworthy; C.A. Buckel; D. Field; D.E. Carpenter; G.R. Plaia.
Influence of turbidity on the incidence of sound production in Atlantic croaker (<i>Micropogonias undulatus</i>) in Pamlico Sound, North Carolina	In: A.N. Popper and A. Hawkins (eds.). The Effects of Noise on Aquatic Life. Springer. NY	2012	Krahforst, C.S.; J.P. Walsh; M.W. Sprague; D.O. Eulie; D.R. Corbett; and J.J. Luczkovich
High Resolution Observations of Wetland Shoreline Change in the Albemarle-Pamlico Estuarine System	Coastal Estuarine Research Federation meeting	2011	Devon Eulie
Short-term Erosion of Wetland Shorelines in the Albemarle-Pamlico Estuarine System	Southeastern Section of the Geological Society of America regional meeting	2011	Devon Eulie
Storm Practices: Lessons Learned from Hurricane Irene,	Coastwatch, NC Sea grant	2012	Michelle Covi
Climate, Weather, and Tourism Workshop: Issues and Opportunities, A Summary Report	ECU Center for Sustainable Tourism,	2008	Covi, M. P., Eulie, D. and Evans, A.

'Risk Communication and Perception of Climate Change and Adaptation in Northeastern Coastal North Carolina	Coastal Zone 2011,	2001	Covi, M. P. and D. J. Kain.
The Dynamics of Human Developed Land Use and Cover Patterns Along the US Atlantic Coast	US-IALE Annual Symposium	2012	Andrew Bennett
Social Landscapes and Land Cover Characterization of Coastal Barrier Island Communities	Annual Meeting of the Association of American Geographers, New York, NY	2012	Andrew Bennett
Male:female ratio changes in spiny dogfish (<i>Squalus acanthias</i>) fishery-dependent surveys in Cape Cod, MA	28th Annual Meeting of the American Elasmobranch Society, Vancouver, Canada	2012	Dell'Apa, A., J. Cudney-Burch, and R.A. Rulifson
The Role of Social Resilience in Marine Protected Area Establishment	Coastal Zone 2011, Chicago	2011	Shona Patterson
Power, Governance and Multi-stakeholder Participation	Coastal Zone 2011, Chicago	2011	Sarah Young
NMFS. 2011. A Report on the History of United States Swordfish Fishing and a Development/Management Plan for the United States Swordfish Fishery Prepared Pursuant to ICCAT Recommendation 10-02.	National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.	2011	Jennifer Cudney

6. Awards and Honors

Table E1. Awards and Honors

Award or Honor	Date	Name	Brief Description
Outstanding Student Presentation Award	2011	Sarah Young	Outstanding Student Presentation Award for best student presentation at Coastal Zone 2011
Walter B. Jones Memorial Award for Excellence in Coastal and	2012	Michelle Covi	From NOAA national Ocean Services

Marine Graduate Study			
Best student paper award	2010	Cecilia Krahforst	Bi-annual meeting of the Atlantic Estuarine Research Society
First place for oral student paper awards	2010	Cecilia Krahforst	24th Annual Meeting of the Tidewater Chapter of the American Fisheries Society. Annapolis, MD
Best Graduate Oral Presentation in the Natural Sciences	2012	Devon Eulie	Research and Creative Achievement Week at ECU
ESRI Map Award	2012	Brent Gore, Matt Carey, Travis Hill and Michelle Covi	Cartography award for Sea Level Rise Vulnerability Map for the Albemarle Pamlico Sound area.
ECU – Research and Creative Week. Best Graduate Oral Presentation on Social Sciences	March 2012	Michelle Covi	Research presentation award for “Sea-level Rise Perception and Decision Making in Plymouth, North Carolina”
World of Difference Award,	2012	Michelle Covi	Ecology Action Center
SAS Ambassador	2011	Hillary Huffer	SAS
John A. Knauss Marine Policy Fellowship	2011	Jennifer Cudney	National Sea Grant College Program
Walter B. Jones Memorial & NOAA Excellence Award for Coastal and Ocean Resource Management, Excellence in Coastal and Marine Graduate Studies	2012	Jennifer Cudney	From NOAA national Ocean Services

A3. The Program in Maritime Studies

B3. Activity Narrative

The Program in Maritime Studies at East Carolina University is a two year 36 credit Masters Degree concentration in Underwater Archeological Science. Studies and training include method and theory of shipwreck archeology and underwater data recording techniques, as well as maritime history of the western hemisphere, the history and archaeology of maritime archaeological landscapes, waterfronts, and harbors, as well as the study of any human activity associated with oceans, rivers, lakes, and the waterborne transportation industry, and related economics.

History

The Program in Maritime Studies originated in 1981 under the foresight and vision of Professors Bill Still (Historian) and Gordon Watts (Nautical Archaeologist). From its humble beginnings the program has grown to become one of the premier programs of its kind in the world. Thus far the Program has been housed in the History Department but operates as a separate unit with its own budget, director, staff, physical space, equipment, and Graduate Assistants.

This Semester we will graduate our 200th MA student, with 10 total graduations planned this year. Our average incoming class from the program's inception is 12 students per year, though we operate with many more now, and have roughly 53 - 55 students on campus at any given time. From 1981 until 2008 (available statistics) we graduate our students at the rate of 71%, with 72% of these graduates gaining employment in the field. Thirty-three of our graduates have gone on to earn PhDs either with our own Coastal Resource Management Program or from other universities, with 91% of these people working in upper level management and faculty positions. Student recruitment and increased qualification has spurred our program growth with entry level student GPAs and GRE scores that qualify virtually all of our students for Graduate Scholar Awards.

Initial faculty and staff in 1981 included one faculty archaeologist, one associated history professor, and one staff archeologist. This has grown over the years to 5 faculty archaeologist positions, 3 associated faculty history positions, and 3.5 staff members consisting of a conservator, an archaeologist, and an administrative assistant.

In 2011 the program was given permission to continue planning a PhD in Maritime Archaeology by the University. The plan has not yet been submitted to the GA for review. Implementation of this plan involves a significant step for the program. It will, however, insure the development and continued success of the program into the future.

Unique Activity

There are only 5 academic programs in the world that train archaeologists to work underwater and only four that offer specific degrees in Underwater and Nautical Archaeology (ECU, Texas A&M, Bristol, England, West Florida, and Flinders University in Adelaide, Australia). Of all of these locations, ECU is best situated to study wrecks of the Atlantic

Seaboard, especially given ECU's relationship with the Coastal Studies Institute on Roanoke Island. Nicknamed "the Graveyard of the Atlantic" the coast of North Carolina is littered with hundreds of wrecks both underwater and on the beaches. This cultural maritime heritage is a resource for the Program and the Heritage Tourism Industry of the coast. In addition to its numerous oceanic sites, the state is uniquely suited to the cultural resource study of Riparian, Sound and Lake environments since sound and river transport vessels abound and were tremendously important to the historic and economic development of the region and state.

It should also be noted that the Program does not limit its activities to North Carolina, as important as those are. Projects span the gamut of geographical locations from the Caribbean to the Great Lakes and the Mediterranean to Midway Island in the Pacific. These projects garner great publicity for the University and the State, truly making this an international program. In this light the program attracts a great many out of state and international students many of whom stay to work in the state, while others return to their native lands forming a worldwide network of alumni.

Significant Impacts (Research, Education, Society), Examples:

In 2009 Program researchers identified the oldest shipwreck in the state. Its remains had captured a great deal of interest when they washed up the previous year near Corolla, N.C., on the outer banks. This ship, dated between 1610 and 1650 by its hull structure, still contained French coins, but more importantly, it gave us and the public, a rare look at a vessel of this age. The wreck has since been transported to the Hatteras Shipwreck Museum .

This summer ECU researchers and graduate students worked off the coast of Albania in the Adriatic Sea on a late Roman period shipwreck with our partner RPM Nautical Foundation. This is a significant find from this period and we are the first to document this vessel.

In January 2012, researchers with the Program verified their 1994 findings of a sunken PBY WWII patrol bomber in Hawaiian waters, when relatives of the pilot of that plane contacted the university to identify it as having been destroyed during the Battle of Pearl Harbor. No official report was made concerning this plane since the last moments of it and its crew were obscured by smoke. One witness, however, confirmed our published archaeological findings that stated the evidence demonstrated that the crew was likely attempting to take off when the plane was destroyed by attacking fighters. This is a rare circumstance where archaeological analysis was verified over 50 years after the fact by an eyewitness account.

Significant Challenges (1 year) (5 years)

1 Year

The University has charged the Program In Maritime Studies to plan a PhD degree in Nautical Archaeology. The implementation of this planning has gone according to schedule and the necessary resources to implement this plan are within reach of the program. However, the program has twice before planned a PhD, only to have it rejected because the program was not an independent unit. Our next challenge, therefore, is to place the program in an independent administrative position to allow continued planning. The Program has, therefore, taken steps to both disassociate itself from the History Department and create an independent Department of Maritime Studies.

5 Year

The headquarters of the Maritime Program (Admiral Eller House) is scheduled for demolition in 2015. The university architectural planning committee, however, has not offered

an alternative to the Eller House for the Program. The Program has, therefore, found a donor of land and buildings at a nearby facility that could serve as a new headquarters for the program. The donation of the land has been secured and significant private donations are in the offing to create a Maritime facility. However, the plan awaits University approval and support.

Future Directions for and Sustainability

The future growth of the Maritime Studies Program will hopefully include permission to establish and implement the PhD degree in Nautical Archaeology. The Program is in a good position to begin the implementation process. Equipment for a PhD degree is no different from the equipment already available for the MA Program. Additional library resources would help to establish the PhD, but the university support system already in place (in boating and water safety) is well funded, staffed, and already well established. One new position within the archaeological faculty plus 3 new Graduate Assistantships would place the program on a good footing to establish the PhD.

Sustainability for the program will depend largely on the actual physical facilities of the Program. As mentioned, a large donation of land with buildings is in the offing, awaiting university permission and support. It seems entirely possible that a School or College of Coastal Science, now in the discussion phase, could be permitted to join us in this project, largely funded by the private sector.

One possible future direction for the program after the establishment of a PhD, is a plan for an Undergraduate Program in Maritime and Naval Studies. An Undergraduate Degree in Maritime and Naval Studies would make ECU the most comprehensive underwater archaeological training program of its kind in the world. Program and University infrastructure could already support this concept, however, the establishment and location of a headquarters in the near future is key.

C3. Resources

1. Personnel

Table C1. Personnel

Name	Title and department/college	Role
Dr. Lynn Harris	Asst Prof/Hist/HCAS	Nautical Archaeologist
Dr. Nathan Richards	Assoc Prof/Hist/HCAS	Nautical Archaeologist
Dr. Brad Rodgers	Dir and Prof/Hist/HCAS	Nautical Archaeologist
Dr. David Stewart	Asst Prof/Hist/HCAS	Nautical Archaeologist
Open Search Tenure Track	Asst Prof/Hist/HCAS Prof/Hist/HCAS	Nautical Archaeologist Historian
Dr. Mike Palmer	Assoc Prof/Hist/ HCAS	Historian
Dr. Carl Swanson	Assoc Pro/Hist/ HCAS	Historian
Dr. Wade Dudley	Archaeologist I/Hist/HCAS	Nautical Archaeologist
Calvin Mires	Lecturer/Hist/HCAS	Conservator
Susanne Grieve	Administrative	Program Assistant
Karen Underwood	Asst/Hist/HCAS	Archaeological Assnt
Open Search .5 Annual	Archeological Asst/Hist/HCAS	

Undergraduate Students: 0

Graduate Students: 60 (31 enrolled in class) (22 ABT on campus) (7 ABT off campus)

Post-Docs: 0

2. Funding

Table C2: Revenue

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Federal	\$139.4 G				
State (not including university)	\$5 G	\$3 G	\$4.5 G		
Institution (e.g. University)					
Foundation			\$50 G	\$11.4 G	
Other*	\$1.3 G				
Total	\$145.7 G	\$3 G	\$54.5 G	\$11.4 G	\$52.9 G

This Revenue Table includes grants, contracts, and funding procured by 4 faculty members of the Maritime Program for the periods listed. Some of this funding is routed through granting agencies most through ECU Sponsored Programs. It should be noted that funding is not a priority in the History Department. Most of this funding goes directly to student and program field research.

Table C3: Expenses

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Personnel	\$436G	\$436 G	\$436 G	\$401 G	\$421 G
Programmatic	\$73 G	\$60 G	\$49 G	\$49 G	\$49 G
Physical infrastructure					
Maintenance and operation					
Equipment (>\$5,000)					
Other Direct Costs*					
Indirect Costs					
Total	\$509 G	\$496 G	\$485 G	\$450 G	\$470 G

On campus physical infrastructure expenses are provided by the University. Personnel includes 5 Program Faculty Archaeologists and 3 Faculty/Staff personnel. It does not include the 3 professors associated with the program from the History Department. The figures fluctuate in 2012 due to a retirement and hiring lag time. The program operational budget has undergone reduction since 2009 due to the national economic contraction and the state's response.

3. *Physical infrastructure*

The Program in Maritime Studies is headquartered out of the Admiral Eller Building on the main campus of ECU. Additional facilities include equipment storage and staging facilities located at the West Campus VOA site. This facility also serves Diving and Boating Safety. The program conservation laboratory is located near the Allied Health Building and occupies both a double-wide trailer and an associated wet lab.

D3. Research, Teaching, Public and Professional Service

1. *Teaching and Instruction (if applicable)*

Table D2. Teaching and Instruction for Degree Credit

Course title, number, and level	Dates offered	Instructor(s) and affiliation(s)	Brief description of course (one sentence)	Enrollment Figures
HiIST 6810	Fall	Rodgers	History of Ship Construction	18
HIST 6805	Fall	Harris	Theory of Nautical Archaeology	18
HIST 3993	Fall	Greive	Approaches to Historical Objects	6
HIST 6610	Fall	Harris	Legal Issues in Maritime Studies	4
HIST 3980	Fall/Spring	Stewart		16
HIST 6010	Fall	Swanson	Shipwreck Archaeology	12
HIST 6845	Fall	Grieve	Maritime Hist. of Atlantic	6
HIST 6825	Fall	Dudley	Advanced Conservation	12
HIST 6885	Fall	Stewart	Sea Power	6
HIST 6850	Fall	Richards	Recording Watercraft	13
HIST 5520	Spring	Rodgers	Field Semester Research	16
HIST 6825	Spring	Harris	Maritime History from 1815	8
HIST 6080	Spring	Stewart	Am Maritime Material	6
HIST 6020	Spring	Swanson	Culture	8
HIST 6820	Spring	Harris	European maritime History	18
HIST 6210	Spring	Palmer	Colonial History	6
HIST 6890	Spring	Stewart	Research Methods	10
			War and Society	
			Ship Reconstruction	

f.) *Public Service, Outreach and Community Engagement*

The Maritime Studies Association, organized by graduate students of the program, gives lectures at local museums, schools, and community centers on a regular basis. In addition, Dr. Richards, Head of the Maritime Heritage Section of the Coastal Studies Institute, will be conducting and planning community outreach programs for Manteo and the Outer Banks as part of his regular assignments.

g.) Professional Service

Table D5. Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service provided
N.C. Maritime Advisory Council	1996-2012	Larry Babits	
QAR Advisory Board	2011-2012	Lynn Harris	
Coastal Maritime Council	2012	Brad Rodgers	
Coastal Maritime Council	2012	Nathan Richards	
Society for Historical Archaeology	1981 – Present	All Faculty	
Advisory Council on Underwater Archaeology	2009- Present	Lynn Harris	

E. Outputs and Impacts

1. Publications

Books Peer Reviewed (approximately 30 Total): 5 Examples Since 2008

Corbin and Rodgers, The Steamboat Montana and the Opening of the West, Excavation and Architecture, 2008, University Press of Florida.

David Stewart, The Sea Their Graves, An Archaeology of Death and Remembrance in Maritime Culture, 2011, University Press of Florida.

Nathan Richards, Ships Graveyards, Abandoned Watercraft and the Archaeological Site Formation Process, 2008, University Press of Florida.

Lawrence Babits, Historical Archeology of Military Sites, 2011, Texas A & M University Press.

Lawrence Babits, “Long, Obstinate, and Bloody” The Battle of Guilford Courthouse, 2009, University of North Carolina Press.

Articles & Chapters Peer Reviewed Since 2008

Harris, L. 2010 South Carolina Shipyards: Labour, Logistics, Lumber and Ladies. *Journal Of Maritime Archaeology*, Volume 5, Issue I, 17-35.

Brown, D. and Cooper K. and Harris, L. 2010 The Plantation boat *Accommodation*: An Icon of the South. *Nautical Research Journal*, 56 (2), 93-114.

Harris, L. et al. 2010 *SS Eduard Bohlen*, Meob Surf Boats and Grillenberger Diamond Settlement: Historical and Archaeological Assessments in Namib-Naukluft Park, Namibia. Report prepared for the National Heritage Agency, Namibia.

Harris, L. et al. 2011 Colonial Conundrums, Cannon Piles and Clear Water: Investigation of the Catalina Island Shipwreck, Dominican Republic. Report prepared for the Oficina Nacional de Patrimonio Cultural Subacuatico, Dominican Republic.

Richards, Nathan et al. 2013 The Meyer's Boatyard Vessel, Part 2: The Archaeological Investigation of An M-Class Gunboat, in *Bermuda Journal of Archaeology and Maritime History*. In Press.

Richards, Nathan et al. 2012 The Meyer's Boatyard Vessel, Part 1: The Historical Significance of M-Class Gunboats, in *Bermuda Journal of Archaeology and Maritime History*. In Press.

Richards, Nathan et al. 2012 A Bermudian Workhorse: The Dockyard Lighter Wreck, Royal Navy Dockyard, *Bermuda Journal of Archaeology and Maritime History*. In Press.

Richards, Nathan et al. 2009 Dockyard 'Workhorse': Unidentified Wreck is Most Likely a Steam Lighter, *Maritimes: Magazine of the Bermuda Maritime Museum*. Volume 21(3): 18-19.

Richards, Nathan et al. 2009 A Gunboat Rediscovered, in *Maritimes: Magazine of the Bermuda Maritime Museum*, Volume 21(3): 11-13.

Richards, Nathan et al. 2008 *Virtual Modelling and 3D Photogrammetry for Maritime Heritage Exercises in Eos Photomodeler Pro 5.0*, in *Bulletin of the Australasian Institute for Maritime Archaeology* Volume 32: 27-41.

Rodgers, Bradley. 2009 "Skeletons in Black Bay," *Maritimes*, Vol. 21(3), 14-16.

Stewart, David. 2011 “Naval Monuments and Memorials: Symbols in a Contested Landscape.” *Historical Archaeology of Military Sites: Methods and Topic*, edited by Clarence Geier, Douglas Scott, Larry Babits, and David Orr, pp. 197-207. College Station: Texas A&M University Press.

Rodgers, Bradley. “Vernacular Craft of the Great Lakes,” In, *At the Edge of the Known World: Vernacular Boats and Ships as Technological Adaptations to New Environments*, in Amanda Evans and Mark Staniforth. In Press.

Richards, Nathan, Bradley Rodgers et al., *The Vernacular Craft of Castle Island, Washington, N.C.* In, *At the Edge of the Known World: Vernacular Boats and Ships as Technological Adaptations to New Environments*, edited by Amanda Evans and Mark Staniforth. In Press.

2. *Technical Outputs*

Program researchers are obligation to publish the results of site excavations and projects. At times these publications are partner co-sponsored. At present there are approximately 35 of these reports ranging from 50,000 to 150,000 words. Many can be viewed and printed as PDFs from our web site. Others can be found with the Wisconsin Historic Society.

In addition 198 MA Theses have been produced through the program. Most of these works are primary archaeological research conducted during our field projects depicting various shipwreck sites or other submerged or marine landscape features or the theoretical application of archaeological analysis.

3. *Awards and Honors*

Table E1. Awards and Honors - Selected

Award or Honor	Date	Name	Brief Description
National Register of Historic Places	2003	Rodgers	Bullhead Point Nomination
Cleveland St. Book Award	1996	Rodgers	Guardian of the Great Lakes
Partners in Conservation Award	2009	Richards	NOAA partnered project
SHA Dissertation Prize	2004	Richards	Society for Historical Archaeology
Archaeological Research Trust Award	1999	Harris	South Carolina Inst. For Archaeology

A4A. Other Center and Program Activity: PhD in Economics

B4A. Activity Narrative

- Context: The proposed doctoral program in Economics has gone through the lengthy process that has led to the final step of Request for Authorization to Establish (RAE) a New Degree Program. The package was submitted to UNC General Administration on June 11, 2012 with supporting cover letter from the Office of the Chancellor. We received a letter dated July 27, 2012 acknowledging the submission and indicating the start of a six-week review period. On September 13, 2012 the review was placed on hold pending the delivery of findings from the UNC System Coastal and Marine Science Activities Review. The reason why the PhD in Economics was placed on hold was because the program incorporates training in theory and application of risk analysis tools to coastal hazard risk as one of four main thrusts. Four (21%) of the Economics faculty members explicitly focus their research on issues relevant to coastal science and policy, with an additional six faculty exhibiting some research activity within the coastal arena.
- The mission and history of the Activity.

The goal of the program is to provide advanced training towards a research doctorate in economics with a particular focus on developing and applying innovative theories of decision making under uncertainty to selected areas that build upon and support current university strengths and strategic directions. Recent developments in the field of economics in the area of decision making under risk and uncertainty have included novel modeling techniques that incorporate mathematical properties of probability distributions that have “fat tails.” These techniques are especially important when considering low-probability-high-consequence events such as natural disasters, pandemic disease outbreaks, and the recent financial system meltdown. Another recent development has been in the area of behavioral economics that incorporates behavioral biases within economic institutions. The scope of this program will underline ECU’s commitment to produce and support leaders and decision makers in these aspects of the economy, environment, and public health. There will be four primary areas of focus related to those strengths and directions: environmental risk; at risk populations and public health; risk and decision making; and analytic and econometric tools of risk evaluation and response. These areas directly support ECU’s strategic directions of training and preparing leaders to deal with coastal hazards, providing education at the highest level for the new century, supporting economic prosperity and development, and contributing to the development of health care and the delivery of medical services that will benefit the North Carolina coastal region.
- Unique, competitive, compelling, and/or strategic importance.

Unique: This program is unique among degree programs in North Carolina in its focus on coastal hazards and the economic analysis of the large-scale risks and uncertainties posed for human populations by natural, environmental events. It brings faculty with long experience in PhD programs (e.g. Harvard, Columbia, Northwestern, University of Colorado, Texas Tech, Alabama) and expertise in both natural hazards and the theoretical and behavioral

foundations of decision making. This combination, applied to the study of coastal hazards and risk mitigation will lead to the development of new expertise and experts in those areas.

Competitive: The Economics Department has a track record of attracting quality students, both domestic and international, into its MS in Applied & Resource Economics, many of whom continue in nationally ranked economics PhD programs. The demand (assessed need) for, and competitiveness of, the proposed PhD program is argued extensively in the RAE submitted to UNC GA. We anticipate placing PhD researchers in both Federal and State agencies. Agencies such as the NC Department of Environment and Natural Resources, NC Department of Commerce and the Office of State Budget and Management, routinely recruit for professionals with the skill sets of our graduates. Moreover, private research organizations, non-governmental organizations, and foundations are also potential employers for those who complete the program. The current and anticipated demand for all groups will be more than sufficient to secure placement of the number of PhDs projected. The demand for trained economists translates into high paying jobs. In 2011 the Bureau of Labor Statistics reported the average salary for all economists as \$84,000. The 2010 survey by the American Economic Association reports beginning salary for PhD economists at \$80,000 to \$120,000. US government positions for PhD economists report \$79,000 to \$120,000 beginning salary (GS 11).

Compelling: The program will focus on four areas reflecting ECU's current strengths and supporting its strategic directions in the areas of economic development and the improvement of human health through social science research, education, leadership, and partnership, particularly as they relate to our coastal region. It complements and supports the full range of coastal research activities at ECU through its advanced analysis of human behavioral response to the risks and uncertainties in our coastal region. The specific foci of the program, discussed more fully in the RAE, are:

- i. Environmental Risk - Analysis of the coastal environment and the design of environmental policy must accommodate the risk and uncertainty that is embodied in any study of events which combine low probabilities with high expected losses, such as natural disasters, or of volatile environmental trends associated with climate change and its impact on human populations. Research is essential to the development and implementation of policies for mitigating and adapting to these risks and securing orderly economic development of the coastal region. This branch of the program integrates with the research and policy focus of the *Center for Natural Hazards Research* (CNHR), the *Institute for Coastal Science and Policy* (ICSP), the *Coastal Resources Management* (CRM) PhD program, all at East Carolina University, and the *Coastal Studies Institute* in Manteo.
- ii. At Risk Populations and Public Health - Other current public policy concerns of the coastal region, including public health risks (epidemics, obesity, AIDS, etc.), poverty risks (poor nutrition, inadequate shelter, etc.), and social exclusion risks (discrimination, unemployment, inequality of opportunities, etc.), will be addressed with the research techniques of the proposed program.
- iii. Risk and Decision Making – The proposed program will educate economic analysts with the technical skills necessary to deal with the issues of risk and uncertainty in a broad variety of contexts. The need to support sophisticated decision making arises

from recognition that most interesting problems at some level involve irreducible elements of uncertainty. Specification of appropriate analytic frameworks for optimal decision making involves challenges to which this branch of the program responds. Specific innovative frameworks to be applied are discussed in the RAE.

- iv. Analytic and Econometric Tools of Risk Evaluation and Response – To analyze and manage risks in a changing world, our graduates need to be at the frontiers of knowledge in the areas of risk analysis, capable both of training others and advancing the scientific tools available for application. These skills complement the advanced natural science technical skills developed in the other coastal programs at ECU.

Strategic Importance: The proposed program is directly responsive to the University's strategic directions to advance research and creative activity to enhance economic development of the region, and to take a leadership role in solving regional problems. Its importance lies in its unique contribution to the development of economic-analytic skills required to understand the human dimension of, and human behavioral response to, the uncertainties revolving around the unique problems of a coastal region. The program complements and strengthens the other social and natural science programs at ECU, and has particular synergies with the CRM PhD, by providing rigorous analytic tools for the study and resolution of coastal problems involving risks and uncertainties, particularly behavioral response uncertainties. It in turn will be strengthened through close interaction with the natural and other social scientists at ECU, as discussed in the RAE. However, this PhD will develop and bring to coastal research skills and analytic tools generally missing in all other coastal programs in North Carolina.

- The most significant impact(s) of the program on research, education, and/or society (including direct contributions to policy or management decisions) since January 1, 2008.

Once the PhD program is fully established and reaches steady state, it will have a significant impact in four areas:

- (1) Provide advanced technical economics training, focusing on the analytic tools most relevant for coastal issues; this will be a unique advanced education program in North Carolina;
- (2) Provide both fundamental and applied research, using those tools, to the uncertainty and risks affecting the coastal region, including hurricanes, flooding, sea-level rise, and climate change. This research will address issues of risk analysis and mitigation, disparate impacts on the health and welfare of coastal populations, and the formulation and implementation of regulatory activities and policy responses, both always subject to human behavioral constraints;
- (3) Produce highly paid specialists with the most advanced mathematical, statistical, and economic analytic tools who are capable of understanding and working with natural scientists in governmental and NGO positions, as well as training future specialists in these areas;
- (4) Produce highly paid specialists capable of informing and working with managers responsible for the preparations for, and responses to, natural and man-made coastal events

- Most significant challenges that will be faced by the Activity in the next year, and in the next five years.

This is a proposed program, awaiting Authorization to Establish from UNC GA. The review of the program has been put on hold pending completion of the UNC System Coastal and Marine Science Activities Review. Because of this hold, we expect the first cohort of PhD students to be admitted no earlier than August 2015, half way to the 5 year horizon. We anticipate RAE approval in the coming year, presenting the challenge of making the new program known to the profession and potential students, and attracting a high quality first class in the PhD program. The RAE elaborates how we plan to address that challenge, once we are authorized to begin. The second challenge of the program is to hire additional faculty with relevant expertise, both replacing losses during the current financial crisis and completing the hiring plan, supported by HCAS, that is outlined in the RAE. Over the 5 year horizon, and beyond, the primary challenge is to grow the program to meet and exceed UNC program productivity standards through: (1) admission of high quality students; (2) expansion of externally funded research; and (3) deepening existing interaction and synergies with other programs and activities at ECU, and in eastern NC, studying the coastal and maritime issues relevant to our region – this PhD program will bring unique analytic skills to the study of the human dimension of these issues.

- Future directions for, and sustainability of, the Activity in the next year and in the next five years.

Once established, this PhD program will provide highly technically trained PhD economic analysts with particular expertise on natural hazards, environmental, and natural resource issues particularly relevant to our coastal region. These scientists will be familiar with the work of natural scientists and be prepared for employment in a broad range of governmental and NGO positions dealing with coastal issues, as well as for academic teaching and research positions. While nothing can happen in the next year, as we await UNC GA approval of our RAE, over the 2-3 years of activity before the 5-year horizon we will be bringing a first cohort through all course work and into the beginning of independent, supervised, PhD research. For a majority of our students, the focus of the program is such that the research will be on hazards and risk analysis relating to coastal issues. Within 5 years of the authorized launch of the program (2019-20), the first graduates will enter the job market. Sustainability of the program will be guaranteed, as outlined in the RAE, by support of ECU, the use of some students as teaching assistants, and support of students through external funding. A current major program initiative is to apply, jointly with CRM, for an NSF IGERT grant supporting PhD students, an application made possible by the interdisciplinary, coastal studies, nature of this PhD program. In addition, with support from HCAS, the number of faculty in the program will be increased through new hiring in the next 5 years, again as outlined in the RAE, in order to provide for growth of the program to sustainable levels.

C4A. Resources

1. Personnel

Table C1. Personnel

Name	Title and department/college	Role/Research Faculty Expertise
Richard E. Ericson	Professor of Economics	Chair, Department of Economics Game theory and dynamic analysis of decision making under risk and uncertainty.
Okmyung Bin	Associate Professor of Economics	Coastal Resources. Hedonic econometric methods. Market and Nonmarket valuation of risk and risk mitigation.
John Bishop	Professor of Economics	Director of Graduate Studies Measures of poverty and risk management
Andrew Keeler	Professor of Economics	Head, Public Policy and Coastal Sustainability Program, Coastal Studies Institute Co-Director, UNC-CH Outer Banks Field Site Coastal Policy and Benefit Cost Analysis
Mohammad Jahan-Parvar	Associate Professor of Economics	On one-year leave Department of Treasury Econometrics of Extreme Value Theory and Financial Risk Analysis
Jamie Kruse	Professor of Economics	Director, Center for Natural Hazards Research Decisions under Risk and Uncertainty, Behavioral Economics, Natural Hazard Risk, Mitigation and Insurance. Economics of Wind Hazards.
Craig Landry	Associate Professor of Economics	Asst. Director, Center for Natural Hazards Research; Research Scientist, Institute for Coastal Science and Policy Coastal Environmental Risk, Mitigation and Insurance. Behavioral Economics. Environmental Market and Nonmarket Valuation Methodologies
Jonathan Lee	Assistant Professor of Economics	Quantitative Analysis of Environmental Risk
Haiyong Liu	Associate Professor of	Econometric Methods for Risk

	Economics	Analysis. Coastal Poverty and health disparities.
Lester Zeager	Professor of Economics	Impacts of Coastal Hazards on Poverty and Inequality. Negotiations and Conflict Resolution.
Chris Jackson	Administrative Associate	Staff Support for Center for Natural Hazards Research, Point of Contact for Annual Hurricane Workshop. External Grant Administration.
Six additional Graduate Faculty Members	Two Professors, two Associate Professors and two Assistant Professors of Economics	Econometric and economic Analysis.
Faculty Search Underway	Assistant Professor of Economics	Coastal Resources, decision making under risk and uncertainty, environmental economics, public economics

C4A. Research, Teaching, Public and Professional Service

1. Research

Table D1. Research

Project title	PI/CoPIs – include institution	Sponsor	Amount	Dates
Need and Tools for public policy formation for encouraging non-traditional energy exploration off the coast of North Carolina	Andrew G. Keeler (PI), ECU/CSI Michael Piehler, UNC-CH	North Carolina Ocean Energy Program	Total \$35,481	2012 - 2013
Economic Values of Coastal Erosion Management	Craig Landry (PI), ECU; John Whitehead (CoPI), App State	NC Sea Grant	\$129,035, \$77,448 from sponsor, \$59,778 to ECU	2012 – 2013
Welfare Economics of Beach Nourishment Projects Using OCS Sand Resources	Craig Landry (PI), ECU	US Army Corps of Engineers and Bureau of Ocean Energy	\$215,000, total \$150,000 to ECU	2012 – 2013

		Management		
Modeling Natural Disaster Risk Management; a stakeholder perspective	Jamie Kruse (CoPI), ECU; Richard Ericson , ECU; Rachel Davidson (PI), University of Delaware; Linda Novick (CoPI), Cornell University; Thomas O'Rourke, Cornell University; John van de Lindt, Colorado State University	Department of Commerce, National Institute of Standards and Technology	Total \$750,000 \$125,000 to ECU	2010 - 2013
Development of a Quantitative Model for Measuring Economic Resilience to Hurricanes	Jamie Kruse (CoPI), ECU Bradley Ewing (CoPI), Texas Tech Daan Liang (PI), Texas Tech University	National Science Foundation	Total \$350,000 \$91,360 to ECU	2010 - 2013
RENCI @ East Carolina University	Tom Allen (PI), ECU; Jamie Kruse (CoPI), ECU; Donna Kain (CoPI), ECU; JP Walsh (CoPI), ECU; Reide Corbett (CoPI), ECU;	Renaissance Computing Institute	\$80,000 carryover	2010 - 2012

2c) Public Service, Outreach and Community Engagement

Table D4. Public Service, Outreach and Community Engagement

Public Service / Outreach/Engagement	Dates	Personnel Involved	Participants in program	Number of participants
NCEM/ECU 2012 Hurricane Workshop. Annual one day workshop for interaction and information exchange between academic community and	May 2012	Jamie Kruse, ECON; Tom Allen, GEOG; Donna Kain, ENGL; Craig Landry, ECON; Chris Jackson, CNHR ECU researchers,	North Carolina Department of Emergency Management, coastal emergency managers, State Government,	200

emergency management community.		undergrad and graduate students.	Media (print and television), National Weather Service, NC Sea Grant , National Hurricane Center	
Pitt County Development Commission. Works to foster industrial and commercial development in Pitt County—make recommendations to City, County and State governments.	2008 – present	Richard Ericson, ECON	Leaders from the government, academic and business communities plus staff.	25
US National Climate Assessment-Invited Talk	Feb. 2012	Andrew Keeler, ECON/CSI	Chapter authors, other scholars and practitioners	75
Resources for the Future, “Redistributional Impacts of the National Flood Insurance Program”- Invited Talk	May 2011	Okmyung Bin, ECON; John Bishop, ECON; Carolyn Kousky, Resources for the Future	Scholars and practitioners	30
NCEM/ECU/NWS 2011 Hurricane Workshop.	May 2011	Jamie Kruse, ECON; Tom Allen, GEOG; Donna Kain, ENGL; Craig Landry, ECON Chris Jackson, CNHR ECU researchers, undergrad and graduate students.	North Carolina Department of Emergency Management, coastal emergency managers, NC Department of Transportation, Media , National Weather Service, Military	150
North Carolina Coastal Resources Commission – Invited Talk	Feb. 2011	Andrew Keeler, ECON/CSI	Commissioners, staff, public	125
NCEM/ECU 2010 Hurricane Workshop	May 2010	Jamie Kruse, ECON; Tom Allen, GEOG; Donna Kain, ENGL; Craig Landry,	North Carolina Department of Emergency Management,	100

		ECON Kevin Mills, CNHR ECU researchers, undergrad and graduate students.	Coastal Emergency Managers, State Government, Media	
Center for Sustainable Tourism Webinar on Wind Energy	Oct. 2012	Craig Landry	Government, citizens	75
Summer Planning Institute, Department of Geography, East Carolina University	June 2011	Craig Landry	Planners	80
Ocracoke Island/Hatteras Island Chamber of Commerce: Rodanthe, NC	May 2010	Craig Landry	OBX business owners	25
Outer Banks Create the Future Initiative – Invited Talk	April 2010	Andrew Keeler, ECON/CSI	General Public	150
Tenth Anniversary Hurricane Floyd Symposium. Two day event that included a one day public forum and a one day research conference	Sept. 2009	Jamie Kruse, ECON; Tom Allen, GEOG; Okmyung Bin, ECON; Scott Curtis, GEOG; Donna Kain, ENGL; Craig Landry, ECON Kevin Mills, CNHR ECU researchers, undergrad and graduate students.	Former Governor Hunt, representatives from the legislature, NOAA-AA Laura Furgioni, North Carolina Department of Emergency Management Director Doug Hoell, National Weather Service, NC Sea Grant, UNC System Researchers and Administrators, Academic Researchers, General Public	500

d) *Professional Service*

Table D5. Professional Service

Board or Group name	Dates	Activity member name and affiliation (ALL Department of Economics Faculty)	Service provided
Mississippi-Alabama Sea Grant Consortium	2011-2016	Kruse	Technical Review Panel
Albermarle Pamlico National Estuary Program Science and Technical Advisory Committee (APNET STAC)	2011 - present	Keeler, Landry	Keeler 2011 – present, Member 2012 – present, Executive Board Landry 2008-2009, Member
<i>Marine Resource Economics</i>	2010 – present	Landry	Associate Editor – manage peer review of manuscripts
<i>Union of Concerned Scientists</i>	2009 - present	Keeler	Advisory services related to climate change policy.
Behavioral and Social Science, <i>Natural Hazards Review</i>	2008 – present	Landry, Kruse	Landry 2011-present, Associate Editor – manage peer review of manuscripts Kruse 2008-2009, Guest Associate Editor
<i>Journal of Business Valuation and Economic Loss Analysis</i>	2007 - present	Kruse	Board of Editors
Economics Education and Research Consortium	1996 - present	Ericson	Member – 1996 Russia/Network Program Chair – 2000 Russia/Network Program Board of Trustees – 2002 Executive committee - 2002
Air Force Office of Scientific Research	2012	Ericson, Kruse	Workshop on Catastrophic Risks, Stanford, CA, presenter and invited participant.
The Coastal Society’s 23rd Conference	2012	Landry	Organizing Committee, “Valuing Ecosystem Goods & Services” Research Track
National Science	2008-	Landry, Kruse	Landry

Foundation	2012		<p>2012 <u>Proposal Review Panel - Infrastructure Management for Extreme Events</u> Kruse <u>Workshops</u> 2011 “Creating a More Disaster Resilient America,” Arlington, VA; invited attendee; 2008 “Toward a Natural Hazard Vulnerability and Resiliency Observatory,” College Station, TX; invited participant; <u>Proposal Review Panel-</u> -Graduate Research Fellowship Program (GRFP) (Economics) 2011 -Integrative Graduate Education and Research Training Program (IGERT) (Environment) 2010 -Engineering Research Centers Program, 2009 -Decision, Risk and Management Sciences standing panel 2007-2008 -Site visit team, Engineering Center of Excellence, 2008 <u>Mentor-</u> 2008-2010 “Enabling the Next Generation of Hazards and Disasters Researchers”</p>
National Weather Service, NOAA	2012, 2011	Kruse	<p>Weather-Ready Nation Workshop, 2012 Birmingham, AL,; 2011 Oklahoma City, OK; invited participant</p>
NOAA Northeast Fisheries Science Center, Social Sciences Branch	2011	Kruse	<p>External Program Review Panel</p>
US Geological Survey National Center	2011	Kruse	<p>Workshop “The Role of Economics: integrating economics into the USGS portfolio,” Reston, VA;</p>

			speaker and invited participant.
National Oceanic and Atmospheric Administration (NOAA)	2010	Kruse	Chief Economist and Senior Advisor for the Social Sciences -Member, Research Council -Co-Chair, Research Council Social Science Committee -Co-Chair, Research Council Ad hoc Committee on Scientific Integrity -Lead, Social Science Theme, NOAA Deepwater Horizon Science Team
White House Office of Science and Technology Policy	2010	Kruse	-Member, Subcommittee on Social, Behavioral and Economic Science. -Member, Subcommittee on Ocean Science and Technology Policy. -Co-Chair, Interagency Working Group on Ocean Social Science.
White House Deepwater Horizon Oil Spill National Incident Command	2010	Kruse	Member, Economic Solutions Team
Deepwater Horizon Oil Spill Principal Investigator's Conference	2010	Kruse	Organizing Committee
North Carolina House of Representatives	2009	Kruse	Legislative Offshore Energy Exploration Research Study Committee member appointed Speaker Joe Hackney.
RENCI Center for Coastal Systems Informatics and Modeling	2008	Kruse	Founding Director
Academic Journals: <i>Coastal Management Journal</i> , <i>Journal of Environmental Economics and Management</i> , <i>Ecological Economics</i> , <i>Environmental and</i>	2008-present	Bin, Landry, Liu, Kruse	Referee

<p><i>Resource Economics, Land Economics, Marine Resource Economics, Journal of Risk and Insurance, Natural Hazards Review, Resource and Energy Economics, Risk Analysis, Weather and Forecasting, Southern Economic Journal, World Development, Journal of Economic Behavior and Organization, Journal of Public Health Management and Practice, Journal of Regional Science, Conflict Management and Peace Science, Journal of Conflict Resolution.</i></p>			
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e) Outputs and Impacts

1. Publications

Forthcoming

Bin, Okmyung and Craig E. Landry. 2012. “Changes in Implicit Flood Risk Premiums: Empirical Evidence from the Housing Market,” forthcoming *Journal of Environmental Economics & Management*.

Eckerd, A. and **Andrew Keeler.** 2012. “Going Green Together? Brownfield Remediation and Environmental Justice,” forthcoming *Policy Sciences*.

Bin, Okmyung and Jeffrey Czajkowski. 2012. “Valuing Changes in Coastal Water Quality: Evidence from the Housing Market in South Florida,” forthcoming *Marine Resource Economics*.

Petrolia, Dan, **Craig E. Landry,** and Keith Coble. 2012. “Risk Preference, Risk Perception, and Flood Insurance,” forthcoming *Land Economics*.

Published

Grabowski, J. H., R. D. Brumbaugh, R. Conrad, **Andrew Keeler,** J. Opaluch, Charles Peterson, Michael Piehler, Sean Powers, Ashely Smyth. 2012. “Economic Valuation

- of Ecosystem Services Provided by Oyster Reefs,” *Bioscience* 62(10): 900-909.
- Bin, Okmyung, John Bishop**, and Carolyn Kousky. 2012. “Redistributional Effects of the National Flood Insurance Program,” *Public Finance Review*, 40(3):360 - 380.
- Landry, Craig E.** and Jingyuan Li. 2012. “Participation in the Community Ratings System of NFIP: An Empirical Analysis of North Carolina Counties,” *Natural Hazards Review* 13(3): 205-220.
- Ericson Richard**, and **Xuan Liu**. 2012. “Welfare Effect of Interest Rate Shocks and Policy Implications,” *Applied Financial Letters*, 22(22): 1899-1917.
- Landry, Craig E.**, Tom Allen, Todd Cherry, and John C. Whitehead. 2012. “Wind Turbines and Coastal Recreation Demand,” *Resource and Energy Economics* 34: 93-111.
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- Landry, Craig E.**, Paul Hindsley, **Okmyung Bin**, **Jamie B. Kruse**, John C. Whitehead, and Ken Wilson. 2011. “Weathering the Storm: Measuring Household Willingness-to-Pay for Risk-Reduction in Post-Katrina New Orleans,” *Southern Economic Journal* 77(4): 991-1013.
- Landry, Craig E.** and Paul Hindsley. 2011. “Valuing Beach Quality with Hedonic Property Models,” *Land Economics* 87(1): 92-108.
- Jilcott, Stephanie B., **Haiyong Liu**, Justin B. Moore, Jeffrey W. Bethel, James Wilson, Alice Ammerman. 2010. “Commute Times, Food Retail Gaps, and Weight Status in Rural and Urban North Carolina Counties,” *Preventing Chronic Disease*, 7(5), 1-10.
- Liu, Haiyong**, Thomas Mroz, and Wilbert van der Klaauw, 2010. “Maternal Employment, Migration, and Child Development.” *Journal of Econometrics*, 156(1), 212-228.
- Bin, Okmyung , Craig E. Landry**, and Gregory F. Meyer. 2009. “Riparian Buffers and Hedonic Prices: A Quasi-Experimental Analysis of Residential Property Values in the Neuse River Basin,” *American Journal of Agricultural Economics* 91(4): 1067-

- Ewing, Bradley, **Jamie Brown Kruse** and Dan Sutter. 2009. "An Overview of Hurricane Katrina and Economic Loss," *Journal of Business Valuation and Economic Loss Analysis*. 4(2):1-12
- Whitehead, John, Ben Poulter, Christopher Dumas, and **Okmyung Bin**. 2009. "Measuring the Economic Effects of Sea Level Rise on Shore Fishing," *Mitigation and Adaptation of Strategies for Global Change*, 14(8): 777-792.
- Bin, Okmyung**, and Bob Edwards. 2009. "Social Capital and Business Giving to Charity Following a Natural Disaster: An Empirical Assessment," *Journal of Socio-Economics*, 38(4): 601-607.
- Landry, Craig E.** and **Haiyong Liu**. 2009. "A Semi-Parametric Estimator for Revealed and Stated Preference Data: An Application to Recreational Beach Visitation," *Journal of Environmental Economics and Management* 57(2): 205-18.
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- Bin, Okmyung**, **Jamie Brown Kruse**, and **Craig E. Landry**. 2008. "Flood Hazards, Insurance Rates, and Amenities: Evidence from the Coastal Housing Market," *Journal of Risk and Insurance* 75(1): 63-82.
- e.) List non-refereed publications such as journal articles, reviews, conference papers, books and book chapters directly related to Activity.
- Hales, David, William Hohenstein, Marcie Bidwell, **Craig E. Landry**, David McGranahan, Joseph Molnar, Lois Morton, and Maria Vasquez. 2013. Chapter, "Rural Communities," *Synthesis of the National Climate Assessment*, US Global Change Research Program: Washington, DC.
- Kruse, Jamie Brown**. 2012. "Economics of Disasters," 1st World Congress of Oceans: Ocean Disaster Assessment and Prevention. Dalian, CHINA.
- Ericson, Richard E.** and **Jamie B. Kruse**. 2012. "Preference Representations in the Face of Catastrophic Risks," Columbia Consortium for Risk Management and Air Force Office of Scientific Research Workshop on Catastrophic Risks, Stanford Research Institute (SRI), Menlo Park, CA. <http://columbiariskmanagement.net/AFOSR-Event.php>
- Kruse, Jamie Brown**, Jeff Lazo, Erwann Michel-Kerjan, Kevin Simmons, Dan Sutter. 2012 "Economics of Severe Weather Warnings," White Paper prepared for Weather Ready Nation Workshop, Birmingham, AL.

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A4B. Other Centers and Programs: RENCI ECU (RENCI@ECU) Center for Coastal Systems Informatics and Modeling (C-SIM) <http://www.ecu.edu/renci>

B4B. Activity Narrative

The Renaissance Computing Institute (RENCI) (an institute of UNC-Chapel Hill) funded the development of RENCI@ECU in 2007, its first regional engagement center. Working with researchers at the RENCI anchor site in Chapel Hill and with faculty and community groups in Greenville and coastal areas, RENCI@ECU began with a focus on interdisciplinary applied research, emphasizing coastal disasters, hazards, and environmental problems. By bringing together researchers in a wide range of disciplines, faculty and staff collaborate to develop a better understanding of how the physical landscape, biological processes, human activity, and demographics impact the environment, the local economy, and human life when disasters hit the coast.

RENCI@ ECU is about creating partnerships between academic researchers, NGOs, businesses, educational institutions, government agencies, and the general public to advance disaster research efforts and enable education and economic development. Working together, we aim to reduce the economic impact and loss of life caused by coastal disasters and improve the lives and livelihoods of North Carolinians. One specific goal of RENCI@ECU is to build and maintain an integrated North Carolina coastal informatics system that includes human and ecosystem health factors; records of geological, biological, and chemical processes; information about human activity, attitudes, social networks, and population densities; and inventories of disaster response resources.

Mission and Vision

To support research and outreach that improves understanding of the interaction between physical, biological, and human processes in North Carolina's coastal region, especially as the processes relate to coastal disasters.

RENCI@ECU supports focused research on the relationship between disasters and physical, biological, and human coastal systems. This Center transcends any single research discipline. RENCI@ECU also engages the public of eastern North Carolina to identify and address important needs and implement solutions.

Evolution of RENCI@ECU

The RENCI@ECU approach is highly integrative and uniquely collaborative while engaging with coastal- and marine-interested public and private-sector entities. Since the first 3-year funding and buildout of RENCI@ECU (AY2006-2009), a second 3-year renewal grant from RENCI UNC-CH was awarded. The original center and award was directed by Dr. Jamie Kruse (also Director of CNHR) and setup ECU as the first regional engagement center and a distinct emphasis on coastal hazards. This second 3-year grant challenged RENCI@ECU to follow a path toward sustainability. Redirection from RENCI at UNC-Chapel Hill shifted the

strategy of the center at ECU towards greater applied and geospatial research, with a new director appointed in 2008 (Dr. Tom Allen). However, budgetary cuts and realignment of the RENCI UNC-CH center as a standalone institute within UNC-Chapel Hill have seen each succeeding year 2009-2012 incur reduction of base funding, with RENCI@ECU operating now in its seventh year on a mix of external grants and limited residual grant carryover and internal funding towards a self-sustaining situation. Strong engagement has attracted additional external funding, and state agencies and federal partners are supporting most of the activity through grants. As RENCI UNC funds have drawn down, ECU research has expanded. In addition, ECU internal activities have evolved, from maintaining the core technology (e.g., Visualization Wall) and various geospatial computing support to include in-reach (e.g., graduate training, Visualization Challenge competition), and outreach activities (e.g., Annual NC Hurricane Workshop with CNHR.)

- RENCI@ECU C-SIM fills unique gaps at ECU and across the UNC system:
 - ECU's Center for Geographic Information Science no longer has capacity for quick-response and high-end data analysis and grants. Hence, RENCI@ECU currently fills a university and regional gap for GIS expertise and data. The center also is the only coastal geospatial research unit in North Carolina. Although virtually all other centers and institutes all have some GIS capacity, none have the same focus on the breadth of applications, faculty and personnel depth, and computational niches.
 - Whereas ICSP is more focused on a broad range of research and graduate training, RENCI@ECU has emphasized interdisciplinary coastal research and a significant amount of related outreach and education.
 - Arising from RENCI UNC's desire for the engagement center to build collaborative relationships and conduct applied research, RENCI@ECU has emphasized rapid response and strongly engaged research over high-risk, basic, or theoretical projects. Nonetheless, some technological and computational innovations have garnered funding (e.g., wetlands remote sensing and mapping, sea-level rise simulation modeling.)
 - The primary distinctions from ECU CNHR and RENCI UNC-CH include the application of GIScience and Technology (geospatial techniques including Geographic Information Systems (GIS), remote sensing, and spatial analysis) and associated environmental modeling, including environmental quality and slow-onset complex problems (e.g., coastal erosion, sea-level rise) with a strong emphasis on geospatial technology and visualization.
 - RENCI@ECU faculty and staff have contributed heavily to the FEMA-funded NC Sea-Level Rise Risk Management Study, leading the development of both coastal landform evolution modeling (Allen) and human response (Crawford) in separate multidisciplinary teams.
- RENCI @ECU maintains high-performance computing and GIS at ECU, with continual engagement to Economics, Maritime Studies, Geological Sciences, Geography, Biology, Technical Communications, and Sustainable Tourism.
- With faculty now serving as program heads at UNC Coastal Studies Institute, RENCI@ECU has partnered on grants from a wide array of agencies (projects detailed below).

- RENCIE@ECU warehouses an extensive coastal GIS database for coastal observing systems and monitoring. Data are contributed by collaborating faculty and agencies and provided to researchers, students, and other partners.
- At present, we are developing a long-term plan for funding for the **NC Digital Coastal Atlas**, a project conceived to support research infrastructure, outreach, and in-reach (via geospatial data, metadata, and a strong role for the ECU Joyner Library). This effort will include construction of a repository for related data and developing expertise with sufficient staffing to support research proposals and projects and amplify the research revenue while also providing strong outlet and dissemination tools (workshops, online media, and publications.)
- New collaborations are also emerging with faculty in two other units of ECU, the **Terrain Analysis Laboratory** (focusing on digital ground laser scanning) and the **Public Health Program** (focusing on coastal air quality and exposure), largely through complementary expertise in environmental analysis and RENCIE@ECU's capabilities in GIScience. Public health activity is actually a re-engagement, as the first cycle of RENCIE@ECU included a project analyzing medically-fragile populations and evacuation in coastal areas.
- Major impact: RENCIE @ECU has developed and received *multi-disciplinary grants via engaged scholarship* and a regular conduit between ECU and numerous state, federal, and local stakeholders. Grants and collaborative engagement intersect with a vast network of agencies, but chiefly NC Sea Grant, NC Division of Coastal Management, NC Division of Crime Control (Emergency Management), NC National Estuarine Research Reserves, and NC Department of Public Health. With Federal-related entities, RENCIE@ECU is actively engaged with Albemarle-Pamlico National Estuary Program (APNEP) (co-administered by US EPA and NC Department of Environment and Natural Resources), US Fish and Wildlife Service, US Geological Survey, NOAA National Weather Service, NOAA Cooperative Institute for Climate and Satellites, and NOAA Center for Sponsored Coastal Ocean Research.
- Some notable multiplier effects of the interdisciplinary grant activities of RENCIE@ECU are:
 - Supported over 20 students in research assistantships, from undergraduate to masters and doctoral levels, across 5 major programs.
 - Faculty success, in part spurred from RENCIE@ECU, has spurred many of our participating faculty to higher performance and levels (i.e., two are now affiliated with UNC CSI; two are department associate chairs, and one is a now jointly appointed between ICSP and a department.)
- Major challenges: The greatest challenge has been the transition from a multi-year state-supported entity (i.e., from a grant/contract) to essentially a soft-money Center, with an annually renewed scope of work based on federal and state budgets. Today's more tenuous structure presents an ongoing challenge to maintaining staff continuity and recruiting strong graduate students. Additionally, we are challenged to sustain the VisWall equipment and other infrastructure without a core budget and staff. Thus, we must develop research projects and funding streams to continue to operate as originally

designed and intended. Without research grants utilizing this particular equipment, its maintenance will decline or internal support (from departments, RGS, colleges or institutes) will be required. Efforts to pursue research grants and identify alternative home and/or users have been accelerated.

- The nature of engaged and interdisciplinary scholarship are ever difficult to rationalize in disciplinary-centered departmental evaluations of faculty, yet we nonetheless desire to encourage problem-based multi- and interdisciplinary research, recognize its societal value, and hope it can continue to be accomplished.

C4B. Resources

1. Personnel

Table C1. Personnel of RENCI@ECU C-SIM

Name	Title and department/college	Role
Dr. Tom Allen	Associate Professor/ Department of Geography Thomas Harriot College A&S	Director, RENCI@ECU Engagement Center for Coastal Systems Informatics and Modeling
Dr. JP Walsh	Associate Professor of Geological Sciences, ICSP; UNC CSI	Associate Director, 2009-Present
Ms. Michelle Covi	Outreach Coordinator (and CRM doctoral candidate)	Center outreach and research support (half- time SPA, grant- funded)
Mr. Robert Howard	Technology Coordinator/RGS	Technology coordinator, geospatial research analyst (EPA non-faculty, first day 29 Oct 2012, replaced SPA position)
Affiliated Faculty		
Dr. Jamie Kruse	Professor of Economics, Director of CNHR, founding and past director RENCI@ECU	Affiliated Research Scientists
Dr. Reide Corbett	Professor of Geological Sciences; ICSP; UNC CSI Associate Professor/ECON-	

Dr. Craig Landry	ICSP	
Dr. Donna Kain	Associate Professor/English Technical Communications	
Dr. Tom Crawford	Associate Professor/Geography	
Dr. Jeff Johnson	Professor of Sociology	
Dr. Lloyd Novick	Professor of Public Health, Director of Public Health	
Dr. Enrique Reyes	Associate Professor, Biology	

b) Students (limited to current only)

Four Geography MS students (Matt Carey, Brent Gore, Doug Peterson, and Zach Oyer), completing theses (sea-level rise modeling, living shoreline site suitability modeling, wetlands mapping, and estuarine erosion, respectively.) One Geological Sciences MS student (Ian Conery), in final year of thesis research on NC coastal change. Two new masters students pending Spring/Fall 2013 will work on SALCC and DCM Coastal Atlas grants.

One Outreach Coordinator (Coastal Resources Management PhD pre-doc, half-time grant EPA position), working on the NC Coastal Atlas and NOAA CICS grant, and developing the NC Sea Grant Sea-Level Rise Communications grant.

2.Funding

RENCI@ECU Revenues by fiscal year for the past three years, the current year and a projected year are given in the table below.

Given the interaction and potential double-counting of joint and collaborative project funding between ECU units in this review, this table data includes ONLY the grants that Director Tom Allen is PI lead or Co-PI. In addition, the phased reduction is evident in funding from RENC UNC-CH, with the gradual addition of grants from State sources (NC Sea Grant and NC Division of Coastal Mgt.) and an uptick in federal grants (Fish and Wildlife Service, S. Atlantic Landscape Conservation Cooperative, and NOAA). In addition, ECU RGS allocated a vacant position to the role of Geospatial Research Associate (EPA non-faculty, replacing the SPA position we had funded in our renewal grant by RENC UNC –CH. This position is filled as of October 29, 2012 and is reported in pro-rated current amounts and projected for FY14.)

Table C2: RENCI@ ECU Revenue*

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Federal	0	0	\$89K	\$89k	\$285k
State	0	\$15K	\$35k	\$60K	\$95K
Institution	\$105K	\$95K	\$25K	\$30K	\$60K
Foundation	0	0	0	0	0
Other* N/A					
Total	\$105k	\$110k	\$129k	\$179k	\$440k

* To avoid confusion, revenue and expenses from projects led by Walsh and Corbett are not included. Summarized focuses on 2009-current RENCI@ECU period.

The slight decline in expenses trends FY10-12 for RENCI@ECU reflect the reduction of faculty and graduate students directly supported by RENCI and gradual transition to their support on other, departmentally-administered grants. In addition, programmatic, physical, and maintenance costs are fairly flat, yet new costs are required to be covered in the current and next FY in support of the NC Coastal Atlas initiative (which is being built into budgets for the federal and state grants.) The increase in personnel costs projected for this and next FY similarly highlight the need for staff to implement the atlas and GIS technology infrastructure and support faculty research.

Table C3: RENCI@ECU Expenses*

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Personnel	\$90k	\$70k	\$70k	\$80k	\$100k
Programmatic	\$10k	\$10k	\$10k	\$40k	\$45k
Physical infrastructure	\$5k	\$5k	\$5k	\$5k	\$5k
Maintenance and operation	\$5k	\$10k	\$15k	\$5k	\$5k
Equipment (>\$5,000)	0	0	0	\$5k	\$20k
Other Direct Costs*					
Indirect Costs	\$10k	\$8k	\$10k	\$20k	\$40k
Total	\$110k	\$105k	\$100k	\$145k	\$225k

* To avoid confusion, revenue and expenses from projects led by Walsh and Corbett are not included. Summary focuses on the current RENCI@ECU renewal period 2009-current.

3. Physical infrastructure

Major assets of RENCI@ECU are currently valued at approximately \$175k and spread over a workspace of approximately 1,000sq.ft. An additional \$20k of computing hardware and \$15k of software and storage capability are projected in the coming FY (via grant funding and leveraging with ECU ITCS and Joyner Library.)

- Dodge Sprinter van with diesel generator and mobile HAM radios.
- RENCI@ECU has a 6ft x 20ft. “Visualization Wall” with rear-projected high-def and 3D-capable displays.
- Two rack-mounted servers for data storage and web-map GIS servers (expanding to three).
- One portable computer kiosk (on exhibit at The Estuarium museum, Washington, NC.)
- Portable spectroradiometer for remote sensing field data collection.
- “Sound Rover” personal watercraft (“jet ski”) with depthsounder and GPS (stored at UNC CSI, Nags Head Lab)
- Wall-mounted plasma display system (Rivers Bldg)
- Gigapan robot camera imaging device
- Broadband multimedia kiosk and ceiling-mounted LCD projectors and document cameras in a dedicated seminar room (RW room 102).
- Portable spectroradiometer (for remote sensing field data collection)
- All facilities and instrumentation are detailed and shown online at <http://www.ecu.edu/renci>

All assets are owned by ECU Division of Research and Graduate Studies (Rover van and Viswall components currently asset tags of UNC-CH in preparation for transferal to ECU.)

D4B. Research, Teaching, Public and Professional Service

1. Research

Funded research in the table below documents the 2009-2012 RENCI@ECU phase II period. Only projects under the lead or co-direction of RENCI Director Allen and conducted within RENCI@ECU are included.

Table D1. Research*

Project title	PI/CoPIs – include institution	Sponsor	Amount	Dates
Synthesis of High and Low Marsh Habitat Mapping, Vulnerability and Responses to Sea-Level Rise in the South Atlantic Region	Allen/ Walsh, ECU; Morris/USC; Alexander/Skidaway	S.Atlantic Landscape Conservation Coop. (US FWS)	\$285k	2012-2014
NC Coastal Atlas Design and Implementation	Allen, Walsh, ECU	NC Div. Coastal Mgt.	\$70k	2012-13 (pending)
Risk Communication and Perception of Climate Change and Adaptation in Northeastern North	Donna Kain, Michelle Covi, ECU	NC Sea Grant	\$5500	2011

Carolina				
Renci@ECU Regional Engagement Center: Attacking Coastal Hazards of North Carolina Renewal Proposal for 2009-2012	Allen, Walsh, Kain, Crawford, Corbett, Landry, ECU	RENCI UNC- CH	\$600,000	2009-2012
Maps, Marshes, and Management Applications: Ecological Effects of Sea-Level Rise in North Carolina	Allen, ECU	NOAA Office of Sponsored Coastal Ocean Research, NC Sea Grant, APNEP, The Nature Conservancy	\$90k	2011-2013
Assessment of Surface and Ground Water Hydrology and Vegetation at the Emily and Richardson Preyer Buckridge Coastal Reserve, NC	Manda (ICSP- GEOL), Allen, ECU	NC Div. Coastal Mgt.	\$71k	2010-2012
Investigating SAR Remote Sensing for Updating National Wetland Inventory in North Carolina	Allen, Wang, ECU	USFWS	\$20k	2010-2012
Battle of the Atlantic: Resources Identification and Assessment Survey	Richards (HIST- CSI), Allen, ECU	National Park Service and NOAA	\$160k	2010-2012
Benefits and Costs of Offshore Wind Farms in North Carolina	Landry (ECON, ICSP, CNHR), Allen, ECU	ASU Energy Council	\$39k	2008-2009

2. *Teaching and Instruction*

Only non-degree credit instruction and seminars are included. Director Allen’s instruction for the Coastal-Marine Studies Minor, Department of Geography, and Masters of Sustainable Tourism are not included. Students working in RENCI@ECU on projects have also received substantial, albeit informal, geospatial and computational training on-the-job.

Table D3: Non-Degree Credit Instruction

Workshop/Instruction title	Dates offered	Instructor(s) and Affiliation(s)	Brief description of instruction (1 sentence)	Enrollment Figures
Viswall Challenge Training	2008-2012	Tom Allen Stephen Sanchagrin	Participants in the Visualization Challenge were trained in presentation techniques for VisWall	40 students
Annual NC Hurricane Workshop *	2010-12	Allen, Kruse, Kain, Covi, ECU joint CNHR with RENCI@ECU	Continuing education training for emergency management professionals (State, local, and non-governmental)	300
Public seminars	2012, 2011, 2010	Tom Allen Michelle Covi	Seminars on natural hazards topics for teachers, emergency managers, and other public audiences	2,000

* The Hurricane Workshop is both a formal training program of NC Emergency Management and an outreach activity of ECU CNHR and RENCI@ECU.

Public Service, Outreach and Community Engagement

Table 4 captures a sampling of our more visible engagement activities, primarily those arising in a multi-day activity with ongoing planning, design, and followup with scientists and agency collaborators.

Table D4. Public Service, Outreach and Community Engagement

Public Service / Outreach/Engagement	Dates	Personnel Involved	Participants in program	Number of participants
Hurricane Floyd Symposium	2009	Tom Allen, Michelle Covi,	Public, managers,	300+

		Stephen Sanchagrin	professionals, researchers,	
NOAA-in-the-Carolinas Annual Workshop	2009-2012	Tom Allen	Public, Federal and state agencies	100
Create NC Hazards User Group	2009	Tom Allen	NC GIS professionals	30
Dare County Hurricane Evacuation Simulation Exercise (Felix 2010) (organized and facilitated by RENCI@ECU)	2010	Tom Allen, Stephen Sanchagrin, Michelle Covi, Donna Kain, Burrell Montz	Dare County Control Board, NC and VA Emergency Mgt, National Park Service, US Coast Guard, NC State Police	25
Annual NC Hurricane Wkshop	2010-12	Tom Allen Michelle Covi Stephen Sanchagrin	Emergency managers, communicators and responders, researchers, meteorologists	100+ annual
NC Sea-Level Rise Wkshop and Risk Mgt Study	2009-11	Tom Allen	Researchers, State Floodplain Mgt.	200+
StormViz project	2009	Tom Allen Stephen Sanchagrin	Emergency managers, public	
ISPRS Student Lidar Wkshop	2011	Tom Allen	Intl. graduate students	35
ASPRS Student Challenge	2012	Tom Allen, students	Students	30
Estuarium Kiosk	2012	Tom Allen, Travis Hill, Michelle Covi	General public	
ECU Visualization Challenge	2009-12	Tom Allen, Stephen Sancharin, Michelle Covi	Higher education students	40
Open houses, science festival/fairs, outreach events	2008-2012	Tom Allen, Michelle Covi	k-12 teachers and students, families, general public	100 annual
Plymouth Sea-Level Rise Project	2010-2011	Tom Allen, Michelle Covi, Robert Howard	Local government leaders and community	40

			leaders	
Water Resources and Human Health Risk Assessment	2012	Tom Allen, Lauren Thie (NC Div. Public Health)	NC DPH, CDC	50

Professional Service

Table D5. Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service provided
Albemarle-Pamlico National Estuary Program	2009-present	Tom Allen, RENCI@ECU	Advisory and oversight to EPA and NCDENR Secretary
NC DENR Strategic Habitat Areas Committee	2011-2012	“	Advice on GIS and coastal habitats
TNC Climate Adaptation Program Advisory Comm.	2010-2012	Tom Allen, Reide Corbett	Advice
National Weather Service Advisory Board	2009-2011	Tom Allen, ECU	Advise on forecast products and usage
AAG Coastal and Marine Geography Group	2008-present	“	Group leadership, organization

E4B. Outputs and Impacts

1. Publications

Refereed (Allen lead or co-author only since 2008 for RENCI@ECU projects.)

Allen, T.R. 2012. Estimating Coastal Lagoon Tidal Flooding and Repletion with Multidate ASTER Thermal Imagery. *Remote Sensing*, special issue on applications of thermal remote sensing, 4(10):3110-3126.

Allen, T.R., G.F. Oertel, and P.A. Gares. 2012. Mapping Coastal Morphodynamics using Geospatial Techniques. *Geomorphology* 137:138-149.

Landry, C., T. Allen, J. Whitehead, and T. Cherry. 2012. Offshore Wind Turbines and Coastal Recreation Demand. *Resource and Energy Economics* 34(1):93-111.

Allen, T.R., S. Sanchagrin, and G. McLeod. Geovisulization for Storm Surge Emergency Management. In: Tiefenbacher, D., Ed., *Approaches to Disaster Management - Examining the Implications of Hazards, Emergencies and Disasters* (in press.)

- Allen, T.R., T. Crawford, and Y. Wang. 2012. Remote Sensing of Land Cover Dynamics. In: Bishop, M. and J. Shroder, eds., *Treatise in Geomorphology* (in press.)
- Cleckner, H.C., T.R. Allen, and A.S. Bellows. 2011. Predictive Spatial Modeling of Mosquito Abundance and Habitats. *Remote Sensing* 3(12):2663-2681.
- Anderson, A. and T.R. Allen. 2011. Mapping Historic Hookworm Disease Prevalence in the Southern US, Comparing Percent Prevalence with Percent Soil Drainage Type using GIS. *Infectious Diseases: Research and Treatment* 4:1-19.
- Allen, T.R., G.F. Oertel, and G.M. McLeod. 2011. Coastal Flushing and Tidal Repletion Patterns in Multitemporal ASTER Thermal Satellite Data: Chincoteague Inlet, Virginia/Maryland. *IEEE Journal of Selected Topics in Applied Remote Sensing*, 4(1):147-158.
- Montz, B.E., Allen, T.R. and Monitz, G.I. 2011. Systemic Trends in Disaster Vulnerability: Migrant and Seasonal Farm Workers in North Carolina. *Risk, Hazard & Crisis in Public Policy* 2(1):1-17.
- Allen, T.R. and Y. Wang. 2010. Selected scientific analyses and practical applications of remote sensing: Examples from the Coast. In: Bossler, J.D., J.B. Campbell, R.B. McMaster, and C. Rizos, Eds. *Manual of Geospatial Science and Technology*, Second edition, pp. 467-485.
- Allen, T.R. and B.A. Shellito. 2008. Spatial Interpolation and Image-integrative Geostatistical Prediction of Mosquito Vectors for Arboviral Surveillance. *Geocarto International*, 23(4):311-325.
- Li, L., L. Xu, A. Jeng, D. Naik, T. Allen, and M. Frontini. 2008. Creation of Environmental Health Information System for Public Health Service: A Pilot Study. *Information Systems Frontiers*, 10:531-542.
- Oertel, G.F., T.R. Allen, and A.M. Foyle. 2008. The Influence of Dainage Hierarchy on Pathways of Barrier Retreat. *Southeastern Geology*, 45(3):179-208.
- Wang, Y. and T.R. Allen. 2008. Estuarine Shoreline Change Detection Using Japanese ALOS PALSAR HH and JERS-1 L-HH SAR Data in the Albemarle-Pamlico Sounds, North Carolina, USA. *International Journal of Remote Sensing*, 29(15):4429-4442.

List non-refereed publications (Allen lead only since 2008)

- Allen, T.R., M. Carey, B. Gore, T. Hill, and M. Covi. 2012. "Sea-Level Rise Vulnerability in the Albemarle-Pamlico Estuarine System," ESRI Map Book, v.27, p. 29.
- Allen, T.R., Wang, Y., Gore, B., Swords, J., and D. Newcomb. 2011. Coastal wetland mapping and monitoring using time series SAR imagery and LiDAR: Alligator River National Wildlife Refuge, North Carolina. *18th William T. Pecora Remote Sensing Symposium*, American Society for Photogrammetry and Remote Sensing, Herndon, Virginia, November 14-17.
- Allen, T.R. and S. Sanchagrin. 2011. Storm surge visualization for communicating risk and uncertainty. *Coastal GeoTools 2011*, Myrtle Beach, SC, March 21-24.
- Allen, T.R. 2011. Assessment of a Methodology to Simulate Geomorphic Evolution of the North Carolina Coastal System: Albemarle-Pamlico Sound Pilot study. NC Sea-Level Rise Risk Management Study (FEMA/NC Division of Emergency Management), October 1.
- Allen, T.R., D. Mallinson, S. Culver, and S. Riggs. 2011. A Methodology to Simulate Geomorphic Evolution of the North Carolina Coastal System. Final report to NC Sea-Level Rise Risk Management Study. June 1.
- Allen, T.R. 2010. Potential Sea-Level Inundation in the Town of Plymouth, NC. *NC Sea Grant*.

2. Technical Outputs

Spatial analysis tools in the form of software code and scripts have been developed and shared with fellow scientists and collaborating environmental and coastal managers and planners. These products include: 1) StormVis website with archive of video, GoogleEarth KMZ data, and powerpoint library of hurricane storm surge 3D data; 2) Storms2Life project (interactive timeline and history of NC hurricanes); 3)

3. Commercialization and Technology Transfer

Computer code and GIS software scripts developed by RENCI@ECU have been held free and open source for sharing with the research community and collaborators.

4. Awards and Honors

Table E1. Awards and Honors

Award or Honor	Date	Name	Brief Description
Walter B. Jones/NOAA award for Excellence in Coastal and Marine Graduate Study	2012	Michelle Covi	Biennial National Award recognizes graduate students whose academic study promises to contribute materially to the development of new or improved approaches to coastal or ocean management.
ESRI Map Award	2012	Brent Gore, Matt Carey, Travis Hill and Michelle Covi	Cartography award for <i>Sea Level Rise Vulnerability Map for the Albemarle Pamlico Sound</i> area.
ECU – Research and Creative Week. Best Graduate Oral Presentation on Social Sciences	March 2012	Michelle Covi	Research presentation award for “Sea-level Rise Perception and Decision Making in Plymouth, North Carolina”

A4C. Other Centers and Programs: Center for Sustainable Tourism (CST)
www.sustainabletourism.org or <http://www.ecu.edu/sustainabletourism/>

B4C. Activity Narrative

The Center for Sustainable Tourism provides services to the coastal region of North Carolina with emphasis on the analyses of tourism's net impact on economic, natural, and social issues. Research and outreach at the Center implements the concepts of financial, environmental, and social accounting to quantify the impacts, ascertain potential tradeoffs, and identify synergy among these dimensions of sustainable tourism. Over time these three dimensions of sustainability, often referred to as the "Triple Bottom Line", reinforce each other by creating long-term approaches that simultaneously promote better jobs, higher profits, better natural environments, and stronger social/cultural dimensions. The Center matches faculty and student expertise with businesses and destination communities to address the challenges in furthering a sustainable tourism economy.

Vision Statement: The Center for Sustainable Tourism embodies innovation in graduate education, leadership development, community consultation, and collaborative research. Devoted to implementing sustainable practices in business operations, public policies, and personal travel behaviors, the Center offers solutions to challenges facing the tourism industry and destination communities as they balance economic viability with socio-cultural and environmental enhancement and equity.

Mission:

1. To advance academic research and analyses that advocate sustainable practices in the travel and tourism industry.
2. To communicate these results to businesses, government planners, destinations, and communities throughout North Carolina, the nation, and globally to influence public policy and business decisions.
3. To help university students understand the broader sustainability issues challenging the travel and tourism industry, train them for management, research, and teaching careers in sustainable tourism and help them secure internships and jobs in the industry.

The UNC Tomorrow Report (General Information Template for Academic Program Review) noted that the Center address issues of economic development regionally in Eastern North Carolina and across the state, as well as global readiness (4.1); it aligns business practices with new realities of economic and resource constraints (4.4); it will lead the way in helping the tourism industry make serious and critical adjustments and adaptations in business practices and operations and communications and marketing (4.4); students aligned with the Center will be prepared to lead the tourism profession and tourism enterprises in adjusting to economic and environmental pressures and transformations (4.4.1); concurrent with these goals is the study of sustainable tourism as a component of the UNC Tomorrow charge to leverage expertise in the study of environmental issues (4.6.2) and the expansion of environmental awareness and responses in communities, businesses and on the ECU campus (4.6.3).

C4C. Resources:

1 Personnel

Table C1. Personnel of Center for Sustainable Tourism

Name	Title and department/college	Role
Dr. Patrick Long	Director	To provide leadership and management in research, academic program development and community outreach and service in sustainable tourism
Dr. Carol Kline	Assistant Professor of Recreation and Leisure Studies	Joint faculty appointment responsible for teaching in MS in Sustainable Tourism and conducting research and performing outreach on sustainability and tourism
Dr. Anne York	Associate Professor of Business/Organizational Management	Joint faculty appointment responsible for Directing and teaching in MS in Sustainable Tourism and conducting research and performing outreach on sustainability and tourism
Mr. Alex Naar	Director of Sustainable Tourism Outreach	Manages the outreach services of the CST to businesses, communities and local and state agencies
Dr. Huili Hao	Director of Research	Conducts and oversees research activities for staff, Affiliate Faculty and students.
Yvette Pierce	Administrative Associate	Office management
Affiliated Faculty		
1. Abdel-Salam, Tarek	Engineering	PI on Renewable Energy in Tourism EPA grant
2. Allen, Tom	Geography	Teaches in MS-ST degree program
3. Bean, Eban	Engineering	Research symposium presenter
4. Coonan, Bryna	Library Sciences	Resource materials coordinator
5. Crawford, Tom	Geography	2 nd home research/GIS
6. Crawford,	Hospitality Leadership	Research symposium presenter and

Alleah		student advisor
7. Curtis, Scott	Geography	Climate, Weather and Tourism research, grant PI, workshop coordinator and author
8. Deale, Cynthia	Hospitality Leadership	Thesis advisor/committee member, researcher/author
9. Dermody, Michael	Film Studies/Fine Arts	Research symposium presenter and student advisor
10. Edwards, Bob	Sociology	MS-ST student advisor and GA supervisor for RESET
11. Edgell, David	Hospitality Leadership	Teaches in MS-ST
12. Egan, Ashley	Biology	Volun-tourism research
16. Fernandes, Luci	Anthropology	Cuba initiative/teaches in MS-ST degree program
17. Kain, Donna	English/Discourse PhD	Co-PI on communication and tourism research
18. Jilcott-Pitts, Stefanie	Public Health	Research symposium presenter and student advisor
19. Kariko, Daniel	Photography/Fine Arts	Research symposium presenter and student advisor
20. Kirchoff, Jon	Marketing	Faculty advisor for student organization on sustainable tourism
21. Kruse, Jamie	Economics	MS-ST Faculty Graduate Program Committee
22. Landry, Craig	Economics	MS-ST Faculty Graduate Program Committee and GA advisor
23. Loomis, David	Coastal Resource Mgmt and Recreation & Leisure Studies	Teaches in MS-ST degree program
24. Marcucci, Dan	Geography/Planning	Research symposium presenter and student advisor
25. Mulcahy, Karen	Geography/GIS	Nature-based/Eco-tourism GIS research
26. Oliver, Jay	Marketing	MS-ST Faculty Graduate Program Committee, GA advisor, teaches in MS-ST and CO-PI on grant.
30. Powers, Rebecca	Sociology	Oil-Spill and Second Home Impacts research
31. Reyes, Enrique	Biology	Research symposium presenter and

32. Richards, Nathan	Maritime History	student advisor Research symposium presenter and student advisor
33. Robinson, Stacy	Marketing	Research symposium presenter, student advisor and CO-PI on grant application
34. Schneider, Paige	Recreation & Leisure Studies	MS-ST Faculty Graduate Program Committee and GA advisor
35. Smith, Catherine	English and Discourse Writing	Oil-Spill research
36. Sweet, Becky	Interior Design	Research symposium presenter and student advisor—First Nations Cultural Center
37. Tice, Larry	History/Emeritus	Wright Brothers research
38. Tuten, Tracy	Marketing	Co-PI on grant application, research symposium presenter and student advisor
39. Vogelsong, Hans	Coastal Resources Mgmt	MS-ST Faculty Graduate Program Committee and MS-ST faculty
40. Weber, Mel	Hospitality Leadership	Research on management and green practices
41. West, David	Organizational Management	Teaches in MS-ST degree program
42. Wilson, Ken	Sociology	Research on oil spill study.

Students

Twelve students are currently conducting research for the Center affecting coastal environments within the following initiatives: Climate, Weather and Tourism; Race, Ethnicity, Social Equity and Tourism; Renewable Energy in Tourism; Tourism Entrepreneurship; Foods and Tourism Product Development; Tourism Impacts and Second Home Development; United States Travel Care Code; and Community Sense of Place.

D4C

1 Research Funding (Current)

- Greening Coastal Vacation Rental Properties. (2012). \$30,000. Targeted program: U.S. Environmental Protection Agency, Source Reduction Assistance Program. Abdel-Salam, T., Long, P. and Naar, A.

- The Impact of Weather on Tourist Decision Making: Planning for Beaufort, NC Ferry Service to Cape Lookout National Seashore. (2012). \$20,000. Carolinas Integrated Sciences and Assessments Minigrant Program 2012-2013. Curtis, S., Hao, H. and Long, P.
- Tourism Impacts and Second Home Development in Coastal Communities: A Sustainable Approach. (2010-13). North Carolina Sea Grant, \$94,952. Long, Hao, Knollenberg, Landry and Crawford.

2. Public Service, Outreach and Community Engagement

NC GreenTravel: Through the Center’s NC GreenTravel Program (www.NCGreenTravel.org), coastal tourism businesses receive formal recognition based upon the type and level of sustainable actions they are implementing. *AAA Travel* has now approved this recognition for its ECO Icon labeling program and includes such businesses in their publication and website outlets. This recognition program is conducted in collaboration with the NC Division of Environmental Assistance and Outreach (DNER) and the Division of Tourism, Film and Sports Development (NC Commerce).

U.S. Travel Care Code: The United States Travel Care Code (www.travelcarecode.org) is designed to provide travelers in the United States with information on how they can reduce the negative impact of their travel and visitor related activities. The Code was created with domestic travelers in mind and includes actions that they can take to protect the environment and support local economies and communities. This program has been developed in partnership with MilesMedia Inc and is available for use by tourism businesses and destinations in branding and marketing efforts.

Nature-Based/Eco-Tourism Mapping Program: The Center is working with partners in Eastern North Carolina to identify and map nature-based tourism assets. The natural resources of the coastal and inland areas include the second largest estuarine and wetland system in the US, with over 5,000 miles of estuarine shoreline, eight major drainage basins, and associated wetland systems. Such an environment offers opportunities to establish an economy based upon eco and sustainable tourism to include hunting and fishing tours, estuarine cruises, wildlife tours, natural history field trips, back-water paddle adventures, horseback riding trails, and camping trips.

Renewable Energy in Tourism (RETI): The Renewable Energy in Tourism Initiative provides coastal tourism businesses with knowledge to expand the economic benefits of implementing sustainable energy practices. Through webinars, publications and funded research initiatives, change is affected in small and mid-size tourism businesses. Partners in this effort include the National Renewable Energy Laboratory, the University of Colorado’s Energy Initiative and Miles Media, Inc.

Weather, Climate and Tourism Initiative: This initiative is designed to assist tourism businesses and destination communities make informed business decisions based upon weather and climate data. Weather and the influences of climate frequently emerge as important criteria for choosing a tourism destination as they help in determining the appeal of a location in absolute or relative terms. The tourism industry is particularly sensitive to weather conditions and climate

variability. Weather fluctuations and climate variability affect tourism planning in addition to the tourists' destination decisions.

Community Sense of Place: In an effort to better understand how coastal communities are affected by tourism development, the Center has conducted research in a number of North Carolina coastal counties. These studies increase understanding of the perceptions of resident property owners and second home owners regarding the impacts of tourism development on land use, the economy, service provision, cultural opportunities, infrastructure, the environment, and the contribution of such actions, to the future success of the county's tourism economy, on the effects of climate and weather on property decisions and recreational pursuits, and on the impacts and benefits of tourism, as well as future support for additional tourism.

Crisis, Hazards and Communication: The call for crisis communication plans in the tourism industry recognizes that a variety of risks to health and safety exist anywhere people travel. Hazards include natural phenomena such as hurricanes, earthquakes, wildfires, and floods; health risks such as SARS, pandemic flu, foodborne illness, and localized disease outbreaks; as well as dangers from technological and industrial failures and human actions such as accidents, and terrorism and political unrest. In the event of a serious situation or incident, effective communication is essential to help people make efficacious decisions regarding their health and welfare and address a variety of eventualities including the similarities and differences in the approaches necessary to communicating about them.

E4C Outputs and Impacts

1 Publications

Published Articles

- Rural Tourism and Second Home Development. *Handbook of Tourism and Quality of Life Research*. (2012). Long, P., Ireland, M., Alderman, D. and Hao, H. Springer Publishers & International Society for Quality-of-Life Studies, pp. 607-633.
- Home Away From Home: A Research Agenda for Examining the Resort Community Second Home Industry in Colorado. (2012). Long, P., Perdue, R. and Venturoni, L. The Routledge Handbook of Tourism Research. Rutledge Taylor and Francis Group), pp 145-156.
- Comparative Review of Second Home Research Findings in North Carolina and Colorado. (2012). Venturoni Surveys & Research, Inc., Linda Venturoni, President.
- Second Home Development in Coastal Counties- A Planners Perspective. (2012). Covi, M., Hao, H. and Long, P.
- Sustaining Ecotourism: The Condor Lodge Conservation Project. (2012). Urias, D. and Edgell, D. *Asian Journal of Tourism and Hospitality Research*, 36(1).
- Modeling Tourist and Community Decision-making. (2011). Kask, S., Kline, C., & Lamoureux, K. *Annals of Tourism Research*, 38, pp. 1387-1409.
- Factors Affecting Tourism Entrepreneurship in the North Carolina Mountains. (2011). Kline, C., Swanson, J. & Milburn, L.A. *Journal of Tourism Challenges and Trends*, 4(1): 77-102.

- Funding Sustainable Paddle Trail Development: paddler Perspectives, Willingness to Pay and Management Implications. (2011). Kline, C., Cardenas, D., Duffy, L. & Swanson, J. *Journal of Sustainable Tourism*, 20(2), 235-256.
- Climate, Weather, and Tourism: Issues and Opportunities. (2011). Curtis, S., Long P. & Arrigo, J. *Bulletin of the American Meteorological Society*, March, pp 361-363.
- Tour Guides as Creators of Empathy: The Role of Affective Inequality in Marginalizing the Enslaved at Plantation House Museums. (2011). Modlin, E. Jr., Alderman, D. and Gentry, G. *Tourist Studies*, 11(1): 3-19.
- Factors Predicting Homeowners' Attitudes towards Tourism: A Case of a Coastal Resort Community. (2011). Hao, H., Long, P. and Kleckley, J. *Journal of Travel Research*, Vol. 50(6), pp 627-640.
- Tourists' Climate Perceptions: A Survey of Preferences and Sensitivities in North Carolina's Outer Banks. (2010). Covington, R., Arrigo, J., Curtis, S., Long, P., & Alderman, D. *The North Carolina Geographer*, Vol. 17, pp. 38-53.
- Beyond Ecotourism: The Environmentally Responsible Tourist in the General Travel Experience. (2010). Dolnicar, S. and Long, P. *Tourism Analysis*, Vol. 14, pp. 503-513.
- Environmentally Friendly Tourists: What do we really know about them? (2008). Dolnicar, S., Crouch, G. and Long, P. *Journal of Sustainable Tourism*, Vol. 16(2), pp. 197-210.
- Symbolic Excavation and the Artifact Politics of Remembering Slavery in the American South: Observations from Walterboro, South Carolina. (2008). Alderman, D. and Campbell, R. *Southeastern Geographer*, 48(3), pp. 338-355.
- Attitudes of resident and second home property owners to climate change considerations and their affects on future property values in coastal counties. Long, P., Hao, H. and Curtis, S. *International Journal of Risk Analysis and Crisis Response*. (in press).
- Homeowners' Attitudes toward Tourism in a Mountain Resort Community: A Comparison of Seasonal and Permanent Property Owners. *Tourism Geographies*. Hao, H., Alderman, D. & Long, P. (in press).
- Using Ecological Systems Theory and Density of Acquaintance to Explore Resident Perception of Entrepreneurial Climate. Kline, C., McGehee, N., Paterson, S. & Tsao, J. *Journal of Travel Research*. (in press).
- Population, Space and Place. Impacts of In-Migration and Coastal Amenities on Housing Growth in Coastal North Carolina, USA. Crawford, T., Bradley D. and Marcucci, D. (in press).

A5A. Other Departments: Department of Geological Sciences (coastal geological, hydrological and oceanographic research)

B5A. Narrative

- **Mission and history.**

In 1967, as East Carolina College (ECC) became East Carolina University (ECU), a five-person Department of Geology was initiated. Its mission, quite different from what had gone before at ECC, was to combine teaching and research activities and, in essence, to help ECU transition from a teaching college to a research university. Given the location of ECU, right from the start, the Department emphasized coastal and environmental studies. Two of the original five faculty members researched in the coastal realm. In the 1980s a new faculty member began a coastal hydrology program.

By 1999, the Department had eight tenure-track faculty members and one fixed-term faculty member. A new Chair (a coastal micropaleontologist) and support from higher administration led a push to increase the research emphasis of the department in coastal geological, oceanographic and hydrological/environmental studies. In the next decade the department added a geochemical oceanographer, a coastal geologist/geophysicist, a coastal sedimentologist, two coastal hydrologists, a coastal organic geochemist, a coastal remote sensing specialist, a sea level researcher, and a coastal physical oceanographer (no longer at ECU).

The department currently has 16 tenured or tenure-track faculty member, one fixed-term faculty member and one Distinguished Research Professor. Four of these faculty members hold joint appointments in the Institute for Coastal Science and Policy (ICSP) and four faculty members contribute to the newly formed (2012) Coastal Water Resources Center within ICSP. In order to emphasize the growing breadth of our department, in 2006, it was renamed the Department of Geological Sciences.

The mission of our department is: To achieve and sustain relevant, high-quality instructional programs for our undergraduate and graduate students; to provide support for and to conduct valuable research; to apply our professional expertise in service to the University, private and public groups, and to local, state, national and international organizations; and to integrate teaching, research and service into the larger, synergistic enterprise of scholarship.

Within this context we regularly revisit our strategic priorities so that we serve our students and dove-tail with UNC's and ECU's strategic goals. Our current departmental priorities reflect our continuing commitment to coastal science:

- 1) Maintain our commitment to strong, basic, educational and research programs in the geological sciences;
- 2) Focus research efforts on emphasis areas in coastal geology; hydrology/environmental geology, and solid Earth geology;
- 3) Continue a leadership role in the newly founded Coastal Water Resources Center;
- 4) Enhance all levels of earth science education in North Carolina.

- **Unique, competitive, compelling, and/or strategic importance.**

Eleven of our 17 faculty members, our Research Instructor and our Distinguished Research Professor spend much of their time and effort teaching, researching and undertaking outreach related to coastal science. This planned critical mass results in a research program that publishes multiple papers a year on coastal matters, has considerable external funding (currently 25 grants totaling ca. \$3.3 million of which 5 are from the NSF) and has ca. 20 graduate students at any

one time undertaking coastal research. A majority of these students acquire jobs dealing with coastal matters. As befits ECU's motto, "To serve", much of the research that we undertake is relevant to the people of eastern North Carolina and its coastal economy and, therefore, to the state of North Carolina. Further, our research findings in coastal North Carolina readily translate to coastal regions around the world. We do not restrict our coastal research to North Carolina. For example, we currently work in the Gulf of Mexico, Alaska, New Zealand, Malaysia, Spain, Portugal and Russia.

Two recent examples of the productivity and strategic importance of our research to North Carolina, its economy and its people follow:

Coastal Geology of North Carolina. This research program was funded for 11 years by the US Geological Survey (\$1,160,642 plus extensive ship-time) and has also received considerable support (over \$1,500,000) from NOAA, the NC DENR, the National Park Service and the NSF. To date, this program has resulted in more than 50 peer-reviewed papers, three PhD dissertations and more than 30 Master's theses. Approximately 200 papers have been presented at regional, national and international conferences. This research program has vastly increased our knowledge of the evolution of the North Carolina coastal region, the current geological and oceanographic processes, and the likely future coastal challenges that the State of North Carolina will face. For example, we have demonstrated how coastal storms drive geomorphological changes in our barrier islands and, therefore, in our coastal water quality. Working with colleagues from other institutions we have also documented the pattern of sea level rise in North Carolina over the past 2500 years, including a tripling of the rate of rise during a single decade around the turn of the 20th century.

Land-use Effects on Water Resources in North Carolina. This program, initiated in 2005, uses tracers and other hydrogeological, geochemical, and geophysical techniques to develop insights into the geological controls and land-use effects on surface water-groundwater interactions and nutrient transport in the North Carolina Coastal Plain. The recent focus has been on wastewater disposal and its effects on groundwater and surface water quality, a subject of great importance to the peoples of eastern North Carolina and to the coastal tourism, including commercial and sport-fishing, industries. The program has received funding from NC DENR, US EPA, USGS, USDA, NC WRRI, CDC, PTRF, EEG and the UNC-system totaling approximately \$1 million since inception.

Examples of our coastal research activities beyond North Carolina are:

Source-to-Sink Research in New Zealand. As part of the NSF Margins Program, the Source-to-Sink (S2S) research initiative was designed to examine sediment production, transport and storage from mountain top to ocean floor. More specifically, the S2S effort has focused research on the processes eroding land and building strata in the sea, with the goal of understanding sediment exchange between land and sea and how this is recorded in the sedimentary record. A current NSF-funded collaborative project uses a combination of modeling, in situ measurements and time-series coring to determine how strata are formed and preserved in the coastal ocean. This research has important implication for carbon cycling and petroleum exploration.

Tracing the Effects of the Gulf of Mexico Oil Spill. Two rapid response proposals related to the 2010 Gulf of Mexico oil spill were awarded by the NSF in 2010. One proposal was an NSF Major Research Instrumentation proposal, which resulted in purchase of a critical piece of equipment related to obtaining the fingerprint of the *Deepwater Horizon* Oil Spill. The other proposal was to determine the pathway of oil spill-derived compounds from the Gulf of Mexico to the Gulf Coast states during the hurricane season of 2010. The research projects have fostered

several research collaborations with individuals outside of ECU as well as in other departments within ECU. One recent paper from the project demonstrates ecosystem effects from the oil spill the Gulf of Mexico.

- **Most significant impact(s) of the program on research, education, and/or society (including direct contributions to policy or management decisions).**

The previous section alludes to several significant impacts of the coastal research program in Geological Sciences concerning coastal management in North Carolina, water quality and the likely effects of increased tropical storm activity and increased rate of sea-level rise. We point out three additional examples that contribute to policy and coastal management decisions.

- 1) We note the influence of a 2011 book, “*The Battle for North Carolina’s Coast*”, authored by Riggs, Ames, Culver and Mallinson. The book is based on several decades of research at ECU and makes suggestions for coastal management in the context of a new vision for the future for coastal North Carolina and its economy. The book demonstrates how “pure” scientific research can be translated into accessible information for managers, politicians, businesses and the general public.
- 2) Several members of the Department of Geological Sciences coastal research team were involved in drafting the draft sea-level rise policy for the NC Coastal Resources Commission. This policy caused considerable controversy in North Carolina during 2012, which was noticed and commented upon as far away as Europe. The Commission’s Science Panel recommended that coastal communities prepare for a possible 1 m rise in sea level by 2100 based on a review of the extensive scientific data.
- 3) Dr. S. Riggs is retired as a teaching faculty member but he holds the position of Distinguished Research Professor in the Department. In addition to coastal research, he is heavily involved in outreach, in particular communicating the science behind climate and coastal change to the public coastal managers, teachers, agencies and politicians. As an example of this work, his activities during the last two years are listed below. Dr. Riggs served on:
 - a. North Carolina Task Force of the U.S. Department of Interior,
 - b. Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE),
 - c. Technical Advisory Committee (TAC) for the Defense Coastal-Estuarine Research Program (DCERP), U.S. Department of Defense,
 - d. Mid-East Resource Conservation and Development, Inc., Soil Conservation Service, U.S. Department of Agriculture,
 - e. North Carolina Governor’s Panel on Offshore Energy,
 - f. North Carolina Legislative Commission on Global Climate Change,
 - g. Review Panel for the NC Legislature Study of Terminal Groins at North Carolina’s Coastal Inlets, NC Coastal Resources Commission (NC CRC),
 - h. NC Legislative Study on Sea-Level Rise for the NC Division of Coastal Management (NC DCM),
 - i. Advisory Committee on Climate Adaptation to the NC Chapter of the Nature Conservancy,
 - j. Science Panel on Coastal Hazards for the NC Division of Coastal Management (NCCRC) and NC Coastal Resources Commission (NCDCM);
 - k. Board of Directors, NC Museum of Natural Sciences, Raleigh, NC,

1. NC Museum of Natural Sciences and UNC General Administration Committee on University Sciences Cooperative Program with the new Nature Research Center in Raleigh, NC.

- **Most significant challenges that will be faced in the next year, and in the next five years.**

The most significant challenge over the next year will most probably be repeated over the next five years. That challenge is dwindling university resources. Although part of this challenge can be addressed by the acquisition of external grants, those external dollars cannot build research capacity without institutional support. Cuts in the UNC system budget have resulted in a two-thirds reduction of the department's operating budget. The vast majority of the remaining funds support the running of a department and its teaching responsibilities. Nothing is left to underpin research. If an instrument breaks then we can dip into returned F and A funds but, as a result, these funds are feeling the pressure.

A second concern involves loss of faculty and the inability to replace them. For example, our sole physical oceanographer, a joint hire with ICSP and an important member of our research team, recently resigned to rejoin his alma mater in Canada. His position was lost to budget cuts and it unlikely that we will get that position back in the near future, if ever. But even if we were to receive approval for a replacement, it would be difficult to hire someone because it is unlikely that we could offer the scale of start-up funds that would be required to attract a research active candidate. Last year, three of our coastal faculty members were being considered for posts elsewhere. We managed to retain them this time but next time will be harder.

Almost perversely, these budgetary problems are occurring at a time when the number of our undergraduate majors has almost tripled, the number and quality of applicants to our graduate program have increased, and the employment opportunities for students with Master's degrees in coastal geology and coastal hydrogeology are burgeoning. All indicators predict excellent employment opportunities for the foreseeable future.

- **Future directions and sustainability.**

Unless there is a dramatic turnaround in the country's economy, we expect the next five years to be a time of consolidation rather than growth in terms of personnel, programs and major infrastructure. However, we have a strong research team and a graduate student body that is increasing in quality. Several of our faculty members are quite recent hires near the beginning of their careers. As they develop in all aspects of their jobs, if external agency funds are available, we will have a very good chance of competing for those funds successfully. Indeed, we have been quite successful in recent years in attracting more NSF grants to our diverse portfolio of external grants. The push for faculty members to teach more classes will be problematic, however, if we wish to grow our research and graduate student education and training endeavors. We expect to continue our close linkages with ECU's Institute for Coastal Science and Policy (four faculty members hold joint appointments with ICSP) and with UNC's Coastal Studies Institute (two joint program heads at CSI are Geological Sciences faculty members).

C5A. Resources

1. Personnel

Table C1. Personnel

Name	Title and department/college	Role
Reide Corbett	Professor, Geological Sciences	Researcher
Stephen Culver	Dist. Prof., Geological Sciences	Researcher
Eduardo Leorri	Assist. Prof., Geological Sciences	Researcher
David Mallinson	Assoc. Prof., Geological Sciences	Researcher
Alex Manda	Assist. Prof., Geological Sciences	Researcher
Rick Miller	Professor, Geological Sciences	Researcher
Siddhartha Mitra	Assoc. Prof., Geological Sciences	Researcher
Michael O’Driscoll	Assoc. Prof., Geological Sciences	Researcher
Stanley Riggs	Dist. Res. Prof., Geol. Sciences	Researcher
John Walsh	Assoc. Prof, Geological Sciences	Researcher
Dorothea Ames	Research Instr., Geol. Sciences	Research Assistant
James Watson	Laboratories technician	Drilling, boat, field support
John Woods	Laboratories technician	Drilling, boat, field support

5 Undergraduates – supporting faculty research projects
 20 MS students – undertaking coastal research for their theses
 1 PhD student – undertaking coastal research for her dissertation
 1 post-doc – undertaking joint research with a faculty member

D5A. Research, Teaching, Public and Professional Service

1. Research

Table D1. Research

Project title	PI/CoPIs – include institution	Sponsor	Amount	Dates
Initiating a new collaboration between East Carolina University	S.J. Culver, D.R. Corbett, S. Curtis, E. Leorri, D. Mallinson, S. Mitra, J.P. Walsh	National Science Foundation	\$49,974	3/2012 to 8/2013

and Universiti Malaysia Terengganu: Post- glacial variations in the East Asian monsoon	(ECU)			
The foraminiferal signature of hurricanes: northern Gulf of Mexico	S.J. Culver (ECU)	Petroleum Research Fund (American Chemical Society)	\$100,000	1/2010 to 8/2013
Collaborative Research: Submarine groundwater and freshwater inputs along the western Antarctic peninsula	D.R. Corbett (ECU)	National Science Foundation	\$344,037	8/2011 to 7/2015
Vulnerability assessment for coastal counties and developed counties	D.R. Corbett and J.P. Walsh (ECU)	Skidaway Institute of Oceanography	\$73,479	8/2011 to 7/2013
Advanced regional and decadal predictions of coastal inundation for the U.S. Atlantic and Gulf coasts	D.R. Corbett (ECU)	University of Pennsylvania	\$78,936	9/2011 to 7/2013
RAPID: Collaborative Research: Signature of the 2011 flooding on the Mississippi subaqueous delta	J.P. Walsh, D.R. Corbett, S. Mitra (ECU)	National Science Foundation	\$58,498	7/2011 to 6/2013
Collaborative research: Formation and preservation of fluvial and marine depositional events, Waipaoa River margin, New Zealand	J.P. Walsh, D.R. Corbett (ECU)	National Science Foundation	\$384, 874	8/2009 to 7/2013
Regional Center for Coastal Systems Informatics and Modeling (C-SIM)	T. Allen, J.P. Walsh, D.R. Corbett, and others (ECU)	RENCI, State of NC	\$200,000	7/2011 to 6/2013

Assessment of surface and ground water hydrology and vegetation at the Emily and Richardson Preyer Buckridge Coastal Reserve, NC	A.K. Manda and T.R. Allen (ECU)	North Carolina Clean Water Management Trust Fund	\$71,398	2010 to 2012
Integrating Science through project-based learning	S. Schleigh (Purdue), A.K. Manda (ECU)	Institute for Global Environmental Strategies	\$37,399	2-010 to 2012
WESTLOGs - Recent evolution of Portuguese W coast ESTuaries: high resolution studies from marshes geoLOGical records	Leorri, E. (ECU), F. Fatela (University of Lisbon)	Fundacao para la Ciencia e la Tecnologia (Portugal).	\$217,500	1/2010 to 12/2012
TANYA - Natural and anthropic environmental transformation of the Cantabrian marshes: adaptation to the climate change	Leorri, E. (ECU), A. Cearreta (University of the Basque Country)	Ministerio de Cienciae Innovacion (Spain)	\$117,000	10/2009 to 12/2012
Non-intrusive geophysical characterization of wastewater plumes in coastal North Carolina	Humphrey, C., O'Driscoll, M., Mallinson, D. (ECU)	North Carolina Water Resources Research Institute	\$30,000	2012 to 2013
Water quality restoration for Meeting House Branch.	O'Driscoll, M., Humphrey, C. (ECU)	Office of the North Carolina Attorney General- Environmental Enhancement Grant	\$33,073	2010 to 2012
On-site wastewater and centralized sewer system nutrient loadings to surface waters in Pitt County, NC	Humphrey, C., O'Driscoll, M., Manda, A. (ECU)	North Carolina Department of Environment and Natural Resources	\$83,473	2012 to 2013

Impacts of sea-level rise and land-use modifications on fringing marsh sustainability	McKee, B. (UNC-CH), Miller, R. (ECU), Rodriguez, A. (UNC-CH)	NOAA, Sea Grant	\$18,027	2010 to 2012
Examining the transport, transformation and fate of materials impacting North Carolina's water resources: an integrated approach using remote sensing, fluorescence spectroscopy and geochemical analysis	Miller, R. (ECU), McKee, B. (UNC-CH)	NOAA, Sea Grant	\$149,683	2012 to 2014
Reprocessing, analysis and synthesis of IOP measurements acquired during the GEO-CAPE Chesapeake field campaign July 2011	Miller, R. (ECU)	NASA	\$30,257	2012 to 2013
On the export of dissolved organic carbon by rivers: assessing the effect of climate variability	Del Castillo, C.E. (Johns Hopkins), Miller, R. (ECU)	NASA	\$312,909	12/2012 to 12/2015
Restoring access to diadromous fish habitat and linkages to forage-fish biomass in the North Atlantic large marine ecosystem	Rulifson, R., Walsh, J.P. (ECU)	NOAA	\$40,030	10/2012 to 9/2014
Synthesis of high and low marsh habitat mapping, vulnerability and responses to sea-level rise in the	Allen, T., Walsh, J.P. (ECU)	Southeast Atlantic Landscape Conservation Cooperative	\$271,861	10/2012 to 9/2014

South Atlantic region				
Preserving the resource base and developing a sustainable coastal economy for North Carolina's coastal system	Riggs, S., Culver, S.J. (ECU)	Kenan Foundation	\$65,000	7/2011 to 6/2013
A multidisciplinary investigation of coastal system response to sea-level rise, climate dynamics, and geomorphic change	Mallinson, D., Culver, S.J., Leorri, E., Mitra, S. (ECU), Mulligan, R. (Queen's University)	National Science Foundation	\$399,922	9/2011 to 9/2014
Geomorphic mapping of Shackelford Banks to determine barrier island evolution in concert with development of the archeological history, Cape Lookout National Seashore, NC	Riggs, S.R., Ames, D. (ECU)	US National Park Service	\$63,099	8/2012 to 2016
Oyster monitoring network for the Caloosahatchee estuary	Mitra, S. (EDU)	Florida Gulf Coast University	\$55,000	8/2007 to 12/2012

Public Service, Outreach and Community Engagement

Table D4. Public Service, Outreach and Community Engagement

Public Service / Outreach/Engagement	Dates	Personnel Involved	Participants in program	Number of participants
NC COHAZ	9/2008 to present	J.P. Walsh, D. Reide Corbett	General public	>60,000 hits
Newspaper articles on oil spill impacts in the Gulf of Mexico (International Business Times, Science Daily,	3/2012	Mitra, S. and Kimmel, D.	General public	1000s

The Voice of Russia)				
UNC CH/ECSU IDEA Summer Science Institute program – field-based presentation/programming; Geological Background and Coastal Hazards of the Outer Banks	2012	D.R. Corbett	High School students	20
Blue Heron Bowl - A "Jeopardy-like" competition for high school students focused on Oceanography.	2011 and 2012	D.R. Corbett, S. Mitra, J.P. Walsh, A. Manda, R. Miller	High School students	>100
Wahl Coates Elementary School presentation on coastal hydrology	2009	A.K. Manda	Elementary School students	30
Epps Middle School presentation on coastal hydrology	2009	A.K. Manda	Middle School students	50
ECU Open House	2009, 2010, 2011, 2012	A.K. Manda, A Heimann, S. Culver	High School students and parents	>1000
NE Region Science and Engineering Fair	2010	A.K. Manda	K-12	>100
Pitt Community College- Swift Creek Watershed Outreach Presentation	2012	M. O'Driscoll, C. Humphrey	Swift Creek Watershed Study Group, Pitt Community College, General Public	50
City of Greenville Stormwater Tour	2012	M. O'Driscoll, E. Bean and C. Humphrey	Greenville City Council, Mayor of Greenville, other City of Greenville employees	12
National Youth Science Camp	7/2012	Miller, R.	High School students (national and international)	120
Presentation at NC Soil and Conservation Workshop, Atlantic	8/2008	Mallinson, D.	General public	100

Beach, NC on :sea-level rise and the fate of the NC coast”				
Presentation to the Sierra Club, Greenville, NC on “The Battle for North Carolina’s coast”	3/2012	Riggs, R., Ames, D., Culver, D., Mallinson, D.	General public	50
Presentation in Buxton, NC on “The Battle for North Carolina’s coast”	1/2012	Riggs, S., Ames, D., Culver, S.J., Mallinson, D.	General public	50
Outreach presentation on coastal geology in NC to high school students in Terengganu, Malaysia	2/2012	Mallinson, D.	High school students and teachers	50
“What is geology?” presentation to Wintergreen Intermediate School, Pitt County, NC	2012	Mallinson, D.	Fourth grade students	30
“Oilpocalypse” presentation at Greenville Science Cafe	2010	Mallinson, D., Walsh, J.P., Mitra, S.	General public	50
North Carolina Center for the Advancement of Teaching	2008 to present	Riggs, S.R.	K-12 teachers	3 to 6 programs/year with 22 teachers per program
Approximately 50 public lectures per year throughout North Carolina	2008 to present	Riggs, S.R.	General public and special interest groups (e.g., programs at various universities, conferences, school groups, clubs, legislative committees, civic organizations (etc)	Several 1000
TV and other educational programs on the NC coast (UNC-TV Exploring NC – 4 programs; PBS	2010 to present	Riggs, S.R.	General public and K-12 schools	10s to 100s of thousands

Frontline – 1 program; educational panels for NC Natural Science Museum, Nature Science Center – 3 programs). Numerous radio talk programs and newspaper interviews (e.g., New York Times, Los Angeles and Chicago newspapers, NC News and Observer, Washinton Star, local Island Free Press, etc				
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E5A. Outputs and Impacts

1. Publications

Twenty representative publications are listed:

Grand Pre, C., Horton, B.P., Kelsey, H., Rubin, C., Hawkes, A., Daryono, M., Rosenberg, G., Culver, S.J., (2012). Stratigraphic evidence for an early Holocene earthquake in Aceh, Indonesia. *Quaternary Science Reviews*, 54, 142-151.

Mallinson, D.J., Smith, C.W., Mahan, S., Culver, S.J., and McDowell, K. (2011). Barrier island response to late Holocene climate events, North Carolina, USA. *Quaternary Research*, 76, 46-57.

Humphrey, C., O’Driscoll, M., & Zarate, M. (2011). Evaluation of on-site wastewater system *E. coli* contributions to shallow groundwater in coastal North Carolina. *Water Science and Technology: Water Supply*, 63, 789-795.

Miller, R.L., Liu, C-C., Buonassissi, C.J., & Wu, A. (2011). A Multi-sensor Approach to Examining the Dynamics of Total Suspended Matter (TSM) in the Albemarle-Pamlico Estuarine System, NC USA, *Remote Sensing*, 3, 962-975.

Allison, M.A., Dellapenna, T.M., Gordon, L.S., Mitra, S., & Petsch, S. (2010). Impact of Hurricane Katrina (2005) on shelf organic carbon burial and deltaic evolution. *Geophysical Research Letters*, 37 (L21605), doi:10.1029/2010GL044547

Alexander, C.A., Walsh, J.P., & Orpin, A.R. (2010). Modern sediment dispersal and accumulation on the Waipaoa outer continental margin. *Marine Geology*, 270, 139-159.

Corbett, D. R. (2010). Resuspension and estuarine nutrient cycling: insights from the Neuse River Estuary. *Biogeosciences*, 7, 3289-3300.

Leorri, E., Gehrels, R.W., Horton, B.P., Fatela, F., & Cearreta, A. (2010). Distribution of foraminiferal assemblages in salt marshes along the east North Atlantic coast: tools to reconstruct past sea-level variations. *Quaternary International*, 221, 104-115.

- Rossi, V., Horton, B.P., Corbett, D.R., Leorri, E., Perez-Belmonte, L., & Douglas, B.C. (2010). The application of foraminifera to reconstruct the rate of 20th century sea-level rise, Morbihan Golfe, Brittany France. *Quaternary Research*, 75, 24-35.
- Mallinson, D.J., Smith, C.W., Culver, S.J., Riggs, S.R., and Ames, D.V. (2010). Geological characteristics and spatial distribution of paleo-inlet channels beneath the Outer Banks barrier islands, North Carolina, USA. *Estuarine, Coastal and Shelf Science*, 88, 175-189.
- Corbett, D. R., Marciniak, K., & Walsh, J. (2009). Distribution and accumulation of trace metals in two adjacent tributaries of the Neuse River Estuary, NC. *Marine Pollution Bulletin*, 58, 1739-1765.
- Walsh, J.P. & Nittrouer, C.A. (2009). Towards an understanding of fine-grained river-sediment dispersal on continental margins. *Marine Geology*, 263, 34-45.
- Corbett, D.R., Marciniak, K., & Walsh, J.P. (2009). Distribution and accumulation of trace metals in two Adjacent tributaries of the Neuse River Estuary, NC. *Marine Pollution Bulletin*, 58, 1739-1765.
- O'Driscoll, M., Soban, J., & Lecce, S. (2009). Stream channel enlargement response to urban land cover in small Coastal Plain watersheds, North Carolina. *Physical Geography*, 30, 528-555.
- Hardison, E.C., O'Driscoll, M.A., DeLoatch, J.P., Howard, R.J. & Brinson, M.M. (2009). Urban land-use, channel incision, and riparian water table decline along Inner Coastal Plain streams, North Carolina. *Journal of the American Water Resources Association*, 45, 1032-1046.
- Kemp, A.C., Horton, B.P., Culver, S.J., Corbett, D.R., Van de Plassche O., Gehrels, R., Douglas, B. and Parnell, A.C. (2009). The timing and magnitude of recent accelerated sea-level rise. *Geology* 37: 1035-1038.
- Mitra, S., Zimmerman, A.R., Hunsinger, G.B., Willard, D., & Dunn, J.C. (2009). A Holocene record of climate-driven shifts in coastal carbon sequestration. *Geophysical Research Letters*, 36 (L05704), 10.1029/2008G036875.
- Mitra, S., Lalicata, J.J., Allison, M.A., & Dellapenna, T.M. (2009). The effects of hurricanes Katrina and Rita on seabed polycyclic aromatic hydrocarbon dynamics in the Gulf of Mexico. *Marine Pollution Bulletin*, 58, 851-857.
- Del Castillo, C.E. & Miller, R.L. (2008). On the use of ocean color remote sensing to measure the transport of dissolved organic carbon by the Mississippi River Plume, *Remote Sensing Environment*, 11, 836-444.
- Leorri, E., Cearreta, A., Irabien, M.J., & Yusta, I. (2008). Geochemical and microfaunal proxies to assess environmental quality conditions during the recovery process of a heavily polluted estuary: the Bilbao estuary case (N. Spain). *Science of the Total Environment*, 396, 12-27

Twenty representative non-refereed publications are listed.

- Riggs, S.R., Mallinson, D.J., Culver, S.J., Ames, D.V., Corbett, D.R., Kemp, A.C., and Horton, B.P. (2012) A 2100-year record of coastal system changes in response to shifts in rates of relative sea-level rise. GSA Annual Meeting, Charlotte, November, 2012.
- Ames, D.V., Riggs, S.R., Culver, S.J., and Mallinson, D.J. (2012) Sea-level rise and public policy in coastal North Carolina. GSA Annual Meeting, Charlotte, November, 2012.
- Minnehan, J., Mitra, S., Scalise, K., Mallinson, J., Leorri, E., Culver, S.J. (2012) Late Holocene sedimentary record of black carbon deposition in coastal North Carolina. GSA Annual Meeting, Charlotte, November, 2012.

- Engelhart, S., Kemp, A.C., Nelson, A.R., Briggs, R.W., Haeussler, P.J., Culver, S.J., Angster, S.J., Bradley, L. (2012) Application of salt-marsh and tidal-flat foraminifera to identify late Holocene land-level changes caused by megathrust earthquakes at Sitkinak Island, Alaska. GSA Annual Meeting, Charlotte, November, 2012.
- Brooks, G. & Mallinson, D. (2011). "The Florida Middle Ground Relict Reef Complex", In N. Buster and C.W. Holmes (Eds.) *Gulf of Mexico, origin, waters, and biota*, (pp. 331-339). College Station, Texas: Texas A&M Press.
- Riggs, S.R., Ames, D.V., Culver, S.J., Mallinson, D.J., 2011. *The Battle for North Carolina's Coast: Evolutionary History, Present Crisis, and Vision for the Future*. University of North Carolina Press, Chapel Hill, NC, 138 p.
- Paerl, H.W., Christian, R.R., Bales, J.D., Peierls, B. L., Hall, N.S., Joyner, A.R., & Riggs, S.R., (2010). Assessing the response of the Pamlico Sound, North Carolina, USA to human and climatic disturbances: management implications. In M. Kennish and H. Paerl (Eds.) *Coastal Lagoons: Critical Habitats of Environmental Change*. CRC Marine Science Series, CRC Press, Boca Raton, FL, p. 17-42.
- Mitra, S., Volety, A.K., & Bartel, J.M. (2010). "Trace organic contaminants (PAHS, PCBs, and pesticides) in oysters, *Crassostrea virginica*, from the Caloosahatchee Estuary and Estero Bay, SW Florida", Pesticides – The Impacts of Pesticide Exposure, InTech Publishing, pp. 207-220.
- Riggs, S.R., Ames, D.V., Culver, S.J., Mallinson, D.J., Corbett, D.R., Walsh, J.P., (2009). "In the eye of a human hurricane: Oregon Inlet, Pea Island, and the northern Outer Banks of North Carolina", In J.T. Kelley, O.H. Pilkey, J.A.G. Cooper (Eds.) *Identifying America's Most Vulnerable Oceanfront Communities: A Geological Perspective*, Geological Society of America Special Paper 460, p. 43-72.
- Walsh, J.P., Ridd, P.V. (2009). "The Fly River delta: a convolver of fluvial, marine and geological processes", In Bolten, B. (Ed.) *The Fly River, Papua New Guinea: environmental studies in an impacted tropical system*, (pp. 620). Burlington, MA: Elsevier.
- Walsh, J.P., Corbett, D.R., Dillard, S.C. (2009). Wave-driven seabed resuspension: a key process modulating sediment and solute dispersal in the Albemarle-Pamlico estuarine systems, NC, USA, ASLO Meeting, Nice, France.
- Corbett, D.R., Walsh, J.P., Cowart, L.M. (2009). Analyzing shoreline change along complex coastlines: approach and interpretations. ASLO Meeting, Nice, France.
- Leorri, E., Fatela, F., Moreno, J., Antunes, C., Cearreta, A., Freitas, M.C., Andrade, C. (2009) The potential use of intertidal foraminifera as sea-level proxies in the Mira estuary, SW Portugal. 6^o Simposio sobre el Margen Ibérico Atlántico, MIA09, Oviedo, Spain.
- Leorri, E., Cearreta, A., Milne, G.A., Gehrels, W.R. (2009) Modeling and field observations of Holocene sea-level changes along the Atlantic coast of SW Europe to understand current sea level. Sixth International Meeting, International Geoscience Programme Project 495 Quaternary Land-Ocean Interactions, *Driving Mechanisms and Coastal Responses*, jointly organized with The INQUA Commission on Coastal and Marine Processes. Myrtle beach, South Carolina, USA.
- Mallinson, D.J., Riggs, S.R., Culver, S.J., Ames, D., Horton, B.P., Kemp, A.C. (2009). The North Carolina Outer Banks barrier islands: a field trip guide to the geology, geomorphology and processes. IGCP 495 2009 Annual Conference Field Excursion Guide Part II – The Outer Banks of North Carolina USA, 39p.
- Leonard, L., Dorton, J., Culver, S., and Christian, R. (2009). Coastal and Estuarine Observing in North Carolina: Integrating Observation and Science to Understand our Coastal Environment. A White Paper, UNC-W and ECU, June, 2009, 30p.

Hine, A. C., Jarrett, B., Locker, S., Mallinson, D., Naar, D., Donahue, B. (2008). "Coral Reefs, Present and Past, on the West Florida Shelf and Platform Margin", In B. Reigl and R. Dodge (Eds.) *Coral Reefs of the USA: Special Symposium Volume for the 11th International Coral Reef Symposium*, (pp. 127-173). Springer Science.

Riggs, S.R., Culver, S.J., Ames, D.V., Mallinson, D.J., Corbett, D.R., Walsh, J.P. (2008). North Carolina's Coasts in Crisis: a Vision for the Future. A White Paper, Department of Geological Sciences and ICSP, ECU, October, 2008, 26 p.

Mallinson, D.J., Culver, S.J., Riggs, S.R, Walsh, J.P., Ames, D.V., Smith, C.W. (2008). Past, Present and Future Inlets, Outer Banks, North Carolina. A White Paper, Department of Geological Sciences and ICSP, ECU, December, 2008, 22 p.

Corbett, D.R., Walsh, J.P., Cowart, L., Riggs, S.R., Ames, D.V., Culver, S.J. (2008). Shoreline Change within the Albemarle-Pamlico Estuarine System, North Carolina. A White Paper, Department of Geological Sciences and ICSP, ECU, December, 2008, 10p.

A5B. Other Departments: Coastal and Marine Activities in the Department of Biology

B5B. Narrative

Mission and History.

The Department of Biology has long been recognized for its contributions to coastal issues and Coastal Ecology has been identified, for the last 10 years, as one of three core Departmental areas of research focus. The Department has 14 faculty members extensively involved in coastal issues. The interests of these are as varied the diversity of life in the coast. For example, Distinguished Research Professor Robert Christian, ex-President of the Estuarine Research Federation, is an internationally renowned ecosystem modeler who studies energy and nutrient flow in salt marshes and coastal lagoons worldwide. Much of his research has been funded through NSF's U.S. Long-term Ecological Research (LTER) and International LTER programs. Fisheries biologist Anthony Overton in collaboration with Dr. Ed Stellwag, a developmental geneticist, have surveyed menhaden populations in the Gulf of Mexico to assess possible effects of the Deepwater oil spill on embryonic and larval development, research funded by NSF's RAPID program. On the freshwater side, Dr. Claudia Jolls has established a long-term study of the ecology and evolution of rare vascular plant species of the freshwater coastal systems of the upper Great Lakes and of the coastal systems of eastern North Carolina and the Atlantic.

The Department is most closely linked to the Institute for Coastal Science and Policy, to which four faculty members are jointly appointed (though holding their tenure in Biology). Several Biology faculty members are faculty affiliates of ECU's Center for Sustainable Tourism, which provides tremendous opportunities for collaborative research in an economically critical area for North Carolina. Additionally, the North Carolina Center for Biodiversity, housed within the Department, seeks to promote research, education, and outreach in the field of biodiversity. The Director of the UNC Coastal Studies Institute (CSI), in Manteo, NC, holds her tenure in the Department and has recently participated in a Biology search committee. Closer interactions and collaborations with CSI are anticipated as facilities and organizations mature. Some of our faculty members are collaborating on teacher outreach work in coastal counties with the Center for Science, Mathematics, and Technology Education.

- Unique, competitive, compelling, and/or of strategic importance.

The Department's educational and research programs provide fundamental and distinctive support for the University's strategic objectives of a) preparing our students for successful entry into a global, culturally diverse workforce, b) leadership development, c) enhancing the educational opportunities and quality for those pursuing a career in the health care professions, and d) economic prosperity. As such, the Department is presently poised to conduct the research and training that is critical to managing our state's valuable natural coastal resources in the face of climate change and population growth through with 1) the establishment of the North Carolina Center for Biodiversity, 2) participation in the doctoral-level program in Coastal Resources Management, and 3) applied research to answer coastal managerial questions.

ECU Biology continues to expand opportunities for students to experience cultural diversity by participating in Latin-American, European and Asian graduate student and faculty-level exchanges and establishing formal international cooperative agreements. The Department currently holds academic exchange agreements with University of Ferrara, Italy, Institute for Agro-technology, Spain, the Institute of Ecology, Mexico and the University of Lille, France.

The Department is deeply connected to other units within the University through graduate training and collaborative research. Our faculty and students have taken a lead role in two of

ECU's largest interdisciplinary PhD programs, Coastal Resource Management (CRM) and the Interdisciplinary Doctoral Program in Biological Sciences (IDPBS). Our faculty contributes to the core coursework of both of these doctoral programs. Our faculty also participates at a high frequency in multi-department, interdisciplinary grant submissions (e.g. with Sociology) partly as a result of sharing faculty positions with the Institute for Coastal Science and Policy.

- Most significant impact(s) of the program on research, education, and/or society.

The Department of Biology has achieved diverse significant impacts through disciplinary research, interdisciplinary research and their integration with educational activities. For example, Dr. **Stellwag** and Dr. **Overton** are collaborating with other faculty members from across the spectrum of Biology on field and laboratory studies of **dispersant-treated crude oil exposure-related developmental defects in vertebrates**. Next Generation DNA sequencing technologies and bioinformatics analysis methods are being developed to reveal the molecular pathways underlying the developmental defects related to crude oil exposure. The career of Dr. Brinson (recently deceased) is perhaps the best illustration of significant impacts as a mentor, teacher and public servant in coastal activities by the Department of Biology. He is credited with developing some of the most rigorous curriculum in estuarine ecology. His contributions to policy and management decisions are best exemplified by his seminal contributions to the **Hydrogeomorphic Classification of wetlands (HGM)**. This approach greatly changed the environmental management of wetlands within the USA and beyond. Dr. **Rulifson** is a fisheries biologist with a wide experience and close contact with fisherfolk, as result of his research on **bycatch issues in commercial fisheries**, and **Gear Development**, including Menhaden purse seines in Chesapeake Bay; Turtle Excluder Devices; bycatch reduction devices and traveling screens for water intakes. He personally trained a remarkable proportion of NC's fisheries biologists. **Dr. Schrenk's** research has centered on fundamental studies of deep subsurface microbial biodiversity, including perhaps the most ambitious, and one of the largest, coastal grants at ECU. His work has profound implications for our understanding of life on earth and on other planets. Dr. **Clough's highly interdisciplinary** research program focuses on the ecology of marine benthic organisms including animal-sediment interactions and the flow of materials in ecosystems, as well as **how to combine traditional and scientific ecological knowledge**. Dr. **Goodwillie**, in collaboration with Dr. **Clough** and others, has been used funding from the **NSF Department of Undergraduate Education** to establish a long-term ecological research experiment on wetlands that serves as an educational resource for undergraduate biology students at ECU. **Since its genesis in 2002, the long-term experiment has been used by more than 2500 biology students**. Students are first trained in plant identification and field methods, then work collaboratively to sample the vegetation, and, finally, test hypotheses of their own design using the large cumulative data set.

- Most significant challenges that will be faced by the Activity in the next year, and in the next five years.

The most significant challenges for coastal activity stem from the challenges and weaknesses presently facing the Dept. of Biology in general. A recent external Unit Review Report stated "The Department's major areas for improvement are infrastructural" and "extremely low stipends for MS students." In contrast, our PhD programs, especially IDPBS, are competitively funded per student but additional student stipends are needed to grow this program. The review committee and our faculty recognize the importance of external grant funding for PhD students, but internal stipends are also essential. Funding to support the research particularly travel and

access to reliable vehicles and well as support for recruitment of quality graduate students at the national-level. A more pernicious problem within coastal activities is rapid loss of senior leadership through retirements (Christian), movement into administration (Clough, West) and potential recruitment from other campuses.

- Succinct description of the future directions for, and sustainability of, the Activity in the next year and in the next five years.

The Department’s continuing strong hires and commitment to coastal research suggest excellent future prospects. Notably, a current search will provide further strength in microbial ecology and anticipated 2013-14 searches are likely to yield outstanding new faculty members with integrative research approaches, potentially on coastal topics. The increasingly integrative departmental research focus and the maturation of recent hires also bode well. A very high departmental ranking in a recent campus analysis, and prioritization of our department for investment by ECU, suggest our activities are sustainable and in fact will increase. The development of the North Carolina Center for Biodiversity (NCCB), the Institute for Sustainable Tourism, and ICSP, all benefiting from strong Biology participation, could together make ECU an outstanding locus of interdisciplinary environmental research. Our geographic setting makes this a natural and authentic prospect.

C5C. Resources

Personnel

Table C1. Personnel

Name	Title and department/college	Role
Ardon, Marcelo	Assistant Professor	Wetland biochemistry
Chalcraft, David	Associate Professor	Population dynamics
Clough, Lisa	Associate Professor	Benthic ecology
Goodwillie, Carol	Associate Professor	Plant evolutionary ecology
Jolls, Claudia	Associate Professor	Plant conservation biology
Kimmel, David	Assistant Professor	Zooplankton ecology
Luczkovich, Joe	Associate Professor	Bioacoustics, estuarine ecology
McKinnon, Jeffrey	Professor, Chair	Evolutionary biologist
Microbial Ecology Search	Assist./Assoc. Professor	Microbial Ecologist
Overton, Anthony	Associate Professor	Fisheries biologist
Reyes, Enrique	Associate Professor	Coastal vegetation modeling
Rulifson, Roger	Professor	Fisheries biologist
Schrenk, Matt	Assistant Professor	Microbial ecology
Stellwag, Ed	Associate Professor	Developmental genetics, toxicology
West, Terry	Associate Professor	Benthic Invertebrates

Undergraduates: currently there are 45 students enrolled in our undergraduate research credit courses who are working with our coastal faculty. 322 students enrolled in coastal courses in the last two semesters (spring 2012, fall 2012).

Graduate Students: currently 26 MS and 15 PhD students involved in diverse research projects by individual faculty.

D5B. Research, Teaching, Public and Professional Service

1. Research

Currently Active Grants

TOTAL: \$5,325,400

1. Ardon, Marcelo. National Science Foundation. Research Starter Grant: Consequences of saltwater intrusion on water quality in coastal plain wetlands. 2012-2013. \$50,000.
2. Chalcraft, David R. The effects of biodiversity on pond communities: incorporating natural patterns of diversity loss. 2007-2013. National Science Foundation (\$625, 000)
3. Clough, L. CZR, Inc. "Continued Support for East Carolina University Research Project NCPC Tract Water Quality Monitoring-2012". \$120,000.
4. Clough, L. PCS Phosphate "Continued Support for East Carolina University Research Project PCS Phosphate Effluent Monitoring and Water Quality in the Pamlico River Estuary, NC-2012" \$73,000.
5. Farwell, Mary; Enrique Reyes; Edmund Stellwag; Leonard Sutton; Melody Bentz The BioExcellence Scholarship Program. 1/15/2012 - 12/31/2016. Sponsor: National Science Foundation (NSF). Funding: \$ 599,945.
6. Goodwillie, Carol, NSF: "EAGER: Developing methods for evolutionary studies in a long-term ecological experiment" NSF 9/10 – 3/13 \$88,872
7. Miles, Rhea; Andrew Morehead, Jr.; Michael O'Driscoll; Anthony Overton, East Carolina Reach-up Program, 1/28/2009 - 6/30/2010, Sponsor: GlaxoSmithKline, Funding: \$ 25,000.00
8. Overton, Anthony. Can Spawning Habitat be Characterized & Prioritized Based on the Presence of Early Life Stages of River Herring, 5/1/2010 - 12/31/2012, Sponsor: U.N.C.-Sea Grant Program, Funding: \$57,726.00
9. Overton, Anthony. Castle Hayne Aquatic Resources Characterization, 10/1/2008 - 9/30/2009, Sponsor: Entrix Inc, Funding: \$ 4,955.00
10. Overton, Anthony. Rieglewood/Cape Fear River Fish Collections, 8/1/2010 - 12/31/2012, Sponsor: CZR Incorporated. Funding: \$ 22,446.00
11. Overton, Anthony. Williamston Water Intake -Roanoke River- Potential Effects on Larval Fish Distribution. 3/1/2012- 12/31/12. Sponsor: Robert J. Goldstein & Associates, Inc. \$17,673.00
12. Reyes, Enrique; Mark Brinson; Robert Christian. Contributions to the Virginia Coast Reserve - Long Term Ecological Research V.12/15/2006 - 11/30/2012. Sponsor: University of Virginia. Funding: \$ 315,000.
13. Reyes, Enrique. Watershed Model for Liberty Island. 10/13/2009 - 6/14/2013. Sponsor: University of Washington. Funding: \$ 122,000.
14. Reyes, Enrique. Integrating Sustainability into Agricultural Education: Water resources

- and Global Climate Change Challenges. 9/1/2011 - 8/31/2014. Sponsor: Southern University. Funding: \$ 35,041.
15. Rulifson, R., "Gastric Evacuation and Daily Ration of Atlantic Spiny Dogfish (*Squalus acanthias*)". NC Sea Grant, Fishery Resource Grant 12-EP-02 (PI, \$18,561). 11/1/2012-6/30/2013
 16. Rulifson, R., "Identification of river herring spawning and juvenile habitat in Albemarle Sound inferred from otolith microchemistry". (Fishery Resource Grant, No. 10-EP-04) (Project Director, \$70,429).
 17. Rulifson, R., "Identifying nursery habitats for coastal sharks within Pamlico Sound, NC". NC Sea Grant Mini-Grant, (PI, \$4,451). 5/30/2012-5/31/2013.
 18. Rulifson, R., "Is Anadromy Responsible for High Strontium Levels in the Primordium of Some Striped Bass Otoliths?" NC Sea Grant, Fishery Resource Grant 12-EP-03 (PI, \$19,787). 9/1/2012-6/30/2013.
 19. Rulifson, R., "Is Cape Cod a Natural Delineation for Migratory Patterns in US and Canadian Spiny Dogfish Stocks?" (Commercial Fisherman's Research Foundation) (Project Director, \$176,348 [\$140,348 to ECU]).
 20. Rulifson, R., "Maturation, Fecundity, Spawning Frequency, and Site Fidelity of the Albemarle/Roanoke Striped Bass Stock". (NC Commercial Recreational Fishing License Grant, No. 2010-F-04) (Project Director, \$205,750).
 21. Rulifson, R., "Origin of Central Southern Management Area Striped Bass Using Otolith Chemistry, and Recommendations for Fishery Management". NC Division of Marine Fisheries, CRFL grant program 2011-F-005 (PI, \$139,202).
 22. Rulifson, R., Cooperative Winter Tagging Cruise, 2013-2015, for Atlantic Striped Bass and Affiliated Species. CRFL (Coastal Recreational Fishing License), NC Division of Marine Fisheries (PI, \$732,659). 1st year funded, year 2 and 3 contingent 7/1/2012-6/30/2015.
 23. Rulifson, R., Identification of Juvenile Spiny Dogfish Habitats in North Carolina Coastal Waters. NC Sea Grant, Fishery Resource Grant (PI, \$106,683).
 24. Schrenk M., Design of Borehole Incubation Chambers to Observe and Experimentally Study the Serpentinite-hosted Subsurface Biosphere. Carnegie-Sloan Deep Carbon Observatory Instrument Development Fund. \$8,000.
 25. Schrenk, M. and 10 other Co-I's. Deep Life I: Microbial Carbon Transformations in Rock-Hosted Subsurface Ecosystems Alfred P. Sloan Foundation. 1/1/2012 to 12/31/2013. \$1,499,989.
 26. Stellwag, Edmund; Anthony Overton; Xiaoping Pan; Baohong Zhang; Application of genetic markers to inform river herring management, NOAA Omnibus and NC Sea Grant Sub Contract Award ,2/1/2012 - 1/31/2014 Sponsor: Duke University Funding: \$ 8,249.00

27. Stellwag, Ed, Anthony Overton, Xiaoping Pan, Baohong Zhang. RAPID: Gulf Crude Oil Effects on Gene Expression During Fish Development. 9/1/2010 - 12/31/2012, Sponsor: National Science Foundation. Funding: \$ 199,477.00
28. Teske, A. M. Schrenk, and J. Biddle, Workshop on Microbial Exploration of the Marine Deep Sediment Biosphere. Consortium for Ocean Leadership. \$15,000.

2. Teaching and Instruction (if applicable)

Coastal and Marine Biology courses (**bold** courses are part of the Marine Biology Electives to Undergraduates)

- BIOL 3660.** Introduction to Marine Biology (3) (F,S,SS) (P/C: BIOL 2250, 2251)
- BIOL 3661.** Introduction to Marine Biology Laboratory (1) (F,S) (C: BIOL 3660)
- BIOL 4504, 4514.** Research Problems in Biology (2,2) (WI, WI) (F,S,SS) (P: Consent of instructor)
- BIOL 5200, 5201.** Invertebrate Zoology (4,0) (F) (P: 6 sh in BIOL)
- BIOL 5220, 5221.** Limnology (4,0) (S) (P: BIOL 2250, 2251; or consent of instructor)
- BIOL 5230, 5231.** Phycology (4,0) (P: BIOL 1200, 1201)
- BIOL 5270.** Marine Community Ecology (3) (S) (P: BIOL 2250, 2251; or consent of instructor)
- BIOL 5351.** Biological Processes and the Chemistry of Natural Water (2) (S) (P: BIOL 2250, 2251; 2 CHEM courses; or consent of instructor)
- BIOL 5351. Biological Processes and the Chemistry of Natural Water (2)
- BIOL 5400. Wetland Ecology and Management (3)
- BIOL 5401. Wetland Ecology Laboratory (1)
- BIOL 5550, 5551. Ichthyology (4,0)
- BIOL 5550, 5551.** Ichthyology (4,0) (F)
- BIOL 5600, 5601.** Fisheries Techniques (3,0) (F,S) (F) (P: BIOL 2250, 2251; or equivalent)
- BIOL 5680.** Current Topics in Coastal Biology (2) (S) (P: Consent of instructor)
- BIOL 7005. Coastal Ecological Processes (4) Formerly BIOL 6910
- BIOL 7010. Estuarine Ecology (3) Formerly BIOL 6010
- BIOL 7020, 7021. Marine Biology (3,0) Formerly BIOL 6020, 6021
- BIOL 7320. Ecological Dimensions of Coastal Management (3)
- BIOL 7330. Ecosystems of Coastal Cities (3)

Public Service, Outreach and Community Engagement

Table D4. Public Service, Outreach and Community Engagement

Public Service / Outreach/ Engagement	Dates	Personnel Involved	Participants in program (e.g. K-12 teachers)	Number of participants
Martin Marietta Public Hearing on Mining and Discharge into Blount's Creek	June 2012	Eban Bean, Dave Kimmel, Joe Luczkovich	Public, Coastal Federation, Tar-Pamlico River Foundation	50
Helped to coordinate two	April	D.	General Public	200

Earth Day Events held at East Carolina University. One involved a public lecture by Dr. Joe Roman and the other was an Earth Day exposition on ECU's main campus that included lab tours, exhibits, and hands-on activities by university personnel, non-profit groups, and environmentally-themed companies	2012	Chalcraft, others		
Guided tour of experimental plots	April 2012	Carol Goodwillie	General Public	5
Presentations: 2012-Greenville GO Science	2012	L. Clough	General Public	50
Greenville Sierra Club	2012	L. Clough	General Public	
Led tour on amphibians, aquatic insects and fish at River Park North in Greenville, NC as part of Earth Day Celebration organized by the North Carolina Center for Biodiversity	April 2011	D. Chalcraft	General Public	150
Invited participant. Discussion panel "What does sustainable tourism look like?" Center for Sustainable Tourism – Meet, Greet, and Learn Event.	Feb. 28 th , 2011.	E. Reyes	General Public	40
Invited panel member. Film presentation "Sun Come Up". ECU student chapter of the Coastal Society.	Feb. 3, 2011.	E. Reyes	General Public	50
TV interview: "Gone to Seed" on "Exploring NC", UNC Public Television	October 2010	C. L Jolls	Watchers of UNC Public Television	still airs as of 2012
Dept. of Biology Darwin Day Celebration,	Feb. 2010	D. Chalcraft, McKinnon, Goodwillie, others	General Public	50
Invited presenter. Climate Change in North Carolina". APNEP sponsored "Ocean	Nov. 11, 2009.	E. Reyes	science k-12 teachers	15

Awareness Day” Science Teacher’s Workshop.				
Project in soil microbe analysis, teacher training workshop	Summer 2009	Carol Goodwillie	Middle school teachers	20
NC Rare Plants Discussion Group	March 2009	C. L. Jolls	scientists and land managers	20
Presentation. Climate Change Potential Impacts to the Virginia Coastal Reserve. The Nature Conservancy. Climate Change Workshop.	Feb. 11, 2009.	E. Reyes	TNC managers	25
Invited Speaker for public lecture series. Estuarium, Washington, NC.	Apr. 16, 2008.	E. Reyes	General Public	30
NC Center for the Advancement of Teaching, Coastal Ecology Workshop	March 2008	C. L. Jolls	K-12 teachers	20
Invited speaker. “Forecasting Long-Term Ecosystem Response to Climate Change in North Carolina”. Seminar Series. UNC Institute for Marine Sciences	Feb. 15, 2008.	E. Reyes	Graduate Students and Faculty IMS-UNC CH	25
Fisheries Management was recently featured on Fox Business News Series “Empty Nets” http://winmedia.ecu.edu/cas/overtona/Temp/fb2011/fb2011.html		A. Overton	General Public	

E5B. Outputs and Impacts

1. Publications

20 Relevant Publications

*student co-author

1. Binion, S.A., A.S **Overton**, and K.L. Riley. 2012. Foraging potential of larval alosines in lower Roanoke River and Albemarle Sound, North Carolina. *Marine and Coastal Fisheries* 4:228-238.
2. Cathey, A.M., Miller, N. R., & **Kimmel**, D. G. 2012. Shell microchemistry of juvenile *Mercenaria mercenaria*: spatiotemporal patterns and implications for modeling larval dispersal. *Marine Ecology Progress Series*, 465, 155-168.

3. Coronado C., H. Alvarez-Guillen, J.W. Day, E. **Reyes**, B.C. Perez, F. Vera-Herrera, R.R. Twilley. 2012. Litterfall dynamics in carbonate and deltaic mangrove ecosystems in the Gulf of Mexico. *Wetlands Ecology and Management*. 20:123-136.
4. Dell’Apa, A., **Kimmel**, D. G., & Clo, S. 2012. Trends of fish and elasmobranch landings in Italy within the frame of the law 41/82: overview of elasmobranch management aspects. *ICES Journal of Marine Science*, 69 (6), 1045-1052.
5. Dell’Apa, L. Schiavinato, and R.A. **Rulifson**. 2012. The Magnuson–Stevens act (1976) and its reauthorizations: Failure or success for the implementation of fishery sustainability and management in the US? *Journal of Marine Policy* 36(3):673-680.
6. Devreker, D., Souissi, S., Pierson, J. J., **Kimmel**, D. G., & Roman, M. R. 2012. An experimental approach to estimate egg production and development rate of the calanoid copepod *Eurytemora affinis* in Chesapeake Bay, USA. *Journal of Experimental Marine Biology and Ecology*, 416-417, 72-83.
7. Fagherazzi, S., S. Temmerman, J. van de Koppel, A. D’Alpaos, **E. Reyes**, C. Craft, J. Cluogh, J. Rybczyk, S. Mudd. 2012. Numerical models of salt marsh evolution: ecological and climatic factors. *Reviews of Geophysics*. 50, RG1002, doi:10.1029/2011RG000359.
8. Hernandez, J.P. * and D. R. **Chalcraft**. 2012. Priority effects of overwintered *Rana* tadpoles on larval southern toads. *Oikos* 121:259-267.
9. **Kimmel**, D.G., Boynton, W. R., & Roman, M. R. 2012. Long-term decline in the calanoid copepod *Acartia tonsa* in central Chesapeake Bay, USA: an indirect effect of eutrophication? *Estuarine, Coastal and Shelf Science*, 101, 76-85.
10. McKinnon, J.S., N. Hamele, N. Frey, J. Chou, A. McAleavey, J. Greene, and W. Paulson 2012. Male choice in the stream-anadromous stickleback complex. *PLOS One* 7: e37951.
11. Mitra, S., **Kimmel**, D. G., Snyder, J., Scalise, K., McGlaughon, B. D., Roman MR, Jahn GL, Pierson JJ, Brandt SB, Montoya JP, Rosenbauer RJ, Lorensen TD, Wong FL, Campbell PL, (2012). Macondo-1 well oil-derived polycyclic aromatic hydrocarbons in mesozooplankton from the northern Gulf of Mexico. *Geophysical Research Letters*, 39 (L01605).
12. Mohan, J.E., R.A. **Rulifson**, D.R. Corbett, and N.M. Halden. 2012. Validation of oligohaline elemental otolith signatures of striped bass using in situ caging experiments and water chemistry. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science*. 4(1):57-70.
13. Morse, J.L., **M. Ardón**, and E.S. Bernhardt. 2012. Greenhouse gas fluxes in southeastern coastal plain wetlands under contrasting land uses. *Ecological Applications* 22: 264-280
14. Morse, J.L., **M. Ardón**, and E.S. Bernhardt. 2012. Using environmental variables and soil processes to forecast denitrification potential and nitrous oxide fluxes in coastal plain wetlands across different land-uses. *Journal of Geophysical Research-Biogeosciences* doi:10.1029/2011JG001923
15. **Overton**, A.S., N.A. Jones, and R. A. Rulifson 2012. Spatial and temporal variability in instantaneous rates of growth and mortality rates of larval river herring in Tar-Pamlico River, Pamlico Sound, North Carolina. *Marine and Coastal Fisheries*. 4:218-227
16. Riley, K.L., S.A. Binion, and A.S. **Overton**. 2012. Estimating the food requirements and prey size spectra of larval American shad. *Marine and Coastal Fisheries* 4:201-217.
17. Roman, M. R., Pierson, J. J., **Kimmel**, D. G., Boicourt, W. C., & Zhang, X. 2012. Spatial patterns in hypoxia and zooplankton in the northern Gulf of Mexico. *Estuaries and*

Coasts, 35, 1261-1269.

18. Thessen, A.E., L.M. **Clough**, A. Whiting, H. Bowers, G.L. Boyer, 2012. "A recurring bloom of toxic marine cyanobacteria above the Arctic Circle" *Harmful Algae News* 46, 12-15.
19. Mcleod, E. B. Poulter, J. Hinkel, E. **Reyes**, R. Salm. 2010. Sea-level impact models and environmental conservation: a review of models and their applications. *Ocean & Coastal Management*. 53:507-517.
20. Poulter, B., R.L. Feldman, M. Brinson, B. Horton, M. Orbach, S. Pearsall, E. **Reyes**, S. Riggs, J. Whitehead. 2009. Managing coastal systems for sea level rise: Coastal policy and research progress in North Carolina, USA. *Ocean and Coastal Management*. 52: 147-153.

Non-refereed publications such as journal articles, reviews, conference papers, books and book chapters directly related to Activity.

- Boesch, D. F., Coles, V. J., **Kimmel**, D. G. , & Miller, W. D. 2010. Chapter 23: Climate change: coastal dead zones, *Life Science Ethics* (pp. 423-434). Dordrecht, The Netherlands: Springer.
- Cahoon, D.R., D.J. Reed, A.S. Kolker, M.M. Brinson, J.C. Stevenson, S. Riggs, R. Christian, E. **Reyes**, C. Voss, and D. Kunz, 2009: Coastal wetland sustainability. In: *Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region*. A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. [J.G. Titus (coordinating lead author), K.E. Anderson, D.R. Cahoon, D.B. Gesch, S.K. Gill, B.T. Gutierrez, E.R. Thieler, and S.J. Williams (lead authors)]. U.S. Environmental Protection Agency, Washington DC, pp. 57-72.
- Clough**, L.M. 2010. *PCS Phosphate effluent dispersal in the Pamlico River estuary: 2009*. Institute for Coastal and Marine Resources, East Carolina University, Technical Report No. 08-01. 33 pp. Greenville, NC.
- Clough**, L.M. 2011. *PCS Phosphate effluent dispersal in the Pamlico River estuary: 2010*. Institute for Coastal and Marine Resources, East Carolina University, Technical Report No. 09-01. 33 pp. Greenville, NC.
- Clough**, L.M. 2012. *PCS Phosphate effluent dispersal in the Pamlico River estuary: 2011*. Institute for Coastal and Marine Resources, East Carolina University, Technical Report No. 08-01. 33 pp. Greenville, NC.
- Cudney-Burch, J.E., R.A. **Rulifson**, and D. Hemilright. 2011. Coastal Movements of Spiny Dogfish Overwintering off the Outer Banks, NC. Completion Report, Fisheries Resource Grant 08-FEG-11, North Carolina Sea Grant, Raleigh.
- Kimmel**, D. G. 2012. Chapter 6.05 - Plankton Consumer Groups: Copepods, *Trophic Structure of Estuaries and Coasts* (Eds. Luczkovich JJ, Wilson J) in *Treatise on Estuarine and Coastal Science* (Eds. Wolanski E, McLusky D) (pp. 95-126). Elsevier.
- Kimmel**, D. G., Townsend, H., Carruthers, T. J. B., & Fertig, B. 2010. Chapter 8: environmental statistics: balancing simplicity and explanatory power, In BJ Longstaff, TJB Carruthers, WC Dennison, TR Lookingbill, JM Hawkey, JE Thomas, EC Wicks, J Woerner (Ed.), *Integrating and applying science: A handbook for effective coastal ecosystem management* (pp. 113-132). Cambridge, Maryland: IAN Press.
- Luczkovich**, J. J. & Wilson, J. 2011. "Trophic Structure of Estuarine and Coastal Ecosystems: An Introduction", In Press, In Joseph Luczkovich, James Wilson (Ed.) *Treatise on*

Estuarine and Coastal Science: Volume 6: Trophic Structure of Coastal Systems. Oxford UK: Elsevier.

- Luczkovich**, J. J., Sprague, M. W., & Krahfurst, C. S. 2011. "Behavior of fishes associated with the production of sound and responses to sounds produced by other species", In Arthur Popper, Brandon Casper, Don Stevens, Anthony Farrell (Ed.) Encyclopedia of Fish Physiology: From Genome to Environment. Oxford UK: Elsevier.
- McKinnon, J.S. and E.B. Taylor 2012. Species choked and blended. Nature (News & Views) 482: 313-314. (*Interview on Nature podcast: http://www.nature.com/nature/audio_video/index.html*).
- Morris, J.T., J. Edwards, S. Crooks and E. **Reyes**. 2012. Assessment of carbon sequestration potential in coastal wetlands. Chap. 24. Pp 517-532. In: Lal, R. K. Lorenz, R.F.J. Huttel, B.U. Schneider, J. vBraun. "Recarbonization of the Biosphere – Ecosystems and the global carbon cycle. Springer. New York. 559 p.
- Pringle C.M., E.P. Anderson, **M. Ardón**, R.J. Bixby, S. Connelly, J.H. Duff, A.P. Jackman, P. Paaby, A. Ramírez, G.E. Small, M.N. Snyder, and F.J. Triska. 2012. Rivers of Costa Rica. In: Costa Rican Ecosystems. Ed: M. Kappelle. University of Chicago Press. Chicago, IL.
- Reyes** E., 2009. Wetland Landscape Spatial Models. In: G.M.E. Perillo, E. Wolanski, D.R. Cahoon, M.M. Brinson, (eds.), Coastal Wetlands: An Integrated Ecosystem Approach. Elsevier, p. 885. ISBN: 978-0-444-53103-2.
- Reyes**, E., K.A. Rose, D. Justic. 2012. Estuarine Ecological Modeling. In: Estuarine Ecology (2nd Edition). Day, J.W., W.M. Kemp, A. Yanez-Arancibia, B.C. Crump. (eds). John Willey, New York. ISBN: 978-0-471-75567-8. 723 pages.
- Rulifson**, R.A. C. Van Salisbury, and M. R. Spidel. 2009. Critical Habitat for Southern Flounder, *Paralichthys lethostigma*: Do Coastal Watersheds Play an Important Role in Life History and Growth? Final Report for Fishery Resource Grant No. 08-EP-03, North Carolina Sea Grant.
- Rulifson**, R.A., A. Gross, and T. Pratt. 2009. Feasibility of Stocking Adult River Herring to Restore Spawning Populations in Albemarle Sound, North Carolina. Completion Report, Fishery Resource Grant 06-EP-09, North Carolina Sea Grant, Raleigh.
- Rulifson**, R.A., G.Wright, and D. Hemilright. 2012. Gillnet Calibration for Spiny Dogfish Abundance Assessment. Completion Report, Fisheries Resource Grant 09-FEG-08, North Carolina Sea Grant, Raleigh.
- Rulifson**, R.A., J. A. Mohan, II, and W. Phillips. 2009. Movements of Striped Bass Between Nursery Habitats in Albemarle Sound Inferred from Otolith Microchemistry. Final Report for Fishery Resource Grant No. 08-EP-02, North Carolina Sea Grant, Raleigh.
- Whiting, A., D. Griffith, S. Jewett, L. **Clough**, W. Ambrose and J. Johnson. 2011. "Combining Inupiaq and Scientific Knowledge: Ecology in Northern Kotzebue Sound, Alaska" Alaska Sea Grant 71 pages.

A5C. Other Departments: Department of Geography

B5C. Activity Narrative

Among the goals of the Department of Geography are coordinated agendas that include the collaboration of colleagues to address real problems within the locale of eastern North Carolina, with much of the focus on coastal areas. This includes research, teaching, and

outreach. The interdisciplinary nature of the Geography Department at ECU positions it to address a wide range of coastal and marine issues ranging from climate dynamics, sustainable use of resources, and coastal hazards, incorporating advanced geospatial technologies. This uniquely positions the department to apply its expertise to analyze local and regional coastal and marine problems from a spatial perspective. In addition, the Urban and Regional Planning Program within the Department has as one of its areas of concentration coastal planning and development. Thus, the Department closely ties teaching and research in coastal areas – with both natural and social science emphases, as well as integration of the two areas.

The Department’s work is clearly competitive, having garnered a national reputation for cutting-edge research in coastal science and policy, particularly coastal geomorphology, coastal planning, hazards, and tourism. The development and application of geospatial technology, including GIS, remote sensing, and terrestrial laser scanning to this work makes it particularly compelling. The most significant impacts center on the advancements in our understanding of the dynamics of coastal areas as they respond to natural and anthropogenic processes that this work has fostered. Of particular significance is the work between atmospheric scientists, human geographers, and planners in the department to provide a comprehensive, integrated approach to coastal dynamics. Examples of applied work with direct applications to policy and planning include: (1) a multi-year project, undertaken in conjunction with the North Carolina Department of Transportation, to analyze the environmental impacts of a new bridge spanning Currituck Sound; (2) geospatial analyses of areas and land uses to be potentially impacted by a rise in sea level, undertaken to assist with state hazard area mapping, and (3) evaluations of the use of National Weather Service storm surge warnings by emergency managers and the public, following Hurricane Irene.

To date, the Geography Department has had very good success with external funding from state and national agencies for its coastal and marine work. Securing future funding will be a challenge given government budget cuts. In addition, current political attitudes toward climate change and environmental research could present a new set of challenges. At the same time, the track record of Departmental research indicates an ability to rise to such challenges, particularly given the relationships that have been developed with local and regional decision-makers.

The Geography Department is now searching for a new planning faculty member and an important emphasis of that position is coastal and environmental planning. In addition, a proposal for a new Masters of Community Planning, with a focus of Eastern North Carolina and coastal planning will be submitted to UNC GA in the near future for approval.

C5C. Resources

1. Personnel

Table C1. Personnel

Name	Title and department/college	Role
Thomas Allen	Associate Professor of	Coastal GIS: Teaching and research

	Geography, HCAS	
Thomas Crawford	Associate Professor of Geography, HCAS	GIS and land use: Teaching and research
Scott Curtis	Associate Professor of Geography, HCAS	Atmospheric Science: Teaching and research
Jennifer Brewer	Assistant Professor of Geography and ICSP	Fisheries and resource management: Teaching and research
Tracy Van Holt	Assistant Professor of Geography and ICSP	Social systems, conflict, and resource management: Teaching and research
Paul Gares	Professor of Geography	Coastal Geomorphology: Teaching and Research
Daniel Marcucci	Assistant Professor of Planning	Coastal and Environmental Planning: Teaching and research
Yong Wang	Professor of Geography	Remote sensing: Teaching and Research
Burrell Montz	Professor of Geography	Coastal hazards and water management: teaching and research

5 undergraduates and 15 graduate students

D5C. Research, Teaching, Public and Professional Service

1. Research

Table D1. Research

Project title	PI/CoPIs – include institution	Sponsor	Amount	Dates
Collaborative Research: Blowout Dynamics at Cape Cod	Paul Gares	NSF	118,654	10/1/10-3/31/14
Development of a climatology of precipitation system organization in North Carolina to improve climate precipitation forecasts	Tom Rickenbach and Rosana Ferreira	NSF	205,960	6/1/11-9/30/13
CESU: Maps, Marshes, and Management Applications: Ecological Effects	Tom Allen	NOAA	87,750	7/1/11-6/30/13

of Sea Level Rise in North Carolina				
Human Responses to Catastrophic Monsoon Events in South Asia: Designing a Spatially Explicit Model in Low-Lying Coastal Bangladesh and India	Tom Crawford	Asia-Pacific Network for Global Change Research	15,000	3/1/12-2/28/13
Social and Behavioral Influences on Weather-Driven Decisions	Burrell Montz	NOAA	24,758	9/1/12-8/31/13
Collaborative Research -- Vulnerability and Resilience Among Small Farmers in Jamaica: An Assessment of Climate Change, Economic Stress, and the Role of Water Management Strategies	Scott Curtis	NSF	47,907	9/1/12-8/31/15

This list does not reflect the projects on which Geography faculty are involved as co-PIs.

2. Teaching and Instruction (if applicable)

- a. Identify courses taught for degree credit that are directly related to the Activity.

Table D2. Teaching and Instruction for Degree Credit

Course title, number, and level	Dates offered	Instructor(s) and affiliation(s)	Brief description of course (one sentence)	Enrollment Figures Total/on-site/distance education
GEOG 4220 Coastal Geography	Fall 2010 Fall 2012	Gares, Geography	Physical and geomorphological dynamics of coastal areas	12-15 on site
GEOG 4540 Coastal Storms	Fall 2010 Fall 2011	Curtis, Geography	Atmospheric dynamics of hurricanes and other coastal storms	12-15 on site
GEOG 6220	Fall 2010	Gares,	Geomorphology of coastal	5-7 on site

Advanced Coastal Geomorphology	Fall 2012	Geography	areas	
GEOH 6230 Earth Surface Processes on the Coastal Plain	Fll 2010	Wasklewicz, Geography	Specialized course on coastal dynamics	5-7 on site
GEOG 4440 Coastal Application of GIS	Spring 2011 Spring 2012	Allen, Geography	Advanced GIS applied to coastal issues	7-9 on site
GEOG 6440 Techniques for Coastal Resource Analysis	Spring 2011 spring 2012	Allen, Geography	Geo-analytical approach to coastal management	13-15 on site
PLAN 5025 Coastal Area Planning and Management	Spring 2011 Spring 2012	Marcucci, Geography (Planning)	Planning techniques as applied to coastal environments	14 on site

Public Service, Outreach and Community Engagement

Table D4. 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
Presentation on “Coastal Storms, Trends vs. Predictions” Tar River Sail and Power Squadron, Greenville, NC, September, 2012	Sept 2012	Scott Curtis		
“Coastal Storms” Presentation to Martin County 8 th Graders	2012	Scott Curtis	8th Grade	

Table D5. Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service provided

Albemarle-Pamlico National Estuary Program (APNEP)	2010-Present	Thomas Allen	Board Vice-Chair
APNEP	2011-Present	Thomas Crawford	Member Scientific and Technical Advisory Board
APNEP	2012-Present	Burrell Montz	Member Scientific and Technical Advisory Board
North Carolina Sea Grant	2011-Present	Thomas Allen	Ad hoc Sea-level Rise Communication Initiative
Saltwater Connections, Hatteras Island	2011	Jennifer Brewer	Resource Team member
Northwest Atlantic Marine Alliance	2010-Present	Jennifer Brewer	Co-Coordinator, Science and Policy Committee

E5C. Outputs and Impacts

1. Publications

Van Holt, T., Moreno, C.A., Binford, M., Portier, K, Mulsow, S, Frazer, T. Influence of landscape change nearshore fisheries in southern Chile. 2012. *Global Change Biology*. 18(7): 2147-2160. <http://dx.doi.org/10.1111/j.1365-2486.2012.02674.x>

Curtis, S., 2012a: In the eye of the storm: A participatory course on coastal storms. *Journal of Geography*, accepted.

Munroe, R., T. Crawford, and S. Curtis, 2012: Geospatial analysis of space-time patterning of ENSO forced daily precipitation distributions in the Gulf of Mexico. *The Professional Geographer*, in press.

Marcucci, D. J.; Brinkley, J. D.; Jordan, L. M. (2012) A Case for Coastal Theory with Lessons from Planning Theory. *Coastal Management*. (Forthcoming Vol. 40:4)

Crawford, T; Bradley, D.; Marcucci, D.J. (2011) Impacts of In-migration and Coastal Amenities on Housing Growth in Coastal North Carolina, USA. *Population, Space and Place*. DOI: 10.1002/psp.1695

Mingsheng Liao, **Yong Wang**, Changcheng Wang and Lin Liu, 2010. Modification of a scattering model based speckle filter applied to coastal environments: a LULC study using PALSAR data. *International Journal of Remote Sensing*. 31(8), 2101-2107. DOI: 10.1080/01431160903283819.

Yong Wang, Mingsheng Liao and Changcheng Wang, 2009. Applications and analyses of satellite-borne L-band synthetic aperture radar data in coastal environments. *Geography Compass*. 3(4), 1465-1482.

Allen, T.R. 2012. Estimating Coastal Lagoon Tidal Flooding and Repletion with Multidate ASTER Thermal Imagery. *Remote Sensing*, special issue on applications of thermal remote sensing, 4(10):3110-3126.

Allen, T.R., G.F. Oertel, and P.A. Gares. 2012. Mapping Coastal Morphodynamics using Geospatial Techniques, Cape Henry, Virginia, U.S.A. *Geomorphology* 137:138-149.

Landry, C., T. Allen, J. Whitehead, and T. Cherry. 2012. Offshore Wind Turbines and Coastal Recreation Demand. *Resource and Energy Economics* 34(1):93-111.

Brewer, Jennifer F. 2012. "Revisiting Maine's Lobster Commons: Rescaling Political Subjects." *International Journal of the Commons*, 6:2.

Brewer, Jennifer F. 2012. "Don't Fence Me In: Boundaries, Policy, and Deliberation in Maine's Lobster Commons." *Annals of the Association of American Geographers*, 102:2, 383-402.

Brewer, Jennifer F. 2011. "Paper Fish and Policy Conflict: Catch Shares and Ecosystem-Based Management in Maine's Groundfishery." *Ecology and Society* 16(1):15 [online]: <http://www.ecologyandsociety.org/vol16/iss1/art15/>

a. Non-refereed publications

Crawford, T and Daniel J. Marcucci. "North Carolina's Final Coastal Frontier: Changing Landscapes, People, and Places. Proceedings of Shape of the Coast 2010, The University of North Carolina – Chapel Hill, School of Law.

Marcucci, D.J. and Wang, Y. "Mid-Currituck Bridge Project – Bridge Deck Runoff Impacts and Mitigations." Project Technical Memorandum to North Carolina Turnpike Authority. (1/3/2011)

A5D: Other Departments: The Coastal and Marine Studies Interdisciplinary Minor (COAS);

A program of the Thomas Harriot College of Arts and Sciences

B5D: Narrative:

The coastal and marine studies minor requires a minimum of 24 credit hours and is designed to provide undergraduate students with an overview of coastal and marine resources. Considerable attention is devoted to the biological, physical, social, and historical aspects of coastal and marine resources. Whenever possible, information from North Carolina and other US coastal and marine environments is used to illustrate or emphasize important concepts. The minor requires three core courses: 1) COAS 2025 Survey of Coastal and Marine Resources; 2) GEOL 1300

Oceanography; and 3) COAS 4025 Society and the Sea Seminar (a research project is included.) In addition, elective credits in the minor may be drawn from a set of courses from biological sciences, physical sciences, maritime history, and social sciences.

The program is led by an advisor, Dr. Tom Allen (Associate Professor of Geography) with advice and oversight of a multidisciplinary Advisory Committee (faculty the Harriott College include those from departments of Anthropology, Biology, Economics, Geography, Geological Sciences, History, ICSP, Planning, and Sociology.) The program currently enrolls approximately 17 minors. In addition to these students, COAS courses also enroll a mix of majors seeking elective credits. Recently, COAS has supported teaching opportunities in the COAS prefix courses for CRM doctoral students, including formal responsibilities and ad hoc guest lectures.

Details:

<http://www.ecu.edu/cs-acad/ugcat/CoastalMarine.cfm>