

UNC System Coastal and Marine Science Activities Self-Study UNC Coastal Studies Institute

November 1, 2012

INTRODUCTION

The need and relevance for regional marine and coastal science research and education centers is grounded both in the inherent rich and complex environment and cultures of the three geographic areas of the NC coast and in the commitment and need for the university to serve these communities through these centers.

In 1999, then President Molly Broad convened a blue ribbon panel led by former chancellor of the University of Maryland, Dr. John Toll, who after much study, recommended that the third center, planned for the NE region, UNC Coastal Studies Institute (UNC CSI), should be an inter-institutional and inter-disciplinary center so the UNC universities could collectively and synergistically work together to enable UNC to attain a greater niche in national and international coastal research.

Today, UNC CSI is a thriving and growing entity the mission of which is as follows:

“The mission of the UNC Coastal Studies Institute is to undertake research, offer educational opportunities, provide community outreach programs and enhance communication among those concerned with the unique history, culture, and environment of the maritime counties of North Carolina. While the Institute will emphasize northeastern North Carolina in its outreach and education programs, its research will broadly address marine and coastal issues as germane to its program foci which are: (1) estuarine ecology and human health (E2H2), (2) coastal processes (CP), (3) sustainable coastal engineering and ocean energy (SCE+EO), (4) public policy and sustainability (PP+CS), and (5) maritime heritage (MH).”

In the past ten years, UNC CSI has strived to fulfill this responsibility. It has recruited accomplished academic faculty, professional public educators, developed technologically advanced dive and boat staff; all supported with a can-do, service and team-oriented administrative culture and staff. Much has been accomplished in rented and loaned space, with minimal operating funds.

BACKGROUND

Operations for the Institute were initiated in 2003 utilizing space donated by Dare County. Two Dare County buildings on Budleigh Street in Manteo—a historic home and hotel—currently house the Institute’s administrative operations, offices for the institute’s engineering, public policy, education, maritime heritage, and public education programs, as well as Sea Grant, UNC Chapel Hill’s Institute for the Environment’s Outer Banks Field Site, NOAA’s Monitor National Marine Sanctuary, and Renaissance Computing Institute (RENCI) partners.

In 2004, with the approval of the Board, the organizational chart for UNC CSI was changed from the standard Director-Associate Director-staff type structure to reflect a shared leadership concept. In partnership with the then-director of UNC Chapel Hill Institute of Marine Sciences, Dr. John Wells, the first joint programmatic work plan between UNC CSI and UNC IMS was drafted. The position description of a program head was conceptualized, and, with the leadership of Dr. Michael Piehler of the Estuarine Ecology and Human Health program, the model has become a reality.

In 2005 the Nags Head Lab was opened. This 6,000 sq. ft. facility, which was previously used as a hospital, was renovated in partnership with the Town for the Institute’s use as laboratories. Rent was generously established by the Town at a rate that allowed them to recover their costs of investment over a ten-year period. This Lab houses the Institute’s field operations, coastal processes and estuarine ecology and human health programs, as well as local offices for partner programs; the Division of Public Health’s Shellfish Sanitation Program and Division of Aquarium, Jennette’s Pier staff. This facility also provides lab support for the National Estuarine Research Reserve, the Marine Mammal Stranding Network, and the S.E. Atlantic Coastal Ocean Observing System (SEACOOS).

In 2007, UNC CSI was authorized by the State of NC to build a 90,000 sq. ft. campus using state-of-the-art LEED-certified construction techniques. UNC CSI was originally planned to be located on land donated by Dare County, but in 2009, the State purchased 204 acres, comprised of both upland and marsh, to accommodate the Institute, primarily because the deep-water access it offered better supported the Institute’s operational needs. The campus includes an 18,000 sq. ft. field research and marine operations facility to support boat and dive dependent work and a 60,000 sq. ft. research and education facility. Dormitories to house students and faculty were authorized and planned but not built. The change in location along with a \$1.3 M legislative reduction to the construction budget (due to the economic downturn) caused a funding shortfall. A capital request of \$14 M was submitted this fall to the President and Board of Governor’s to consider for inclusion in the current five-year UNC capital plan, to build not only the dormitories, but also an auditorium and other previously authorized items.

The campus facilities, which will be completed and ready for occupancy in mid-November 2012, are designed to be flexible and support multi-institutional functional activities and capacities, not dedicated to individuals. The facility also includes state-of-the-art advanced interactive communication and data integration/visualization technologies to support collaborative and geographically far-reaching research, database management and sharing, partnering, on and off campus curriculum delivery, and enhanced public education delivery methodologies. The use of advanced technologies and the need for significant ISP bandwidth is core to UNC CSI effectiveness and hence, UNC CSI is a community anchor partner of the Eastern Broadband initiative and hosts NC Research and Education Network (NC REN) and Microelectronics Center of North Carolina (MCNC) presence on the Outer Banks.

To administer its multi-institutional mission, UNC CSI uses two mechanisms. First, a Board of Directors, the members of which represent the programmatic constituency UNC CSI must serve, guide the Institute by advising both the Director and the Office of the President. The Board oversees and advises on policy matters for UNC CSI, and to that end, ensures focus on interdisciplinary interactions, partnering, and the support for the appropriate allocation of resources. Secondly, as noted previously UNC CSI's programs are led by jointly appointed faculty leaders in partnership with the respective campus academic programs (See O Chart below). These program heads are responsible for building their respective programs academically (research, extension and education) as well as fostering and facilitating collaborative synergies with other academic partners, local communities, state, and federal agencies.

The specific inter-disciplinary and inter-institutional foci of academic programming of the Institute are listed in the order of their establishment.

- (1) Estuarine Ecology and Human Health (E2H2): This program is led by Dr. Michael Piehler who is jointly appointed with the UNC Institute of Marine Sciences and the Department of Marine Science at the University of NC at Chapel Hill.
- (2) Sustainable Coastal Engineering and Ocean Energy Program (SCE and OE): These two programs are led by Dr. Billy Edge in partnership with the NC State University Department of Civil, Construction and Environmental Engineering and the College of Engineering.
- (3) Public Policy and Coastal Sustainability (PP&CS): Dr. Andrew Keeler leads this program in partnership with the ECU Department of Economics.
- (4) Maritime heritage (MH): Dr. Nathan Richards is the program head of this academic area, which is in partnership with ECU's Program in Maritime Studies within the Department of History.
- (5) Coastal Processes (CP): This program is co-led by interim program heads, Drs. Reide Corbett and J.P. Walsh in partnership with the ECU Department of Geologic Sciences and the Institute for Coastal Science and Policy.

UNC CSI has committed, formal programmatic partnerships with NOAA, RENCI, NC DENR, NC Aquariums, and NC Sea Grant. We also direct, administer, and are responsible for the academic content and management of UNC Chapel Hill's Institute for the Environment's Outer Banks Field Site. In the case of the NC Aquarium at Jennette's Pier, we also share facilities.

We have on-going, informal and formal external programmatic partnerships with the following organizations: Dare and Currituck County Cooperative Extension; US Army Corps of Engineers; College of the Albemarle; NC State's College of Design; Dare, Currituck, Hyde, Tyrell, Pasquotank, Perquimans County Schools; Regional Gov-Ed TV; Dare County Curriculum Advisory Committee; NC Biotech Center; NC Chapter of The Nature Conservancy, NC Estuarine Research Reserve; OB Center for Dolphin Research; Marine Mammal Stranding Network; SEACOOS; MARCOOS (regional organizations coordinating the ocean observing research for the eastern Atlantic to the Gulf of Mexico); and the OB History Center. We work closely with Natural Resources Conservation Service, NC Department of Commerce, NC Department Coastal Management, NE Economic Development Task Force, the local Chambers, and civic organizations. We are in the process of negotiating / developing partnerships with The Whalehead Preservation Trust, NEPTec (technology company responsible for the equipment on the International Space Station), NC State PAMS Science Education Programs, and have had preliminary conversations with the NC Museum of Natural Sciences.

UNC CSI's operations are currently funded at \$700 k recurring. These funds are leveraged through the collaborations with our campus partners, who share the costs of the salaries of the jointly appointed Program Heads and contribute, as relevant, equipment, travel, and overhead, resulting in estimated gross operational support estimated at \$1.4 M.

Each program area is responsible for the pursuit of grants and contracts to support their work from state, federal and private sources. The approximate current cumulative total of these resources that directly support UNC CSI research is \$4 M. UNC CSI Foundation is a young and emerging organization, which has contributed \$103,600.00 over the last 2.5 years. We have established governance, administration and implementation of the NC Ocean Energy Program in partnership with the Colleges of Engineering

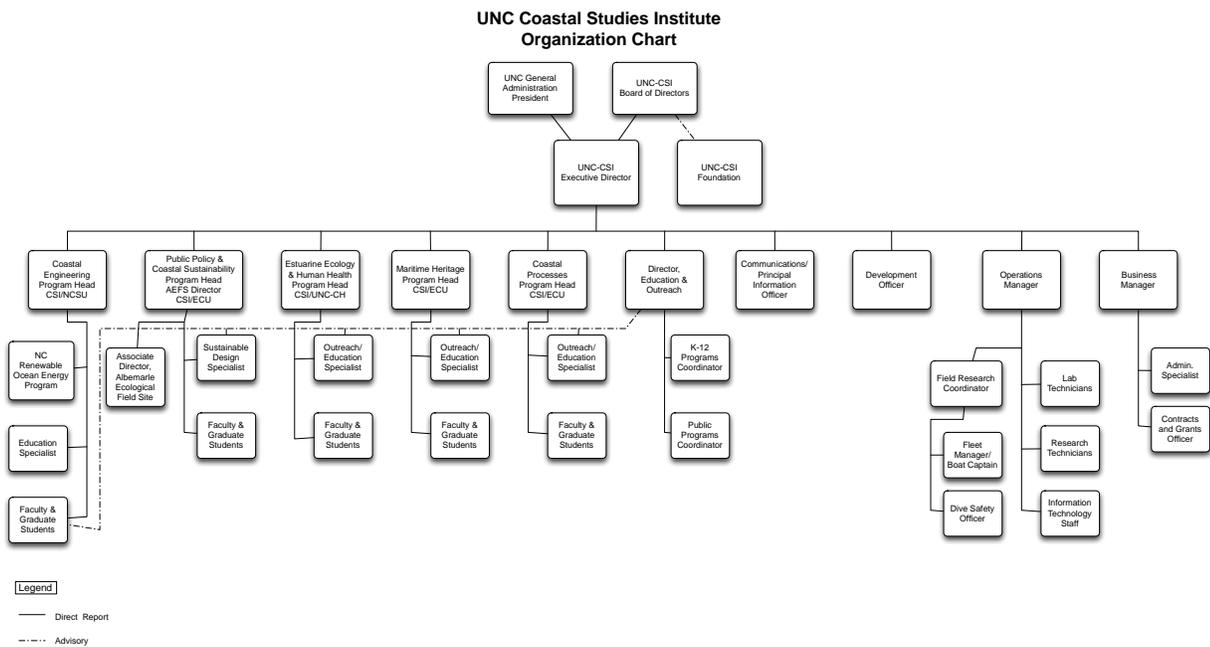
at NC State, UNC Charlotte, and NC A+T. UNC CSI is responsible for the management, research priorities and working agenda. Funded by the State of NC at \$2 M recurring.

All administrative actions are initiated, approved and managed at UNC CSI, however to avoid duplication of administrative operations, UNC CSI receives administrative support from East Carolina University in the form of financial processing, legal, dive/boat certifications, and human resources -- the value of which is estimated to be 10% of the total value of the operations activity or approximately \$200 k (most UNC and NCSU program grants are not housed at nor managed by ECU on behalf of UNC CSI).

While Dare County and the Town of Nags Head have heretofore provided facilities support, with the initiation of operations in a state-owned facility, UNC CSI shoulders additional financial responsibilities. UNC CSI will receive facilities management support from ECU, which is funded by the state at \$1.3M. The logistics of this arrangement are being determined, but preliminarily it is planned that there will be on-site a wastewater treatment plant position, which is shared with NC DENR, facilities manager, general technician, grounds management, and desktop IT and AV support personnel. Other services will be provided by contract and supported by the ECU managed State funds.

With the capabilities of the new buildings come new responsibilities and an increase in scope. While the scale of activities was planned for and anticipated, it now must be implemented. To do so, UNC CSI needs technicians, dedicated network and database IT, dive/ boat staff, and additional fund management staff, and the funds to seed graduate students and young faculty. A request for \$3 M in academic operations funds has been submitted to the President and the Board of Governors for their consideration.

The structure of UNC CSI's organization is below.



UNC CSI's self-study report will review its progress in meeting its goals and objectives as relevant to its mission with the following sections: 1) *Field Operations*, 2) *Public Education*, and 3) *Academic Programs*. A summary in the *Other* section will review the opportunities and challenges relative to inter-institutional and inter-disciplinary marine science operations.

I. UNC Coastal Studies Institute Coastal and Marine Science Activities

A. FIELD OPERATIONS ACTIVITY

Narrative:

The UNC Coastal Studies Institute has been providing field operations research support for the UNC system in the northeastern NC coastal region since it was founded in 2003. Field operations are provided by a team of personnel with extensive local knowledge and are enhanced by numerous federal, state, and private partnerships.

Led by Mr. Michael Muglia, inaugural Field Research Coordinator, UNC CSI began with very modest field operation capabilities. In 9 years, through experience, partnerships, and investments in certifications, training, and equipment, UNC CSI's capacity to handle complex field operations has grown considerably.

The location of UNC CSI is at the confluence of the Gulf Stream and Cape Hatteras, where there is only one very dynamic, dangerous inlet for access to the ocean. This is an advantage because these are the areas we need to study, however, to do so, we need a well developed and highly trained field operation -- it is a treacherous area requiring much local experience combined with technical knowledge. Also, UNC CSI's academic foci require robust field operations: CP, SCE, MH, and OE all do significant portions of their work in the water column, from boats, on the bottom of the estuary, or in the ocean; so a well-trained experience field operation is a necessity.

To that end, an important part of the campus planning, design, land purchase, and facilities construction was to build well-appointed field operations facility. The newly constructed campus facilities will provide a fully operational marine services building with waterfront access, boat slips, boat ramp, dive lockers, dive compressor for mixed gas diving, marine electronics lab, general workshop, and fabrication shop. Current field operations vessels and vehicles include five outboard vessels ranging from 12-25 ft., a jet ski (used for towing sampling devices), a Ford F250 pickup truck, a Dodge Sprinter van (with generator and other items for in situ operational support), technical diving equipment, bench shop equipment, welding equipment, and a full suite of tools for fabrication. Through the research facilities on Jennette's Pier, UNC CSI has direct ocean /beach access. These facilities include a research building at the end of the pier with a winch system to provide direct water access for equipment and divers, high bandwidth communications, power, and educational exhibits that include touch screen displays allowing the public to explore UNC CSI research projects and view live data feeds from deployment equipment and sensors. This site already hosts a Waverider buoy 9 miles offshore, which just provided real time documentation of the wind and waves for Hurricane Sandy and is part of a nationwide network in partnership with Scripps Oceanographic Institute.

Field support personnel have grown to include an experienced dive team of seven, with scientific and technical dive capabilities, and two United States Coast Guard licensed boat captains. A committee, chaired by John McCord and David Sybert, currently manages operations. Field specialists include experts in coastal hydrology, ocean and estuarine observing, land and underwater photography and videography, and maritime archaeological surveying and mapping. Currently, UNC CSI provides field support for multiple ongoing projects, partnerships, and classes. Some examples of ongoing project support includes:

- Wave and ocean current observations for NCSU, UNC Charlotte and UNC A&T for the NC Ocean Energy Initiative
- East Carolina University Maritime Studies Field School for graduate students
- Integrated Ocean Observing System (IOOS) and Southeastern Atlantic Coastal Ocean Observing Coastal Ocean Regional Association (SECOORA) instrument installation and maintenance
- Shipwreck survey and live dive programs with NOAA's Thunder Bay National Marine Sanctuary
- Battle of the Atlantic Archaeological Expedition with ECU's Program in Maritime Studies and NOAA's Monitor National Marine Sanctuary
- UNC CH Institute for the Environment OBXFS field classes
- NC DOT Ocean Outfall Study
- Freshman Oceanography Course Field Trips: UNC-CH
- UNC Wind Study: buoy and wind profiler instrumentation deployment
- UNC CSI's Basic Observation Buoy (BOB) education program for high school students

Significant Impacts

Essential relationships forged with our partners in the Outer Banks region enhance the field support UNC CSI provides to the UNC system. UNC CSI partners on projects with the US Army Corps of Engineers Field Research Facility in Duck, NC, and its field operations capabilities are essential to on-going efforts of the Integrated Ocean Observing System (IOOS) to gather wind, wave, and tidal information critical to the US Navy, Department of Commerce, and NC. UNC CSI's capabilities make possible the specific research and data gathering endeavors necessary for the NC Renewable Ocean Energy Program and the UNC Wind Study. UNC CSI is an essential partner in maritime archaeology dive projects and has a formal partnership with NOAA's Monitor

National Marine Sanctuary. Our fieldwork with the NC Aquariums and Jeannette’s Pier helps provide valuable ocean information to the community’s fishermen, boaters, and educators.

UNC CSI’s Public Education program and its partnerships, such as the Science on the Sphere exhibit at the NC Aquarium in Roanoke Island, benefit directly and are essentially integrated with the ability to offer field operations. For example, our educational partnerships and programming with Dare, Pasquotank, Hyde, Tyrell, Camden and Currituck County Schools make possible field supported projects like the Basic Observation Buoy (BOB) program, which allows regional K-12 schools /children to conduct their own marine observations.

Future Field Operations Growth and Challenges

UNC CSI field operations capabilities will experience extensive growth in the short term, with the opening of the new campus in Wanchese, NC. Plans include several field-based courses for undergraduates hosted by UNC CSI, providing students with scientific field experiences that utilize the natural resources of the area and many of the present field projects UNC CSI has undertaken. The campus site will also provide new opportunities for field research support for university scientists and graduate students at our partner Universities throughout NC. In addition, UNC CSI has taken the first steps towards establishing a regional technical dive training center at the new UNC CSI campus, building on our partnership with NOAA’s National Marine Sanctuaries, existing knowledgeable dive personnel, and technical diving equipment. Notably, UNC CSI’s responsibility to host the NC Renewable Ocean Energy program fosters a need for the ability to routinely make trips to the Gulf Stream, which is a priority in the assessment of potential ocean-based energy sources.

Resources

Personnel

List and provide information on faculty and key staff involved with the Activity (include current faculty searches that are underway or expected). Expand the below table as necessary.

Table C1. Personnel

Name	Title and department/college	Role
John McCord	Education Coordinator/CSI/ Field Ops Co Chair	Boat Captain, Technical and Scientific Diver
Michael Muglia	Research Associate/UNC CSI + UNC CH	Boat Captain, Dive Master and Scientific Diver
Corey Adams	Research Associate/CSI + UNC E2H2	Scientific Diver, Fabricator, Boat Operator
Reide Corbett	Co -Program Head CP, Professor/EUCU + CSI	Scientific Diver, Boat Operator
J.P. Walsh	Co -Program Head CP, Associate Professor/EUCU + CSI	Scientific Diver, Boat Operator
Dave Sybert	Education Associate/CSI/ Filed Ops Co Chair	Dive Master, Technical Diver, and Scientific Diver
Nathan Richards	Program Head MH, Associate Professor/EUCU + CSI	Scientific Diver, Boat Operator

Provide current number and general description of undergraduate students, graduate students, and post-docs involved with the Activity. Do not list individual students or post-docs.

- Listed in the Academic Programs Reports

Funding and Expenses

- All Funding and Expenses are managed by the institute at this time and will be reported in *Other*.

Physical infrastructure

The newly constructed campus site offers significant field operations infrastructure to support the research and education projects of UNC CSI and its partners.

The buildings on the campus include:

- 50,000 sq. ft. research and education building including labs, classrooms, and dockage for up to a 50 foot vessel adjacent to the building
- 18,000 sq. ft. marine operations building
- Large garage/shop with three 20 ft. high roll up doors for small boat/vehicle repair and equipment maintenance
- Two ton overhead crane located in the garage

- Full suite of workshop bench tools and power tools
- Fabrication shop including welding equipment, mill and lathe.
- Electronics shop including soldering station and testing equipment
- Dive equipment and tanks for scientific and technical diving
- Underwater photography and videography equipment including still cameras and high definition and 4K digital cinema cameras
- Nitrox membrane compressor for custom mixed gas scuba tank blending, oxygen booster
- Regulator flow bench, tank tumblers, and equipment for in-house dive gear maintenance
- Dive lockers, indoors and outdoors
- Covered equipment staging area
- Marina with potable water and shore power hook-up
- Boat ramp
- Slips to accommodate vessels up to 50 ft.
- Two ton dock crane for loading heavy equipment
- Vessel pump out facilities

Vessels include:

- 12.5 ft. Zodiac Inflatable (owned by UNC CSI)
- 17 ft. Southern Skimmer Skiff (owned by UNC Institute for the Environment, housed at UNC CSI)
- 21 ft. Parker (Owned by UNC CSI)
- 24 ft. Carolina Skiff (owned by UNC CSI)
- 25 ft. Bentley Pontoon boat (owned by UNC CSI)
- 25 ft. Parker (Owned by NCDENR, housed at UNC CSI)
- Jet Ski (owned by ECU, housed at UNC CSI in partnership with RENCI)

Vehicles include:

- Ford F250
- Dodge Sprinter van
- Dodge Caravan

Research, Teaching, Public and Professional Service

- Will be reported under *Academic Programs* and *Public Education and Outreach* activities.

Outputs and Impacts

- Will be reported under *Academic Programs* and *Public Education and Outreach* activities.

B. PUBLIC EDUCATION AND OUTREACH ACTIVITY

Narrative:

The education and outreach program of the UNC Coastal Studies Institute formally began in 2005 with the hiring of Education Programs Coordinator, John McCord. Education and outreach have always been an essential part of the mission of the UNC Coastal Studies Institute, and the hiring of dedicated outreach staff ensured UNC CSI's commitment to serve the public through active programming focused on fact based, unbiased research-grade information. There is an ever-increasing demand for high quality education and outreach programming. In 2009, David Sybert was hired to assist in the development and implementation of outreach programming, particularly in the growing area of K-12 student and teacher marine science programs, while Michael Muglia (oceanography), Robert McClendon (sustainable design), and Corey Adams (fisheries), and Nancy White (ecology) filled multiple roles between public education, research, and administration.

UNC CSI's education and outreach programming cuts across disciplines to support and complement the research, activities, and mission of the Institute. Programming includes a variety of education and outreach methods including seminars, workshops, forums, lectures, K-12 curriculum, teacher programs, publications, press coverage, video production, multi-media, and web based learning opportunities. Programming content is developed in response to pressing coastal issues, in collaboration with UNC CSI program heads, and consistent with the UNC CSI mission. UNC CSI programming strives to enhance communication between coastal stakeholders on topics of concern regarding natural, cultural, and historic resources while increasing our understanding of coastal systems and their inter-relationships with human systems.

Significant Impacts: Serving the Community

The research and education programs of UNC CSI address current coastal issues and topics of concern to northeastern NC, thereby enabling the community to make informed decisions and choices. Already hundreds of students have been affected by these experiences. Latch – key kids have found the out of doors to be fun and accessible. Its children discovered a new appreciation for the maritime heritage of the Scuppernong River and the Town of Columbia during recent local programming efforts. The entire Hatteras community has contributed to the experiential learning program at Cape Hatteras Secondary School building tanks, cabinetry, and docks in support of the curriculum. New opportunities to experience technical research-grade activities led to a international first place team in the NASA ROV competition from a local high school.

Place-based research with real world applications to the region allows UNC CSI to provide relevant scientific information to decision makers, resource managers, and the public. The newly constructed UNC CSI campus with its classrooms, meeting space, advance media lab, and community design lab will provide places for shared interactive, learning opportunities for the general public, graduate and undergraduate students, K-12 students, and professionals so that they can better understand our natural and cultural systems while exploring ways to adapt to changing environmental and economic paradigms.

Future Education and Outreach Programming

The completion of the new campus will allow for the development of new and exciting programs that take advantage of the juxtaposition of the location, advanced technologies, and talent that the campus provides, has developed, and will attract. New programs, such as those listed below, are being developed for the general public, working professionals, graduate and undergraduate students, and K-12 students and teachers that will take advantage of it all. Offerings will vary from hour-long and half-day programs to weeklong intensive retreats for those interested in a more in-depth learning experience.

Possible on-site programs may include, but are not limited to:

- Lecture series
- Community panel discussions
- On-site exhibitry and visiting exhibit displays
- Experiential labs
- Day-long workshops
- Weeklong retreats
- Scientific documentary film festivals

Possible field experiences/topics may include, but are not limited to:

- Kayak marsh tours
- Estuarine ecology
- Maritime heritage, marine archaeology and cultural resources
- Estuarine and coastal processes
- Sustainable Design practices and community design issues for the coast
- Stormwater management in the coastal plain
- Coastal engineering techniques
- Boat-based experiences exploring local ecology/biology/geology

Professional/Technical Programming

The research performed by UNC CSI and its partners provides stakeholders with valuable insight and data on environmentally and culturally important issues through the use of informed science. UNC CSI endeavors to undertake research and educational programming that is recognized as a trusted resource for policy and decision makers seeking adaptive and flexible ways to accommodate changing environmental and economic conditions. Professional and technical programming will make the best scientific information available through workshops, seminars, publications, multi-media and web-based learning opportunities.

K-12 Programming

Education is central to UNC CSI's mission and extends to the next generation of coastal scientists. UNC CSI employs project-based education methods in K-12 programming. For example, students have designed and constructed created wetlands, bioretention areas and boardwalks on their campuses that will continue to serve and support outdoor learning. Hands-on projects with practical real world application teach 21st century job skills and help UNC CSI communicate complex subject matter in a meaningful way. Onsite programming at the campus will take advantage of the natural systems found on and around the campus site, while making use of the technology and laboratories available within the campus facilities. In addition to on-site programming, school outreach will continue to be a staple of UNC CSI's K-12 offerings. School projects throughout northeastern NC counties allow the Institute to educate students through legacy research projects that engage students and capture their interest in the sciences.

Program offerings may include, but are not limited to:

- Classroom and lab-based programs
- Field experiences (outdoor labs, boat-based programs)
- Overnight programs
- Weeklong camps
- Distance education

K-12 Teacher Programming

In addition to K-12 student programming, UNC CSI will continue to offer a variety of resources for teachers throughout NC. Workshops and lesson plans that focus on current research topics and coastal issues, while meeting NC Department of Public Instruction (NCDPI) standards, integrate well into existing school curriculums and provide teachers with alternatives to traditional classroom teaching methods. UNC CSI education specialists will create an engaging curriculum that encourages inquiry-based learning through hands-on projects and fosters student interest in the fields of science, technology, engineering, public policy, and math.

Program offerings may include, but are not limited to:

- Workshops
- Publications and curriculum both in print and online
- Distance education
- Weeklong summer institutes

Graduate and Undergraduate Programming

UNC CSI education and outreach staff work closely with UNC CSI program heads to facilitate graduate and undergraduate learning opportunities for students through the use on campus facilities and the surrounding natural environment. In addition, UNC CSI education and outreach will assist program heads and partner universities with coordination and technical support for distance education and webcasting.

Web-Based Learning

An organization's website has become one of the most effective tools for the dissemination of information for both research and education purposes. The UNC Coastal Studies Institute plans on a complete redesign of the website that will allow for easier navigation, appeal to a broad range of learning styles, and facilitate the sharing of data sets, publications and research tools between academics, professionals and the general public. This website is intended to be dynamic in nature, allowing visitors to interact with the content in a manner that best suits their needs.

Website elements may include, but are not limited to:

- Web stories
- Video vignettes on current projects
- Publications
- Interactive maps
- Live data feeds
- Indexable data sets
- Calendar of events and online reservation system
- Webcasting and distance education

Mobile Applications

The prolific use of smart phones and mobile applications make for a unique education opportunity for UNC CSI. The development of mobile applications will allow us to connect with the public and other audiences through a variety of media, live data feeds, and interactive components that encourage learning through exploration.

Advanced Media and Visualization Laboratory

Imagery is an extremely powerful education and research tool. For research purposes, it can provide scientists and engineers with the ability to visualize and quantify data in innovative ways. In underwater and aerial applications, it can provide insights into environments and processes that would be difficult to study in any other manner. For educational purposes, it is one of the most effective tools to communicate complex concepts and connect with audiences on larger scales than reached by traditional educational methods. The education and outreach program is developing an Advanced Media and Visualizations Laboratory at UNC CSI that would work closely with UNC CSI program heads and university partners to develop meaningful visualization products for educational and research purposes. This technology, located on the newly constructed campus site, includes an immersive video and audio environment that allows participants to interact with the data and images being displayed in ultra high resolution and 3D environments.

The Advanced Media and Visualizations Lab will develop products for both research and education purposes. While not an exhaustive list, examples of products could include:

- HD and 4K digital cinema productions focusing on the research of UNC CSI and its partners. These products can be ported over for web use, TV and wider distribution.
- Ultra-high resolution data visualization
- Storm surge modeling
- Remote sensing
- Emergency response and urban planning
- Fluid dynamics, wave, current, wind and engineering 3D modeling
- Interactive, scalable ocean observing mapping tools
- Maritime Archaeology Image and Data Center- An interactive, multi-institutional, shared, indexed and searchable clearinghouse for images, video and data on maritime resources

Resources

Revenue

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Federal					
State (not including university)	\$105,000		\$24,048		
Institution (e.g. University)					
Foundation	10,000	\$35,000	\$55,000	\$47,860.80	
Other*					
Total	\$115,000	\$35,000	\$79,048	\$47,860.80	

* Provide a brief description of the Revenue table:

The Revenue table represents sponsored funds awarded to UNC CSI for Education and Outreach activities.

Personnel

List and provide information on faculty and key staff involved with the Activity (include current faculty searches that are underway or expected). Expand the below table as necessary.

Table C1. Personnel

Name	Title and department/college	Role
John McCord	Education Programs Coordinator	Program Coordinator
David Sybert	Education Associate	Educator
Robert McClendon	Sustainable Design Specialist	Sustainable Design
Corey Adams	Research Associate	Estuarine ecology/ fisheries
Michael Muglia	Research Associate	Oceanography

Provide current number and general description of undergraduate students, graduate students, and post-docs involved with the Activity. Do not list individual students or post-docs.

- Will be reported under *Academic Programs*.

Funding

- Will be reported under *Other*.

Physical infrastructure

The newly constructed campus site has significant infrastructure to support education programming that will enable experiences not available locally and in some cases statewide and regionally. Onsite classrooms, wet labs and seminar rooms provide teaching space indoors, while the surrounding environment lends itself to an outdoor learning in field experience classes that focus the natural resources of the campus.

Indoor teaching spaces include:

- Two wet lab classrooms with full AV package (one with distance education capability), 25 student capacity
- Three seminar rooms with full AV package (two with distance education capability), 20 student capacity
- One large flex classroom with full AV package, distance education capability, and adjacent catering kitchen for events
- One visualization lab with full AV package including ultra high resolution 4K projector with 3D capabilities and multi gesture touch table

These capabilities will allow classes to be shared and interact with multiple locations—these visualizations and interactivity with activities such as dives on underwater wrecks are experiences that could not happen elsewhere.

However, until now, much of the programming has been delivered off site using the teaching spaces in the Town Halls, auditoriums, classrooms, and labs of the local communities and schools.

The staff have been incredibly entrepreneurial. Local citizens have built aquaria tanks, docks, boardwalks, and demonstration gardens. In many, many cases this was appropriate and part of the learning experience and capacity building process. Often times, grants and donations garnered by the UNC CSI staff purchased equipment- plumbing supplies (for ROVs), video equipment, microscopes, waders, and sampling nets - for the students they were teaching so they would have the necessary equipment.

Identify workshops, continuing education, or other non-credit bearing instruction to community that are directly related to the Activity.

Non-Degree Credit Instruction

Workshop/Instruction title	Dates offered	Instructor(s) and Affiliation(s)	Brief description of instruction (1 sentence)	Enrollment Figures Total/on-site/distance edu
Master Gardeners	Fall & Spring annually	R. McClendon	Sustainable landscaping and coastal natural communities.	~30 per session
Sustainable Practices for Professional Landscapers (Continuing Education Credit)	Fall & Spring annually	R. McClendon	Sustainable landscaping and coastal natural communities.	~50 per session
Low Impact Development	Fall annually	R. McClendon	Construction and site planning for LID.	~20 per session
GovEd Documentary Filmmaking	Winter annually	John McCord	A two-day course offered to current GovEd members (Dare County, Towns within Dare County, Educational Institutions) annually on video and camera techniques, production and editing for documentary film production.	~15 per session

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
Mid-Atlantic Remotely Operated Vehicle Competition - UNC CSI has been a Co-Sponsor of a regional ROV Competition in which student teams design and build remotely operated vehicles to take part in a mission-based competition held each Spring. First Flight High School won first place internationally in 2010.	2007-2012	John McCord David Sybert	9-12 Students and Teachers from northeastern NC	Over 200 Students annually

<p>Estuarine Ecology and Aquaculture at Cape Hatteras Secondary School</p> <p>Since 2006, UNC CSI has provided programming to 6-12 grade students at Cape Hatteras Secondary School. A variety of project-based education initiatives such as indoor aquaculture and polyculture systems, the development of an oyster research sanctuary behind the school, and the implementation of an ongoing plankton monitoring program are just a few of the programs that engage students in the field of marine science.</p>	2006-2012	John McCord David Sybert	6-12 Grade Students	300 Students annually
<p>Wind Powered Education - UNC CSI and partners have installed wind turbines, held teacher workshops and engaged students in alternative energy curriculum at Cape Hatteras Secondary School, First Flight Middle School in Dare County and JP Knapp School in Currituck County.</p>	2011-2012	John McCord David Sybert	6-12 Grade Students and Teachers	600+ Students, 37 teachers
<p>Elizabeth City Middle School Wetland Project - A constructed wetland was installed behind Elizabeth City Middle School to provide 8th grade science classes with an outdoor laboratory for scientific investigation, as well as water quality improvements for run off reaching the Pasquotank River.</p>	2011-2012	John McCord David Sybert Robert McClendon	8 th grade Students and Teachers	Over 100 students annually
<p>Manteo High School Wetland and Aquatic Life Husbandry - Programming surrounding the construction of a wetland and boardwalk has included the design, planting, and water quality monitoring of the wetland and raingardens on the school's property. Aquarium tanks were set up in three classrooms that provided students the opportunity to learn about parameters needed to sustain life in freshwater ecosystems.</p>	2010-2012	John McCord David Sybert Robert McClendon	9-12 grade Biology, AP Biology, Earth and Environmental Science and AP Earth and Environmental Science classes	130 Students annually, 4 teachers
<p>Basic Observation Buoy Project - UNC CSI engaged students</p>	2011-2012	John McCord David Sybert	8-12 Grade Students from Cape Hatteras Secondary School,	310 Students, 10 Teachers

and teachers from 5 schools throughout NENC in a hands-on project and curriculum that included the construction and deployment of basic observation buoys that collect of water quality and atmospheric data from a variety of areas throughout the Albemarle and Pamlico Sounds.			Currituck High School, Mattamuskeet High School, Columbia High School and Pasquotank High School	
2012 Live Dive: Dive into Maritime Archeology - UNC CSI and partners from Thunder Bay National Marine Sanctuary and Monitor National Marine Sanctuary engaged 8 th grade students in maritime archaeology through hands on programming and a live broadcast from shipwrecks in Lake Huron, Michigan.	Spring 2012	John McCord David Sybert	8 th grade students	55 Students, 2 Teachers
Marine Scientist Summer Camp - UNC CSI, in partnership with Jeannette's pier, held a weeklong marine science summer camp program for students age 12 and up.	Summer 2012	John McCord David Sybert	Students ages 12+	12 Students
Albemarle Green Building Seminar - UNC CSI held three annual green building seminars that focused on green building techniques, storm water management, water conservation and alternative energy applications.	2008-2010	John McCord David Sybert Robert McClendon Nancy White	General Public, Professionals, K-12 Students	Over 400 attendees annually
NC Low Impact Development Manual, Curriculum and Workshops - UNC CSI assisted in the development of curriculum for NC's Low Impact Development handbook. In addition, UNC CSI organized three pilot workshops highlighting the curriculum developed within the handbook.	2010	John McCord David Sybert Robert McClendon Nancy White	Professionals, General Public	150 people
Coastal Growth Strategies Workshop - UNC CSI and partners held two workshops (2008,2009) for elected officials focused on sustainable development strategies for both new development and existing development.	2008-2009	John McCord Robert McClendon	Elected Officials	30 Elected officials each year

Scuppernong River Maritime Heritage Symposium - A daylong symposium for the public and K-12 community highlighting the maritime heritage of the scuppernong river, including a recent archaeological survey performed by UNC CSI archeologists.	Fall 2011	John McCord David Sybert Nathan Richards	General Public, K-12	75 people
Renewable Ocean Energy Symposium - UNC CSI has holds an annual Renewable Ocean energy Symposium highlighting the work of the NC Renewable Ocean Energy Project led by the UNC Coastal Studies Institute.	2011-2012	John McCord David Sybert Billy Edge Nancy White Mike Muglia Corey Adams Mike Piehler Lindsay Dubbs Andy Keeler	General Public, University scientists, engineers, renewable energy private industry	75 people annually
TV Programming for GovED Channels 19 and 20 - UNC CSI is a regular provider of video content for GovEd TV channels 19 and 20 in Dare County, NC. Programming produced highlights the work and research of UNC CSI and its partners.	2009-2012	John McCord David Sybert	General Public	16,000 viewers
Career Days, Community Events, & Booth Programs - UNC CSI regularly participates in K-12 career days, booth programs and community events throughout northeastern NC.	2008-2012	John McCord David Sybert Robert McClendon Corey Adams Mike Muglia Nathan Richards	General Public, K-12	Over 2000 people annually
Currituck Sound Water Quality Public Event - A public event highlighting the importance of water quality and what citizens can do to protect it.	2012	Robert McClendon David Sybert	General Public	150 people

Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service provided
Kitty Hawk Woods NC Coastal Research Community Local Advisory Board	2008-2012	John McCord	Advisory Board Member
Buxton Woods NC Coastal Research Reserve	2008-2012	John McCord	Advisory Board Member
UNC Institute for the Environment Outer Banks Field Site Community Advisory Board	2007-2012	John McCord	Advisory Board Member
Government and Education	2008-2012	John McCord	Committee member,

Access Channels Committee			Current chair of the committee
Camden County Economic Development Commission	2009-2012	Robert McClendon	Commission member
Currituck County Planning Department Technical Advisory Group	2009-2012	Robert McClendon	Committee member

Awards and Honors

Award or Honor	Date	Name	Brief Description
NC Coastal Federation Environmental Educator of the Year	2008	John McCord	Awarded for excellence in educational programming
Partners in Conservation Award	2009	John McCord, Tane Casserley, Joseph Hoyt, Nathan Richards (and others)	Awarded by the US Department of the Interior for best Conservation Collaboration in NC for 2008 (Awarded to CSI, NOAA MNMS, ECU, NPS, MMS, NC DCR)
Dare County Schools Community Partner of the Year	2009	John McCord	Awarded for outstanding commitment to K-12 schools in Dare County, NC
Toyota Tapestry Award for Excellence in Science Education	2008	John McCord	Awarded for excellence in science education
State of NC Soil and Water Conservation Award	2011	CSI Staff	Awarded for environmental stewardship for exemplary design for the CSI campus
Albemarle Resource Conservation & Development Council Award	2011	CSI Education staff	Awarded for service to Pasquotank public schools for developing a created wetland for an outdoor learning environment

C. ACADEMIC PROGRAMS ACTIVITY

Narrative

BACKGROUND:

The *Estuarine Ecology and Human Health (E2H2)* was the beta test for the concept of shared program leadership and management. It began in 2004 with the appointment of Dr. Michael Piehler with UNC Chapel Hill’s Institute for Marine Sciences.

Also, in 2004, UNC CSI’s Science Coordinating Committee, consisting of 35 faculty, leading coastal citizens and professionals, worked to develop UNC CSI’s inaugural strategic planning effort. The prime recommendation was to endeavor to appoint the other programs heads—the joint appointments and the ensuing partnerships were considered essential to the development of the academic programs. Dr. Margery Overton took the lead at NC State to work with the director to foster the formation of the coastal engineering program--now led by Dr. Billy Edge in partnership with NC State’s Department of Civil Engineering. Drs. Jaime Kruse, Joseph Fridgen and Richard Ericson took the lead at ECU to help with the development of the PP+CS Program, led by Dr. Andrew Keeler in partnership with ECU’s Department of Economics.

Maritime Studies at ECU is a very unique program nationally, and our staff at UNC CSI have been supporting maritime field activity since the beginning. Collaboration with this program ramped up in 2008 with the initiation of the Maritime Field School and then again under Dr. Nathan Richards’ leadership beginning in 2010. Dr. Richards’ started as an interim appointment with the permanent appointment as the MH program head finalized in the summer of 2012.

Coastal Processes research was also part of the daily scope of activities at UNC CSI from the beginning. UNC CSI shared a position with Dr. Harvey Seim of UNC Chapel Hill's Department of Marine Sciences to support the SECOOS effort, which was led by Mr. Michael Muglia, who also inaugurated and developed Field Operations for UNC CSI. Additionally, the ECU Department of Geological Sciences has a long history of work on the Outer Banks and in the northeast NC region. The CP program leadership just recently benefitted from the interim appointments of Drs. Reide Corbett and J.P. Walsh.

Activity Data

1. ESTUARINE ECOLOGY AND HUMAN HEALTH (E2H2)

The E2H2 program began in 2004 with the hiring of a Program Head and Research Technician in 2005. Despite having temporary laboratory space, E2H2 generated significant external funding to conduct research on issues critical to linking coastal ecology to human activities, and in some cases, human health. Post-doctoral researchers, graduate students, and undergraduate students have benefited from participation in the execution of this research.

Description of the Program

The estuaries and near-shore marine waters of northeastern NC are a valuable natural and economic resource. Tourists and residents are drawn to their natural beauty and recreational value while the fishing community relies on them for economic prosperity. The natural variables, that once dominated and shaped our estuarine systems, are now tested by the increasing pressures of coastal development and human derived impacts. It is the goal of E2H2 to improve our understanding of estuarine function and its relationship to human activities while providing valuable data and information to decision makers, educators, and the public to answer the pressing issues and questions of the region.

The E2H2 program will continue to focus its research agenda on examining the feedbacks between human activities and a suite of ecological variables. We will investigate the link between landscape modification and water quality (eutrophication and pathogen fate and transport), human induced alterations of the carbon cycling in coastal systems, the characteristics and values of estuarine ecosystems, the implications of ocean energy generation on offshore processes and organisms, and changes in coastal ecosystem properties and processes with increasing atmospheric concentrations of greenhouse gases. Examples of ongoing projects in the E2H2 program include ocean outfall stormwater monitoring and mitigation, investigation into sustainable estuarine shoreline stabilization, and environmental assessment of offshore waters for marine hydrokinetic siting.

Due to the presence of strong programs in complimentary disciplinary areas at institutions with marine science foci (UNC-CH, UNC-W, NCSU, ECU, ECSU), E2H2 will focus energy and time on fostering relationships with universities throughout the state and region that have faculty expertise and student interest and demand, but perhaps not as developed a coastal presence. E2H2 will lead efforts to engage and form partnerships with this significant "land-locked" population. This effort will involve visits to any interested universities and colleges and focused efforts to form mutually-beneficial partnerships.

The E2H2 research agenda is also strengthened and broadened by collaboration with other UNC CSI program areas. E2H2 is presently engaged in interdisciplinary research with the CSE and PP+CS programs, examining the interactions between ocean energy projects and marine and coastal ecosystems, processes, and organisms; and economically valuing ecosystem services, respectively. Some examples for future collaboration are investigating the role of wrecks as ecosystems (MH) and evaluating relationships between sediment transport and nutrient dynamics (CP).

Outputs and Metrics

- Research proposals will be generated in collaboration with our peer institutions to financially support the research objectives outlined above and to fund student research.
- Peer-reviewed publications are essential to convey research findings and will be a core output of the E2H2 research program.
- White papers to inform a range of user groups on topics critical to the region will be another core output of the E2H2 research program.
- The development of an Estuarine Ecology and Human Health Volunteer Program overseen by the Estuarine Ecology and Human Health Specialist will train volunteers in the correct protocols for testing basic water quality parameters and also how to interact with the public. Volunteers will collect water quality information from a variety of strategic locations in northeastern NC that will be made publically available via a web database.
- Curriculum will be developed and experiential learning opportunities will be offered to extend E2H2 research to K-12 and informal education audiences.
- Workshops and seminars will be offered to a range of stakeholders to convey scientific findings from E2H2 research.

Academic Programming

Field School Classes and Programming

E2H2 faculty plan to continue to teach an estuarine ecology class to UNC CH Outer Banks Field Site (OBXFS) students each fall (10-15 students) and summer classes on energy and the environment through the OBXFS each May and July (10 -15 students each).

We also plan to enhance undergraduate programs via the interface between UNC CSI and the UNC Chapel Hill, Institute for the Environment, Morehead City Field Site (MCFS) and OBXFS. This idea stems from the specific need for undergraduate training across the natural-social science bridge. Interdisciplinary, experiential learning will allow students to experience the complexity of today's environmental issues.

We envision courses team taught by multiple campus faculty and scientists incorporating environmental science, land-water interface, water quality, and ocean observing systems. These courses could be either intensive short courses (2 short courses over the course of a single semester), where portions of the course would have students housed for 1 week to 2 week stints at UNC CSI facilities, and working with program scientists and faculty. Potentially, independent research projects for students could stem from these classes where students can work on data sets from deployed observing systems in relation to real environmental issues (i.e., temperature changes, sea level rise, water quality).

Capstone experience courses currently run at the MCFS could be expanded so that students can become familiar with large scale environmental issues that the NC coast faces by "Capstone Camp" held at UNC CSI. Students would interact intensively with experts in specific fields at UNC CSI and OBXFS and return to MCFS to complete the Capstone. Similarly, OBXFS students who are more focused on social science and humanities facets of coastal issues would spend some portion of their capstone experience with UNC CSI scientists and at UNC IMS. Emerging near-term topics for Capstone projects include: 1) storm water and water supply, 2) climate change impacts on coastal communities, 3) development-zoning, impervious surface coverage, and water quality impacts 4) beach access regulation and 5) effects of marine and coastal protected areas. Progress on the project would be tracked on the UNC CSI and campus websites and on a newspaper science page. The results will be presented to the public in a workshop lecture series.

This effort will include both undergraduate and graduate level opportunities for students because courses at UNC IE MCFS field site will be cross listed to graduate students at Duke and CMAST.

Distance education

Ecology classes can be taught from the UNC CSI campus and streamed to UNC system universities via video conferencing.

Personnel

List and provide information on faculty and key staff involved with the Activity (include current faculty searches that are underway or expected). Expand the below table as necessary.

Table C1. Personnel

Name	Title and department/college	Role
Michael Piehler	Program Head at UNC CSI	Lead Estuarine Ecology and Human Health Program
Corey Adams	Research Technician	Support E2H2 Program
Lindsay Dubbs	Research Assistant Professor	Affiliated faculty

Provide current number and general description of undergraduate students, graduate students, and post-docs involved with the Activity. Do not list individual students or post-docs.

-5 undergraduates, 3 graduate students

Physical infrastructure

E2H2 Space

CSI

	SF
Molecular lab	485
Radioactive lab	118
Instrument lab	194
Wet lab	793
Env. Chamber	96

IMS

	SF
Analytical lab	400

E2H2 Equipment

CSI	Inverted microscope
High Performance Liquid Chromatograph	COST \$500,000 (CSI Building funds)
Gas Chromatograph	
Liquid Scintillation Counter	8 Isco Autosamplers
Carbon/Hydrogen/Nitrogen Analyzer	IDEXX analysis setup
Total Organic Carbon Analyzer	2 YSI sondes
Mass Spectrometer	Field Fluorometer
Gamma Counter	COST \$200,000 (Grant funds/Piehler startup)
Spectrophotometer	
Nutrient Autoanalyzer	
Photosynthetrons (2)	IMS
Precision balances	Fluorometer
-80 freezer	Spectrophotometer
Table top centrifuge	Gas Chromatograph
Shaking incubator	Photosynthetron
Autoclave	8 Isco autosamplers
Microfuge	YSI sonde
DI water purifier (Milli-Q system) (2)	Dissecting microscope
YSI water quality sondes (3)	COST \$200,000 (Grant funds/Piehler startup)
Fluorescence microscope	

Research, Teaching, Public and Professional Service

Research

Project title	PI/CoPIs – include institution	Sponsor	Amount	Dates
Collaborative Research: Microbial Regulation of Greenhouse Gas N2O Emission from Intertidal Oyster Reefs	Piehler – UNC CSI/UNC-IMS BK Song – UNCW M Brush – VIMS C Tobias - UConn	NSF	\$209K Piehler	8/12-7/15
Collaborative Research: the influence of predators on community structure and resultant ecosystem function at a biogeographic scale	Piehler – UNC CSI/UNC-IMS J Grabowski – NEU D Kimbro – FSU R Hughes – FSU J Byers - UGA	NSF	\$175K Piehler	6/10-5/13
Assessing the potential for estuarine nitrogen removal using ecosystem engineers	Piehler – UNC CSI/UNC-IMS	NC Sea Grant	\$120,000 Piehler	4/10-3/13
Denitrification in Barnegat Bay saltmarshes	Piehler – UNC CSI/UNC-IMS D Velinski – ANSP T Quirk - ANSP	NJ DEP	\$52,000 Piehler	4/12-6/13
Public policy for non-traditional energy exploration off the coast of NC	Piehler – UNC CSI/UNC-IMS Dubbs – UNC CSI/UNC-CH A Keeler – UNC CSI/ECU	NC Ocean Energy Program	\$35,481 Piehler	7/12-6/13
Defense Coastal/Estuarine Research Program	Piehler – UNC CSI/UNC-IMS More than 20 PIs	SERDP	\$400K Piehler	8/07-12/12
Monitoring, prioritization, and	Piehler – UNC CSI/UNC-IMS	NC DENR	\$550K Piehler	5/06-12/12

assessment of ocean outfalls of stormwater in Dare Co., NC	R Noble – UNC-IMS N White – UNC CSI			
Collaborative Research: Linking hydrogeomorphology and denitrification in tidal freshwater coastal streams	Piehler – UNC CSI/UNC-IMS C Tobias – U Conn J Harvey - USGS JK Bohlke - USGS	NSF	\$55K Piehler	4/08-3/12
Cataloging Environmental and Regulatory Conditions Affecting Marine Hydrokinetic Energy Extraction in NC	Piehler – UNC CSI/UNC-IMS C Peterson and S Fegley – UNC IMS	NC OE Program	\$71K Piehler	7/11-6/12
Cycling of nitrogen in Lake George, FL sediments	Piehler – UNC CSI/UNC-IMS Gardner – Univ Texas	St. Johns River WMD	\$125K Piehler	3/09-9/11
Reassessing prey availability for river herring in the Chowan River Basin	Piehler – UNC CSI/UNC-IMS Ensign – USGS Leech – Depauw Univ	FRG - NC Sea Grant	\$64,000 Piehler	3/08-6/11
Sustainable Estuarine Shoreline Stabilization: Research, Education and Public Policy in NC	Piehler – UNC CSI/UNC-IMS Fear – NCNEERS Currin – NOAA Peterson – UNC-IMS Posey – UNC-W	CICEET	\$130K Piehler	10/08-10/11
Multiple nitrogen utilization strategies and phytoplankton species diversity	Piehler – UNC CSI/UNC-IMS H Paerl – UNC-IMS R Noble – UNC-IMS	NSF	\$25K Piehler	3/05-4/09
SLR2005: Modeling estuarine habitat response to rising water level	Piehler – UNC CSI/UNC-IMS C Peterson – UNC-IMS R Luettich – UNC-IMS	NOAA	\$320K Piehler	10/05-9/09

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
Internship/ Independent Study, ENST 395, undergraduate	Fall Semester	Corey Adams UNC CSI/ Lindsay Dubbs UNC CSI	Project based internship with local and state government, NPO, private sector or university developed around students primary career interests.	8 -14 per semester
Coastal and estuarine ecology (for UNC-Chapel Hill), ENST 489, undergraduate	Fall Semester	Lindsay Dubbs (UNC- CH)	An overview of coastal and estuarine ecosystem characteristics and processes and introduction to environmental management with a focus on ecosystem based management	8-14 per semester
Energy and the Environment: A Coastal Perspective (for UNC-Chapel Hill), ENST 490,	Maymester and summer session 2	Lindsay Dubbs (UNC- CH)	Introduction to coastal and ocean-based energy generation, including petrochemical, wind, wave, ocean current, tidal current, ocean thermal energy conversion, and salinity gradient and transmission and the potential effects they may have on	8-14 per semester

undergraduate			marine and coastal ecosystem, organisms, and communities.	
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Non-Degree Credit Instruction

Workshop/Instruction title	Dates offered	Instructor(s) and Affiliation(s)	Brief description of instruction (1 sentence)	Enrollment Figures Total/on-site/distance edu
Leadership Carteret	2/11	Piehler	Provided information on estuarine climate change research in NC	~35
NC Estuarine Research Reserve Estuarine Shorelines: Value, Regulations, and Stabilization Workshop	9/20/11	Lindsay Dubbs (UNC-CH)	30 minute lecture on how wetlands are affected by climate change to engineers, consultants, realtors, developers, and property owners	30/30/0

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
High School Student Shadows	N/A	Corey Adams UNC CSI	High School Students	1-5 per year
High School Career Day	N/A	Corey Adams UNC CSI	High School Students	30
Lecture in AP Environmental Science at West Carteret High School	Annually	Michael Piehler, UNC CSI	High School Students	30
Career Day, Morehead City Elementary School	2009-2012	Michael Piehler, UNC CSI	Grades 4-5	100
Presentation at the APNEP State of the Sounds Symposium on the 2011 APNEP ecosystem assessment	11/17/11	Lindsay Dubbs-UNC-CH and UNC CSI	Public and state and federal agencies	100
NC CLIMATE Fellows Teacher Retreat field trip on the Outer Banks where a presentation about wetlands and how they will be influenced by climate change was delivered	3/24/12	Lindsay Dubbs-UNC-CH and UNC CSI	NC high school science teachers	25
Prepared a soils lesson for the IDEA summer science institute where under represented middle school student from Elizabeth City, North Carolina and the surrounding counties that are interested in geosciences participated in a one-week summer institute	8/2/12	Lindsay Dubbs-UNC-CH and UNC CSI	NC middle school students	20

Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service provided
National Oyster Goals Project Science Advisory Team	Jan '11-	Michael Piehler, UNC CSI/UNC-IMS	Technical expertise
The Nature	Dec '10-	Michael Piehler, UNC CSI/UNC-	Technical expertise

Conservancy/US Fish and Wildlife Service Climate Change Adaptation Project Scientific Advisory Committee		IMS	
Executive Board of the Albemarle-Pamlico National Estuary Program Science & Technical Advisory Committee	June '08-	Michael Piehler, UNC CSI/UNC-IMS	Technical expertise
Albemarle-Pamlico National Estuary Program Science & Technical Advisory Committee	Jan '06-	Michael Piehler, UNC CSI/UNC-IMS	Technical expertise
PCS Phosphate Science Committee	Jun '10-Feb '12	Michael Piehler, UNC CSI/UNC-IMS	Technical expertise
Clean Water Management Trust Fund Innovative Stormwater Advisory Work Group	Feb '08-Jul '08	Michael Piehler, UNC CSI/UNC-IMS	Technical expertise
NC Oyster Hatchery Advisory Committee	Sep '05-Mar '08	Michael Piehler, UNC CSI/UNC-IMS	Technical expertise
Virginia Sea Grant Review Panel	Oct '10	Michael Piehler, UNC CSI/UNC-IMS	Technical expertise
Maryland Sea Grant Review Panel	Nov '10	Michael Piehler, UNC CSI/UNC-IMS	Technical expertise
Currituck County	February 2010-February 2011	Corey Adams UNC CSI	Water sampling and bacterial analysis, total suspended solid analysis of stormwater ponds
USGS	August 2011-Present	Corey Adams UNC CSI	Bacterial Analysis of water samples for Mid-Currituck Bridge Environmental Impact Statement
US EPA	January/February 2012	Corey Adams UNC CSI	Water Quality Sampling, Bacterial Analysis/ QPCR filtration processing for QPCR inhibition study
NC Coastal Federation	11/11-present	Lindsay Dubbs-UNC-CH and UNC CSI	Serve on the northeast advisory committee
NC Coastal Federation	11/11-present	Lindsay Dubbs-UNC-CH and UNC CSI	Serve on the northeast advisory committee

Outputs and Impacts

Publications

NOTE: Authors in bold are students and post-docs advised by Piehler (26 publications since 2008)

Smyth, A.R., S. P. Thompson, K.N. Siporin, W. S. Gardner, M.J. McCarthy, M. F. Piehler. 2012. Assessing nitrogen dynamics throughout the estuarine landscape. *Estuaries and Coasts*, in press.

Ensign, SH, MW Doyle and MF Piehler. 2012. Tidal geomorphology affects phytoplankton at the transition from forested streams to tidal rivers. *Freshwater Biology*, in press.

Grabowski, J.H., R.D. Brumbaugh, R. Conrad, A.G. Keeler, J. Opaluch, C.H. Peterson, M.F. Piehler, S.P. Powers, A.R. Smyth. 2012. Economic valuation of ecosystem services provided by oyster reefs. *Bioscience*, in press.

- Ensign, S, K Siporin, M Piehler, M Doyle, and L Leonard. 2012. Hydrologic versus biogeochemical controls of denitrification in tidal freshwater wetlands. *Estuaries and Coasts*, in press.
- Rodriguez, A.B., M.N. Waters, M.F. Piehler. 2012. Burning peat and reworking loess contribute to the formation and evolution of a large Carolina-bay basin. *Quaternary Research*, in press.
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- Waters, M.N., M. F. Piehler, J.M. Smoak, and T. S. Bianchi. 2012. Algal community responses to shallow lake dystrophication. *Canadian Journal of Fisheries and Aquatic Sciences* 69 (8), 1433-1443.
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- Christian, R.R., V.F. Camacho-Ibar, M.F. Piehler and A.R. Smyth. 2012. Understanding the nitrogen cycle through network models in coastal ecosystems. *Treatise on Estuarine and Coastal Science*.
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- Converse, R.R., M. F. Piehler and R.T. Noble. 2011. Contrasts in concentrations and loads of conventional and alternative indicators of fecal contamination in coastal stormwater. *Water Research*, doi:10.1016/j.watres.2011.07.029.
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- O'Connor, M.I., C.R. Violin, A. Anton, L.M. Ladwig and M.F. Piehler. 2011. Salt marsh stabilization affects primary producers at the marsh edge. *Wetlands Ecology and Management* 19: 131-140.
- Piehler, M.F., C.A. Currin, N.S. Hall. 2010. Estuarine intertidal sandflat benthic microalgal responses to in situ and mesocosm nitrogen additions. *Journal of Experimental Marine Biology and Ecology* 390:99-105.
- Stumpf, C.H., R.T. Noble, M.F. Piehler and S.P. Thompson. 2010. Loading of fecal indicator bacteria in NC tidal creek headwaters: hydrographic patterns and terrestrial runoff relationships. *Water Research* 44: 4704-4715.
- Waters, M.N., M.F. Piehler, J. Smoak, and C. Martens. 2010. The development and persistence of alternative ecosystem states in a large, shallow lake. *Freshwater Biology* 55:1249-1261.
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2. SUSTAINABLE COASTAL ENGINEERING / NC RENEWABLE OCEAN ENERGY PROGRAM (SCE + OE)

Narrative

The SCE+OE program began in 2009 and since then, it has grown into a significant program at UNC CSI. The mission of the Program in support of the overall mission of UNC CSI is to conduct research while providing support to local communities and the State through an integration of applied and basic research in coastal engineering and ocean energy. Support to the communities is currently done via committee service and support for current education staff, but a professional educator position is planned to deliver programming similar to an extension type service. Research is conducted on several fronts, from addressing local issues to State, national and even international challenges. Additionally, SCE provides a mechanism for educational opportunities for undergraduate and graduate engineering students at NC State University. The SCE is not limited to traditional coastal engineering but includes transportation - marine and surface, port facilities, coastal hazard mitigation, and ocean energy.

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

The SCE program at UNC CSI is in partnership with NC State's Department of Civil, Environmental, and Construction Engineering (CCEE), coordinating years of fragmented activity into a coherent and synergistic effort. This program has been developed to take advantage of multidisciplinary research and educational opportunities in the confluence of academic disciplines and issues related to sustainable engineering made possible by the integrative resources at UNC CSI. The context for this program lies in the complex interactions between natural processes and anthropogenic activities, urban development combined with habitat degradation, as well as water quality problems, public health issues, sea level rise predictions, and a changing storm climate. The objectives of the program are to conduct coastal processes research and techniques for environmentally sound infrastructure, and management strategies that will reliably support long-term sustainability and resilience of both natural and man-made coastal habitats. Moreover, this partnership will support the graduate coastal engineering program that will educate the next generation of engineers so that they may incorporate these methods into designs and further research.

Coastal Engineering is a subdiscipline within the CCEE Department at NCSU and is a new focus for graduate level curriculum within the program. Coastal Engineering requires a knowledge-base in the foundations of engineering, coastal geomorphology, climate change, material science, water quality, and coastal processes in the design, construction, and maintenance of sustainable and resilient facilities in the coastal environment. SCE, in collaboration with other state and university components, have monitored storm events and provided assessment of the impacts on infrastructure for hurricane and tropical storm events, not to mention the natural landscapes that support them.

An MOU with Jennette's Pier, a state owned and NC Aquarium managed pier located in Nags Head, provides an opportunity for coastal, oceanographic and energy research. This unique facility allows opportunities for both teaching and research of processes related to engineering, environment, and society. It also provides an excellent outreach opportunity for UNC CSI to deliver programming to the half million visitors to the pier annually. During the initial construction of the pier, it was used for a field trip for graduate students at NCSU that were studying coastal engineering and marine construction. It also provides an opportunity to test ocean energy devices. Resolute Marine Energy has already conducted tests at the facility. A group from Australia will be testing another wave energy device in 2013. The pier research building, which was designated to UNC CSI, houses

instrumentation including two offshore wave gages, a meteorological package, and an electric lift beneath the pier for inserting divers and instruments. This facility is available to all researchers by permission from a research operations committee comprised of CSI staff and the pier manager.

The pier also provides an excellent opportunity to showcase research and coastal phenomena to the public and to school groups visiting the pier. UNC CSI's education program develops content for and maintains large touch-screen panel displays showcasing the research and real – time data.

UNC CSI manages the ocean energy program with research being conducted over several campuses including NC State, UNC Charlotte and UNC A&T. The strategic directions of the program are:

- Ocean Energy Power Take-off using Magnetic Gears, Dr. Jonathan Bird at UNCC and Dr. Subhashish Bhattacharya at NCSU Freedom Center
- Ocean Compressed Air Energy Storage Including Transmission and Distribution Off the NC Coast, Drs. Joe DeCarolis, Mo Gabr, Shamim Rahman, Andre Mazzoleni, Paul Ro, Iqbal Husain, Emmanuel B. Agamloh, Alex Q. Huang at NCSU
- Need and tools for public policy formation for encouraging non-traditional energy exploration off the coast of NC, Drs. Andrew Keeler and Lindsay Dubbs at UNC CSI
- Renewable Energy from the Gulf Stream, Billy L. Edge, NCSU, Michael Muglia, UNC CSI, Howard Hanson, FAU

Additionally, work, complimentary to the above strategic directions, are:

- Detailed 20-year hindcast of the NC coast out to Bermuda, Kevin Gamiel and Dr. Brian Blanton at RENCI, Dr. Jeffrey Hanson, US Army Field Research Facility, and Billy L. Edge, NCSU
- Develop of smooth particle hydrodynamics code GPUSPH for design of wave energy devices, Kevin Gamiel, RENCI, Dr. Robert A. Dalrymple, Johns Hopkins University, and Billy L. Edge, NCSU
- Testing support for Jennette's Pier, Michael Muglia at UNC CSI

Outputs and Metrics

We anticipate the delivery of the following outputs from our research, extension, and educational activities:

- Research proposals in collaboration with our peer institutions
- Scholarly publications in peer-reviewed journals
- Presentations at valued conferences and workshops
- Educational products including curriculum and experiential learning
- Graduate, undergraduate and public education
- Service to the community, State, nation and to the profession through committees and councils
- White papers to inform a range of user groups on topics critical to the region
- Establish visibility for the renewable ocean energy research program through exhibiting at one conference per year
- Valuable real-time oceanographic information, for example wind and wave measurements, to the local marine community, emergency managers, public officials, and the public

Academics

Educational and academic programs will be developed to complement existing curricula. This will include distance education that will allow faculty working at UNC CSI to teach students throughout the region enrolled in engineering programs. The distance education will allow UNC CSI through NCSU to offer credit and non-credit courses internationally as well.

In 2013, we plan to offer a six-week summer course for a dual undergraduate-graduate course on campus. This will be an extensive field course that will focus on the facilities of ocean energy, beach processes, coastal structures, and field measurements. It is possible that this could be combined in part with the proposed offerings with the summer program.

The capabilities for interdisciplinary education will be developed to engage the E2H2 and CP programs at UNC CSI with SCE to present to the community and to collegiate communities truly interdisciplinary knowledge concerning anthropogenic impacts and sustainability.

To engage the community, we will plan to offer one lecture per semester directly related to the local community issues dealing with sustainability and the local environment. This will be either an invited speaker or a member of the faculty. During the Spring of 2012, a lecture on rip currents was organized and presented by Dr. Robert A. Dalrymple of Johns Hopkins.

Research

Program: There is on-going research in SCE involving several areas. The most significant effort at present is development of renewable ocean energy. This program is funded through the State and focuses on development of electric power from renewable
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wave, tide, and current resources. Currently, an expanded assessment of the wave energy resource off the NC coast is being conducted. An assessment of the potential energy resource from the Gulf Stream has also begun that includes increased field measurements and assessments of existing information.

Our research also includes a study of the capacity of NC port facilities for wind power development, construction and maintenance. As a part of the ocean energy project, we are also developing robust technology for designing more efficient wave energy devices using smooth particle hydrodynamics.

The program will continue to grow with research opportunities, including performance of beach nourishment, port operations, nearshore dynamics, decadal response of the shoreline to sea-level change, and response of inlets to opening and closing of storm cuts through the barrier. The program also maintains an interest in developing remote sensing of water levels throughout the sounds of the State. Hopefully, working with DCM, additional gages can be installed.

In addition, we will be expanding from more traditional coastal engineering to meet the needs of sustainability in engineering marine and surface transportation, multimodal transport, materials, bridges, and maritime structures in the coastal zone.

Equipment:

While much of the current work is primarily office studies and using supercomputer power for computation, many of the needs are field based. The location of UNC CSI and its mission facilitates and enables increased focus on field observations and measurements. As such, there are several items of equipment now engaged in monitoring wave and current conditions along the coast. This supports the ocean energy program and also provides important coverage in areas not previously monitored such as offshore Oregon Inlet. This expands the role of UNC CSI in oceanographic measurement, analysis and assimilation.

As we move into more field related activities there is on-going needs to expand our equipment to allow more detailed observations and measurements. Some of this need can be met though sharing and partnering with other UNC CSI programs. However, there remains much that is unique to the engineering needs that may not be of interest to other programs. With the opening of UNC CSI campus in 2012, some of this equipment will immediately be put to use in the new facility or in the field.

UNC CSI’s work at Jennettes Pier resulted in a unique platform for engineering and scientific field efforts in the region. The pier has been functionally equipped with infrastructure, high bandwidth communications, and instrumentation to facilitate SCE and CP field experiments. The public aspect of the pier provides an exceptional opportunity to demonstrate this fieldwork to the public, K-12, undergraduate, and graduate communities.

Resources

Personnel

Name	Title and department/college	Role
Billy L. Edge	Professor/Department of Civil, Construction and Environmental Engineering, NCSU	Program Head Sustainable Coastal Engineering and Ocean Energy
Lindsay Dubbs	Assistant Research Professor, UNC-CH	Researcher, Ocean Energy Program
Kevin Gamiel	Research Associate/UNC Renaissance Computing Institute	Numerical Modeling, Instrumentation
Michael Muglia	Research Associate/PhD Student/UNC CH	Field Operations/Ocean Observing
Mo Gabr	Professor/Department of Civil, CEEuction and Environmental Engineering, NCSU	Ocean Energy Storage and Erosion
Roy Borden	Professor/Department of Civil, Construction and Environmental Engineering, NCSU	Erosion Potential of Beaches and Inlets

There are eight graduate students, MS and PHD students, plus one undergraduate student.

PHYSICAL INFRASTRUCTURE:

The new campus with laboratory space and the marine operations building will serve as an excellent resource to facilitate research activities. The crane, water supply, air compressor and power supply will aid in development of compressed air storage of ocean energy. This is a strategic component of the ocean energy program. This will be housed in the high bay area of the marine

operations building. Clean wet lab space is available with adequate counter space and will provide opportunities for specific equipment for evaluating the potential for natural bacteria in soil to secrete calcite cementitious material for the stabilization of natural dunes. Additional space in the high bay area will be used to support the development of an in-situ scour probe for assessment of scour potential with soil stabilization. Work supported by the Department of Homeland Security will use the overhead crane, high voltage power supply and the wave tank.

A transportable wave tank will be housed in the laboratory building. The tank is especially constructed for both teaching and research. Additionally, a tidal gage will be installed and tied directly into the server for data recording. Storage is provided for a survey grade GPS system for rapid profiling of shorelines and inlets. The storage will also contain a multi-beam survey system for mapping inlets and offshore.

Three workstations are installed in the computer learning center for computation of ocean energy device hydrodynamics and mooring systems using graphical processor units (GPU's). In addition a quad server with 1600 GPU cores is available for similar hydrodynamic analysis of devices and storm surge computations.

Research, Teaching, Public and Professional Service

Research

Project title	PI/CoPIs – include institution	Sponsor	Amount	Dates
Renewable Ocean Energy	Billy L. Edge - NCSU	NC	\$2,000,000	7/10-6/11
Renewable Ocean Energy	Billy L. Edge - NCSU	NC	\$2,200,000	7/11-6/12
Renewable Ocean Energy	Billy L. Edge - NCSU	NC	\$2,000,000	7/12-6/13
Building Capacity for Renewable Ocean Energy	Lindsay Dubbs (postdoc at UNC-IMS), Michael Piehler (UNC-IMS and UNC CSI), Charles Peterson (UNC-IMS), Stephen Fegley (UNC-IMS), John McCord (UNC CSI)	CSI Ocean Energy Program	\$125,984	7/1/11
Need and tools for public policy formation for encouraging non-traditional energy exploration off the coast of NC	Lindsay Dubbs, Andrew Keeler (ECU and UNC CSI), and Michael Piehler (UNC-IMS and CSI)	CSI Ocean Energy Program	\$35,481	7/1/12

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
CE 596 Special Topic in Coastal Modeling	Spring 2010	Billy Edge - NCSU	Use of numerical models for studying storm surges, tides and water quality in coastal bays and estuaries	12
CE 596 Special Topic in Coastal Structures	Fall 2011	Margery Overton (NCSU) was the lead instructor Billy L. Edge (NCSU) supported the field trip through CSI for observations and monitoring	Design and analysis of soft and hard structures for protection of coastal infrastructure and port and harbor entrances	12

CE 600 Master's Thesis Research	2010-2012	Billy L. Edge - NCSU	Master's Research	2
CE 895 Doctoral Dissertation Research	2010-2013	Billy L. Edge - NCSU	Doctoral Research	1
Coastal and estuarine ecology (for UNC-Chapel Hill), ENST 489, undergraduate	Fall Semester	Lindsay Dubbs (UNC-CH)	An overview of coastal and estuarine ecosystem characteristics and processes and introduction to environmental management with a focus on ecosystem based management	8-14 per semester
Energy and the Environment: A Coastal Perspective (for UNC-Chapel Hill), ENST 490, undergraduate	Maymester and summer session 2	Lindsay Dubbs (UNC-CH)	Introduction to coastal and ocean-based energy generation, including petrochemical, wind, wave, ocean current, tidal current, ocean thermal energy conversion, and salinity gradient and transmission and the potential effects they may have on marine and coastal ecosystem, organisms, and communities.	8-14 per semester

Non-Degree Credit Instruction

Workshop/Instruction title	Dates offered	Instructor(s) and Affiliation(s)	Brief description of instruction (1 sentence)	Enrollment Figures Total/on-site/distance edu
Workshop on Dredging Engineering at Texas A&M University	1/11-15/2010	Edge - NCSU	Presented one hour lecture on Beach Nourishment	48/48/0
Workshop on Dredging Engineering at Texas A&M University	1/10-14/2011	Edge - NCSU	Presented one hour lecture on Beach Nourishment	56/56/0
Workshop on Dredging Engineering at Texas A&M University	1/8-13/2012	Edge - NCSU	Presented one hour lecture on Beach Nourishment	68/68/0
Workshop on Gulf Stream Energy	9/17/12	Muglia - CSI	Present current knowledge of Gulf Stream energy resource for NC	8/8/00
Physics of Rip Currents via Mathematics	Jun-12	Robert A. Dalrymple - Johns Hopkins University	Public seminar on rip currents	20/20/0
NC Estuarine Research Reserve Estuarine Shorelines: Value, Regulations, and Stabilization Workshop	9/20/11	Lindsay Dubbs	30 minute lecture on how wetlands are affected by climate change to engineers, consultants, realtors,	30/30/0

			developers, and property owners	
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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
NC Inland Waterways Association	10/11/11	Mike Muglia - CSI	professional	
NCSU Park Student Organization	2011	Billy L. Edge - NCSU	Freshmen	45
UNC CSI Field School	10/2/12	Billy L. Edge - NCSU	Seniors	13
Presentation at the APNEP State of the Sounds Symposium on the 2011 APNEP ecosystem assessment	11/17/11	Lindsay Dubbs	Public and state and federal agencies	Presentation at the APNEP State of the Sounds Symposium on the 2011 APNEP ecosystem assessment
NC CLIMATE Fellows Teacher Retreat field trip on the Outer Banks where a presentation about wetlands and how they will be influenced by climate change was delivered	3/24/12	Lindsay Dubbs	NC high school science teachers	NC CLIMATE Fellows Teacher Retreat field trip on the Outer Banks where a presentation about wetlands and how they will be influenced by climate change was delivered
Prepared a soils lesson for the IDEA summer science institute where under represented middle school student from Elizabeth City, North Carolina and the surrounding counties that are interested in geosciences participated in a one-week summer institute	8/2/12	Lindsay Dubbs	NC middle school students	Prepared a soils lesson for the IDEA summer science institute where under represented middle school student from Elizabeth City, North Carolina and the surrounding counties that are interested in geosciences participated in a one-week summer institute

Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service provided
American Society of Civil Engineers	10/1/12 - 9/31/15	Billy L. Edge - NCSU	Board of Direction - Technical Region Director, Committee on Technical Activities, Vice-chair Coastal Engineering Research Council, Coastal Structures Committee, Task Committee on Flood Safety Protection

			and Policy Radar Committee
MACOORA	7/10 - now	Mike Muglia - CSI	
TC 114	5/11 - now	Billy L. Edge - NCSU	Develop standards for ocean energy devices
Various journals and agencies	ongoing	Billy L. Edge - NCSU and Lindsay Dubbs - UNC-CH	Reviewing of journal articles and proposals
1 st Annual Symposium on Renewable Ocean Energy for NC	May 2011	Billy L. Edge – NCSU Nancy M. White – ECU and many other CSI	Two day Symposium with international participation
2 nd Annual Symposium on Renewable Ocean Energy for NC	June 2012	Billy L. Edge – NCSU Nancy M. White – ECU and many other CSI	Two day Symposium with researchers and international participation
GPUSPH Developers workshop for better numerical tools for designing ocean energy devices	June 2012	Billy L. Edge – NCSU Kevin Gamiel – RENCI Robert A. Dalrymple – Johns Hopkins University	5 day workshop for defining problem statements and coding
International Journal of Ocean Engineering	2008 – continuing	Billy L. Edge – NCSU	Associate Editor
Academy of Coastal, Ocean, Port and Navigation Engineers	2008 – 2012	Billy L. Edge – NCSU	President and Past President of the Academy
NC Coastal Federation	11/11-present	Lindsay Dubbs-UNC-CH and CSI	Serve on the northeast advisory committee
Climate Literacy and Energy Awareness Network	9/12-present	Lindsay Dubbs-UNC-CH and CSI	Reviewer of climate literacy lessons

Outputs and Impacts

Publications

- Drake Oaks, Billy Edge, and Patrick Lynett, “Evaluation of the Structure of Levee Transitions on Wave Runup and Overtopping by Physical Modeling” accepted for publication, J. Waterways, Ports, Oceans and Coastal Engr., ASCE, Feb. 2011.
- Park, Young H. and Billy L. Edge, “An Empirical Model to Estimate the Impact of Overwash,” Journal of Coastal Research, Vol. 26, No. 6, 2011.
- Irish, J. L., A.E. Frey, J.D. Rosati, F. Olivera, J.M. Kaihatu and B.L. Edge, “Potential implications of global warming and barrier island degradation on future hurricane inundation, structural damages, and population impacted,” Journal of Ocean and Coastal Management, Online publication complete: 9-SEP-2010, DOI information: 10.1016/j.ocecoaman.2010.08.001
- Frey*, A. E., Olivera, F., Irish, J. L., Dunkin*, L. M., Kaihatu, J. M., Ferreira*, C. M., and Edge, B.L., “The impact of climate change on hurricane flooding inundation, population affected, and property damages,” J. Am. Water Resources, Vol. 46(5), 1049-1059, 2010.
- Park, Young H. and Billy L. Edge, “Characteristics of Beach Erosion along the Northeast Texas Coast,” Journal of Coastal Research, Vol 27, No. 3, 2011.
- M.E. Mousavi, J.L. Irish, A.E. Frey, F. Olivera, and B.L. Edge, “Global warming and hurricanes: The potential impact of hurricane intensification and sea level rise on coastal flooding,” Climate Change, 10.1007/s10584-009-9790-0 (online in 2010).
- Dean, Robert G., Julie Dean Rosati, Todd L. Walton and Billy Edge, “Erosional Equivalences of Levees: Steady and Intermittent Wave Overtopping,” Special Katrina Issue of International Journal of Ocean Engineering, Vol. 37, No. 1, Jan 2010, Pages 104-113 .
- Yeh, Po-Hung, Kuang-An Chang, John Henriksen, Billy Edge, Peter Chang, Andrew Silver, Abel Vargas, “Large Scale Laboratory Experiment on Erosion of Sand Beds by Moving Circular Vertical Jets,” International Journal of Ocean Engineering, Volume 36, Issues 3-4, March 2009, Pages 248-255.
- Pandoe, Wahyu and Billy L. Edge, “Cohesive Sediment Transport Model for Matagorda Bay, Texas, with Coupled ADCIRC 2D-Transport and SWAN Wave Models,” Journal of Hydraulics, ASCE, 134, pp 303-314, March 2008.

Non-refereed publications

- Van Ledden, M., J. Lansen, H. De Ridder, B. Edge, Reconnaissance level study Mississippi storm surge barrier, Proceedings of the International Conference on Coastal Engineering, (33), Santander, 2012.

- Edge, B.L., Overton, M. F., , R. A. Dalrymple, A. Hérault, G. Bilotta, M. Onur Kurum, Application of GPU smooth particle hydrodynamics: wave run-up and overtopping on composite slopes, Proceedings of the International Conference on Coastal Engineering, (33), Santander, 2012.
- M.O. Kurum, H. Mitasova, B. L. Edge, and M.F. Overton. Effects of coastal landform changes on storm surge along the Hatteras island breach area. Proceedings of the International Conference on Coastal Engineering, (32), 2010.
- Billy L Edge, Lesley Ewing, Robert G Dean, James M Kaihatu, Margery F Overton, Spencer M Rogers, Paul A Work, Immediate Impacts of Hurricane Ike on the Texas Coast, Proceedings of the International Conference on Coastal Engineering, (32), 2010.
- Edge, B.L. and P.J. Lynett, “Mitigation for Storm Surge and Tsunami Impacts in the United States,” Proceedings of the 6th International Workshop on Coastal Disaster Prevention,” Bangkok, 2009.
- Edge, B.L., R. McPherson and O. Cruz-Castro, “Experimental Study of Wave Forces on Bridge Decks,” Proceedings 31st International Conference on Coastal Engineering, Hamburg, World Scientific, 2008.
- Magoon, O.T., D.D. Treadwell, B.L. Edge, “Lost Jetty of California’s Russian River,” Proceedings 31st International Conference on Coastal Engineering, Hamburg, World Scientific, 2008.
- Irish, J.L., A. Frey, M.E. Mousavi, F. Olivera, B.L. Edge, J. Kaihatu, “Predicting the Influence of Climate Change on Hurricane Flooding,” Proceedings 31st International Conference on Coastal Engineering, Hamburg, World Scientific, 2008.
- Cruz-Castro, O., B.L. Edge, and L. Romijnnders, “Active Absorption of Waves in a 3D Basin “, Proceedings of Deepwater Offshore technology Symposium, Shanghai, China, Nov. 2008.

Technical Outputs

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

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

Commercialization and Technology Transfer

Dr. Jonathan Bird, a UNCC researcher working on the Ocean Energy Program has prepared and submitted two patents:

- Bird J., Flux Focusing Magnetic Gear, Application number 61/542,335, Filing date 10/03/2011.
- Bird J., A Continuously Variable Magnetic Gear, Application number unknown.

Awards and Honors

Award or Honor	Date	Name	Brief Description
Distinguished Member of ASCE	10/09	Billy L. Edge - NCSU	Highest level of distinction awarded to less than 5 % of 140,000 civil engineering

3. PUBLIC POLICY AND COASTAL SUSTAINABILITY (PP+CS)

The PP+CS program formally began when Andy Keeler became program head in the fall of 2010. The program’s genesis was the result of UNC CSI leadership’s recognition that its other programs would synergistically benefit from multidisciplinary collaboration with public policy and social science scholars and practitioners.

The mission of the UNC CSI PP+CS Program is to produce, disseminate, explain, and improve the information that affects public policy decisions. The Program accomplishes this through original and applied research and through outreach and teaching in the state’s colleges and the community at large. The Program works closely with other UNC CSI programs and with our partners in the NC research community to carry out this mission. We also work with our advisory board and civic organizations to make sure that sure that we learn from the community and make our research accessible.

The lives of NC’s coastal residents, and the natural and man-made systems on which they depend, are fundamentally affected by public policies. Basic decisions about zoning, water use, and waste disposal are made and implemented by municipal and county governments. Regional bodies do watershed and economic development planning. Public policy decisions made at the state and federal levels have always been important for coastal residents, but the scale and diversity of regulations, legal decisions, and

administrative processes has become much greater in recent years. Decisions about natural resource management, transportation infrastructure, land and water use, and energy resources all have strong federal and state components.

The PP+CS Program bridges short-term, medium-term, and long-term public policy questions through the unifying theme of adaptation. The ability to adapt to changing circumstances – whether brought about by changes in economic conditions, technology, the natural resource base, external policies, or climatic conditions – requires an understanding of the effects of public policies and the ability to help shape responses to changing conditions. Our mission is to be a constructive part of that process by:

- Producing usable research within and across disciplines;
- Better use of and accessibility of research results;
- Fostering participatory decision-making in the context of research – decision-support tools and public policy processes;
- Acting as an honest broker in helping decision-makers and the public evaluate competing claims in science and policy.

All of PP+CS's work is meant to inform on how public policy contributes to successful adaptation to changing circumstances. While change comes from a variety of sources, the Program has a particular interest in the effects of climate change. Below we outline three specific areas for initial concentration; all are likely to be strongly influenced by climate change in the future.

Shoreline protection

PP+CS, in collaboration with faculty at UNC-W, ECU, UNC-CH, and Duke, is building the capability to model the interaction of individual information sets and attitudes, the economics and local policies governing shoreline engineering and land use, and state and national policies affecting insurance and flood ratings. This effort is designed to be able to examine how policies interact with different patterns of risk drivers (erosion, storms, SLR, etc.) in the medium and long run.

A collaboration with Dylan McNamara of the UNC-W Physics Department is developing an integrated coastal processes and real estate markets model. Results from this model will be featured in an invited address (by Prof. McNamara) to the American Geophysical Union Conference in San Francisco in December as well as a seminar at UNC IMS in October, and we expect to present this at other academic outlets in the coming year as well. The first scientific paper from this work is currently in review.

This work complements work on hedonic modeling Dare County real estate markets led by Craig Landry of the ECU Economics Department. We anticipate that either late this academic year or in the following year, it will be possible to begin coupling the explicitly realistic model with the coastal processes model. Once this is done, we will begin producing results that will be of interest to coastal policy makers and the broader community.

This work highlights the importance of attitudes and beliefs about climate-driven risks to real estate and how they affect the value of coastal property over time. To continue this work, Keeler, McNamara, and Landry are teaming with Laura Moore of UNC-CH, Sathya Gopalakrishna of the Ohio State University, and Brad Murray and Marty Smith of Duke to submit a proposal to the National Science Foundation. As soon as funding is secured, that work will:

- Develop evidence-based scenarios on current attitudes and beliefs about climate- and weather-driven risk to characterize agents in the modeling;
- Assemble and integrate data to make the physical processes and real estate models relevant to specific coastal locations;
- Integrate policy options – insurance, land use regulation, etc. – into the model.

Ecosystem Service Provision:

A second priority area is to develop both estimates of the value of ecosystem services in critical eastern NC locations, and also to analyze policy approaches for aligning incentives with the values of those services. This area is undertaken in collaboration with UNC CSI's E2H2 Program. The Nature Conservancy, which has a substantial investment in oyster restoration in coastal NC, is also interested in collaborating in this work. We anticipate re-submitting a proposal (not funded on its first submission) to NSF and to look for other funding sources as well. We have been reviewing the existing literature on ecosystem services and policy, and we have produced a detailed blueprint of data gaps and research needs to be able to carry this work out for oyster sill establishment in NC's estuaries.

Biodiversity Protection:

A third priority is to begin the process of making UNC CSI an advocate for science and a facilitator of dialog and collaboration in future biodiversity management challenges. We produced a draft white paper on the lessons of the Off Road Vehicle regulation process for the Cape Hatteras National Seashore, and this paper has served as the basis of a proposal for foundation funding to move this work forward. At this point, the priority is to work with the UNC CSI Foundation to get interest from funders, and then use that interest to try to engage key individuals and organizations to ensure that our proposed approach meets community needs and has a reasonable chance of success.

Ocean Energy

PPCS has supported the UNC CSI ocean energy program in researching public policy options and impediments to testing- and commercial scale marine hydrokinetic devices, and has an ongoing program in cooperation with UNC CSI's E2H2 program on understanding and managing the environmental risks of coastal alternative energy development.

Adaptation in Coastal Areas

In addition to the work already discussed, I believe that a productive role for our program is to investigate and analyze the way that public policy choices driven by climate change might affect the options, incentives, and outcomes in coastal areas. There is substantial uncertainty about what climate effects will be at fine geographical scales, and there is also substantial skepticism or confusion among coastal populations and leaders about the basic science and effects of climate change. We feel that focusing on the way that state and federal policy development is likely to affect local circumstances is an effective way of engaging coastal areas in thinking about adaptation – and also one that carries less risk of seeming like outside interference.

Education and Curriculum

The PP+CS faculty member developed and teaches a course at ECU on coastal resource economics that serves PhD students in the interdisciplinary Coastal Resource Management (CRM) program as well as masters students and upper-level undergraduates in the Economics Department. ECU Economics has a Ph.D. program pending that is designed to have a significant emphasis on decision-making under risk for coastal hazards and resources, and the PP+CS program will be an integral part of that effort. One issue is that there is no provision to cover travel expenses between UNC CSI and Manteo for teaching (or other ECU activities); so far this has been covered out of start-up funds that will soon run out.

PP+CS has also assumed leadership of UNC-CH's Outer Banks Field Site (formerly called the Albemarle Ecological Field Site). The agreement between UNC CSI and UNC's Institute for Environment calls for the re-orientation of the semester-long undergraduate program to focus on a rigorous curriculum in the social and policy sciences applied to coastal issues. PP+CS faculty will teach an environmental economics and policy class in the program and this curriculum will serve as a template for PPCS participation in future multidisciplinary programs at CSI.

Outputs and Impacts

Publications

Grabowski, J. H., Brumbaugh, R. D., Conrad, R., Keeler, A. G., Opaluch, J., Charles Peterson, Michael Piehler, Sean Powers, Ashely Smyth, (2012). Economic Valuation of Ecosystem Services Provided by Oyster Reefs. *Bioscience* BioScience Vol. 62 No. 10, 900-909

Eckerd, A. & Keeler, A. G. (in press, 2012). Going Green Together? Brownfield Remediation and Environmental Justice. *Policy Sciences*.

German, L., & Keeler, A. G. (2010). Hybrid Institutions': Applications of Common Property Theory Beyond Discrete Property Regimes. *International Journal of the Commons*, 4 (1), 571-596.

Carter, T. & Keeler, A. G. (2008). Life Cycle Cost-Benefit Analysis of Extensive Vegetated Roof Systems. *Journal of Environmental Management*.

Keeler, A. G. (2012). Sea Level Rise, Government Policy, and Economic Efficiency. *The NC State Economist*.

Keeler, A. G. (2008). State Commission Electricity Regulation Under Federal Greenhouse Gas Cap-and-Trade Policy. *The Electricity Journal*.

4. MARITIME HERITAGE (MH)

Narrative

The academic program of the UNC CSI that addresses cultural resources in northeastern NC and the broader maritime world is within the field of maritime heritage. This area broadly includes maritime history, nautical archaeology, anthropology, and cultural resources management. Specifically, it includes historic shipwrecks that constitute the "Graveyard of the Atlantic" and eastern NC. Maritime heritage research at UNC CSI has been underway since the creation of the institute in 2003, with the MH Program employing its first dedicated personnel (Nathan Richards, as Interim Program Head, now Program Head) in January 2011.

Maritime Heritage is an umbrella term, which signifies the study of history and archaeology and the application of research for the enrichment of present-day people. UNC CSI maritime heritage scholars may engage in the study of physical resources such as archaeological remains (such as sites and artifacts) and archival materials, but may also research more ephemeral aspects of culture such as folklore or cultural landscapes. The MH Program seeks to engage with the tangible and intangible components exemplifying eastern NC's coastal communities for the purposes of preserving the remnants and memories of NC's maritime heritage and to also transform cultural assets into opportunities for tourism and economic development

The maritime historical and archaeological data of eastern NC holds considerable promise for a significant research agenda, which would include:

- Short-term, site-specific investigations focused on particular sites and subjects for their contributions to local and national history. Investigations may be undertaken on sites with a combination of archaeological, historical, technical, educational, recreational, or aesthetic significance. These studies contain the stories important to coastal communities;
- Medium-term, comparative and thematic studies designed to shed light on particularly significant historical events or periods in history, or on industries that have operated within north-eastern NC. These studies seek to enrich our understanding of place, and help us understand the problems faced by, or potentially faced by coastal communities; and,
- Long-term, theory-laden projects aimed at using the region to answer broad questions concerning the processes of archaeological site transformation, and the impact of environmental effects on historical, and archaeological resources (and vice versa). In particular, there is much potential to make examinations of site survivability issues that could have far-reaching impact on the management of cultural resources in NC, and potentially elsewhere. These projects illustrate the global importance of the region and illuminate how the study of the maritime heritage resources of eastern NC will have impact everywhere.

These topics in certain cases also stand to benefit and inform relative to their potential to cross-over into interdisciplinary collaborations with other programs of UNC CSI. Examples include potential impacts to coastal cultural resources due to erosion and accretion (CP), the policy implications of wreck access (PP+CS), the role of wrecks as ecosystems (E2H2), and the development of heritage tourism infrastructure underwater and along the coast (CSE).

Uniqueness, Competitiveness, and Importance of Program

North Carolina has other marine science centers, but only UNC CSI (though its partnership with the Program in Maritime Studies at ECU) has a component that focuses on the submerged cultural resources and maritime heritage that have contributed substantially to the history and development of the region, state, and nation. The location of UNC CSI on the Outer Banks allows for the coast to be open further to coastal historical and archaeological research to an unprecedented level. Furthermore, by existing in an inter-disciplinary research institute, the MH program at UNC CSI is uniquely placed to collaborate with experts from other fields who can bring their skills to bear on the problems of coastal change and how this influences the preservation and utilization of heritage resources along the NC coast.

Impacts of the Program

The impacts of the program are best exemplified via three project examples.

1. The Battle of the Atlantic Expeditions (2008-ongoing). Since 2008, the award-winning, NOAA-led Battle of the Atlantic Expeditions has had UNC CSI and ECU as core partners in documenting the unique resources of NC's submerged World War Two heritage. This has led to the generation of grant funds and the production documentaries enriching the lives of Outer Banks residents through local television (made possible via collaboration with UNC CSI's Education and Outreach Program). Multiple MA theses have also been produced, as have products (posters, dive slates, presentations) for the use of the local dive community (including area dive charters and shops).
2. "Shipwrecks of the Outer Banks" Field Schools. Since 2010, CSI and ECU, along with the support of NOAA's Monitor National Marine Sanctuary have held two field schools on the Outer Banks and have documented almost two dozen maritime archaeological sites (on land and underwater) between Corolla and Avon. These field schools have also seen significant involvement of local organizations such as the Town of Nags Head, the Chicamacomico Life Saving Station, and local businesses. Again, the collaboration between UNC CSI's Maritime Heritage and Education and Outreach Program has culminated in the packaging of this data for the use of the public in local television programming and products such as posters and presentations.
3. The Scuppernong River Maritime Resources Inventory Project. In the fall of 2011, a collaboration of UNC CSI, ECU, and the Pocosin Arts Folk School saw the merging of research and instructional goals. A 12-day project saw MA students from the MA in Maritime Studies at ECU conduct a remote sensing survey of the Scuppernong River and adjacent Bull Bay. In addition to on-water instruction, faculty, staff, and students hosted high school students from Columbia for 2 days of instruction regarding oceanographic survey methods and archaeological and historical research. The project concluded with a series of presentations (including an address at the Scuppernong River Festival) and a 1-day symposium attended by over 80 local people. Two posters have been produced (on display at the Columbia Library), and two publications are pending.

Future Directions

Future directions include:

1. A continuation of successful research and teaching initiatives such as the Battle of the Atlantic Expedition;
2. Pending collaborations with UNC-system organizations (such as ECU’s Center for Sustainable Tourism);
3. Pending collaborations with organizations within eastern NC. This includes entities within Currituck County (such as the Whale Head Preservation Trust) and Dare County (such as the Chicamacomico Life Saving Station, and the Town of Nags Head) as well as local people; and,
4. The expansion of community based maritime archaeological and historical training via the Nautical Archaeology Training scheme (an ECU-CSI collaboration).

Resources

All of the rooms below are used in addition to the single and double offices (120 and 230 sq. ft., respectively) housing MH personnel:

- Drafting/Mapping Room—Main Building (571 sq.ft.). A room at the core of the MH program. This area is used for processing of hand-drawn field data in the form of site plans and illustrations of archaeological sites. Also used for the storage/archiving of said products.
- GIS Lab—Main Building (337 sq.ft.). A shared space for the production of maps and charts and for geospatial analysis in support of Maritime Heritage projects.
- GIS & Remote Sensing Lab—Main Building (572 sq.ft.). A shared space used for the preparation of remote sensing projects and data processing, interpolation, and presentation.
- Mission Ready Room—Marine Services Building (374 sq.ft.). A shared space used in advance of field work. Used for last minute equipment staging and preparation.
- Data Analysis Lab—Marine Services Building (245 sq.ft.). A shared space used immediate following on-water field work on multi-day projects.

EQUIPMENT

- Archaeological survey equipment. General-purpose equipment that makes up the basic archaeological toolkit. Includes drafting equipment, tape measures, cadastral surveying instrumentation and hand-held Global Positioning Systems (GPS) (value \$15,000)
- Terrestrial gradiometer. Instrumentation used for the detection of ferrous material buried in sediment (value \$36,000)

Other spaces supporting the Maritime Heritage Program based at East Carolina University are included in the Activity Report of ECU’s Program in Maritime Studies.

Personnel

Name	Title and department/college	Role
Nathan Richards	Program Head, UNC CSI Associate Professor, ECU Program in Maritime Studies, Department of History	Leadership, Research, Teaching, Professional and Public Service

Provide current number and general description of undergraduate students, graduate students, and post-docs involved with the Activity. Do not list individual students or post-docs.

Currently advising 1 PhD Student (ECU Coastal Resources Management Program) and 9 MA students (MA in Maritime Studies). Additionally classes held in the area with ECU and CSI support involve up to a dozen graduate students per semester.

Research, Teaching, Public and Professional Service

Research

Project Title	PI/CoPIs - include Institution	Sponsor	Amount	Start Date	End Date
USS Huron: Determining seasonal rates of corrosion	Nathan Richards, Tom Horn	NC Seagrant	\$ 2,250.00	4/26/2012	5/1/2012

Ship Ashore! The role of risk in the development of the United States Lifesaving Service and Wrecking Patterns Along the NC Coast	Nathan Richards, Joshua Marano	NC Seagrant	\$ 3,000.00	4/14/2011	4/1/2011
The Value of Maritime Archaeological Heritage: Understanding the Cultural Capital of Shipwrecks in the Graveyard of the Atlantic	Calvin Mires, Nathan Richards	NC Seagrant	\$ 3,000.00	4/28/2010	4/2/2010
The Battle of the Atlantic: Resources Identification and Assessment Survey	Nathan Richards, Tom Allen	American Battlefield Protection Program (National Park Service)	\$139,400.00	1/31/2010	2/31/2012
At the Crossroads: Maritime Systems in Transition and the Elizabeth City Ships' Graveyard	Nathan Richards, Lindsay Smith	NC Seagrant	\$ 3,000.00	5/1/2009	12/1/2009
Wrecks and Wrecking in St. Georges Island, Bermuda: An Archaeology and History of Economic Opportunism	Nathan Richards	Waitt Institute for Discovery/National Geographic Society	\$ 11,327.00	5/30/2008	5/30/2009
Hard Times for Small Craft: A Study of the Wright's Creek Abandoned Vessel Complex	Nathan Richards, Jaqueline Marcotte	NC Seagrant	\$ 2,279.00	5/21/2008	5/21/2009
Proposal for Maritime Archaeology Survey: Suspected Remains of HMS Medway	Nathan Richards	W.E.C. Limited	\$ 27,888.00	2/29/2008	02/29/2009
Proposal for Maritime Archaeological Survey: Unidentified Iron Vessel, Bermuda Dockyard, Bermuda	Nathan Richards	Correia Construction Company	\$ 14,671.00	2/29/2008	02/29/2009
The Ferrous Shipbuilding Tradition: A Comparative Nautical Anatomy	Nathan Richards, Bradley Rodgers	Research Development Grant Program, ECU	\$ 39,986.13	1/1/2006	1/1/2007
Exploring Two Albemarle Sound River Systems	Larry Babits, Nathan Richards, Frank Cantelas, J.P. Walsh	NOAA Oceans Exploration	\$ 55,703.00	10/19/2005	10/19/2006

Teaching and Instruction for Degree Credit

Course Title, number, and level	Dates offered	Instructor and affiliation	Brief description of course (one sentence)	Enrollment Figures: Total/on-site/distance education
HIST 5530: Summer field school	Summer, 2010	Nathan Richards, CSI/ECU	4-week field school teaching underwater archaeological survey methods	12 MA students (Program in Maritime Studies, ECU) (on site)
HIST 6835: Advanced Methods for Maritime Archaeology	Fall, 2011	Nathan Richards, CSI/ECU	12-day field school teaching remote sensing methodologies.	8 MA students (Program in Maritime Studies, ECU) (on site)

HIST 6850: Field school in maritime archaeology	Fall, 2012	Nathan Richards, CSI/ECU; John McCord, CSI; David Sybert, CSI	4-week field school teaching underwater archaeological survey methods	8 MA students (Program in Maritime Studies, ECU) (on site)
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Non-Degree Credit Instruction

Workshop/Instruction Title	Dates Offered	Instructors and Affiliations	Brief description of course (one sentence)	Enrollment Figures: Total/on-site/distance education
Scuppernong River Heritage Symposium	11/29/2011	Nathan Richards, ECU & CSI; John McCord, CSI; David Sybert, CSI	A symposium relating to the history and maritime archaeology of the Scuppernong River	80 attendants (approximate)
UNC-Coastal Studies Institute: Maritime Heritage Program	1/6/2012	Nathan Richards, ECU & CSI	Session of 12 papers concerning work in Maritime Heritage undertaken jointly by ECU and CSI collaborators (SHA conference, 2012)	50 attendants (approximate)
The Scuppernong River Maritime Heritage Project: Interim Report (2011-2012)	5-Oct-11	Nathan Richards, ECU & CSI	Presentation at the Scuppernong River Festival (Columbia, NC)	50 attendants (approximate)

Public Service, Outreach and Community Engagement

Public Service/Outreach/Engagement program name and brief description (one sentence)	Dates	Personnel Involved	Participants (e.g. K-12 teachers)	Number of Participants
NAS Introduction Course (Inaugural day-long public program teaching maritime archaeology to the public)	5/21/2012	Nathan Richards, CSI and ECU	PhD Students	12
Shipwreck Recording Lecture and Practical (Hatteras High School)	5/24/2012	John McCord, CSI; David Sybert, CSI; Nathan Richards, CSI & ECU	High school students	10
Maritime Archaeology: The Scuppernong River & Bull Bay Project	27-Sep-11	Nathan Richards, CSI & ECU; John McCord, CSI; David Sybert, CSI;	High school students	100 (2 sessions)

Professional Service

Board or Group name	Dates	Activity member name and affiliation	Service Provided
Editorial Board: International Journal of Maritime Archaeology	2012-present	Nathan Richards, ECU & CSI	Editorial advice
Australian Research Council: Committee of Experts	2010-present	Nathan Richards, ECU & CSI	International Assessor (Grant review)
NOAA Ocean Exploration Grants	2007	Nathan Richards, ECU & CSI	Grant review

PAST Foundation	2005-present	Nathan Richards, ECU & CSI	Research Associate
Flinders University: Department of Archaeology	2008-present	Nathan Richards, ECU & CSI	Adjunct Research Fellow (thesis review)
American Academy of Underwater Sciences: Scholarship Committee	2004-2007	Nathan Richards, ECU & CSI	Scholarship application review
Australian Institute for Maritime Archaeology: Scholarship Committee	2011-present	Nathan Richards, ECU & CSI	Scholarship application review
Australian Institute for Maritime Archaeology: Editorial Board	2003-present	Nathan Richards, ECU & CSI	Editorial advice/article review
Society for Historical Archaeology: Historical Archaeology (Journal)	2007-2012	Nathan Richards, ECU & CSI	Associate Editor
Various other journals	2002-present	Nathan Richards, ECU & CSI	Reviewer for articles in journals such as "Australian Archaeology," "Historical Archaeology," "The Great Circle," "International Journal of Historical Archaeology," "Marine Technology Journal," and "Conservation and Management of Archaeological Sites"

Outputs and Impacts

Publications

Richards, Nathan T. (2011) Ship Abandonment, in Catsambis, Alex, Ben Ford and Donny Hamilton (eds.), Oxford Handbook of Maritime Archaeology, Oxford University Press, United Kingdom, pps. 856-878.

Richards, Nathan T. (2008) Ships Graveyards: Abandoned Watercraft and the Archaeological Formation Process. University Press of Florida Gainesville.

Richards, Nathan T., Brian Diveley, Michelle Liss, and Sami Seeb. (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.

List non-refereed publications

Richards, Nathan T. (2012) UNC-Coastal Studies Institute: Maritime Heritage Program, 6 January, Society for Historical Archaeology Conference, Baltimore MD.

Richards, Nathan T. (2011) The Scuppernong River Maritime Heritage Project (2011-2012), 29 November Scuppernong River Heritage Symposium, Columbia, NC.

Bright, John, Nathan T. Richards, Tom Allen, Joseph C. Hoyt, and John Wagner (2012) The Battle of the Atlantic Expedition 2011: The Battle of Convoy KS-520 (NC, 15 July 1942). Report to the American Battlefield Protection Program, Washington DC.

Richards, Nathan T., and Joseph C. Hoyt. (2009) Dockyard 'workhorse': Unidentified wreck is most likely a steam lighter, in Maritimes: Magazine of the Bermuda Maritime Museum. Volume 21(3): 18-19 (With Joseph C. Hoyt).

Richards, Nathan T., Calvin Mires, Joseph C. Hoyt and Peter Campbell. (2009) A gunboat rediscovered, in Maritimes: Magazine of the Bermuda Maritime Museum. Volume 21(3): 11-13.

Rodgers, Bradley A., Nathan Richards and Theresa Hicks. (2009) Skeletons in Black Bay: Wrecks bridge the gap between iron- and steel-hulled sailing ships, in *Maritimes: Magazine of the Bermuda Maritime Museum*. Volume 21(3): 14-16.

Awards and Honors

Award or Honor	Date	Name	Brief Description
Partners in Conservation Award	2009	Tane Casserley, Joseph Hoyt, Nathan Richards, John McCord (and others)	Awarded by the US Department of the Interior for best Conservation Collaboration in NC for 2008 (Awarded to CSI, NOAA MNMS, ECU, NPS, MMS, NC DCR)

5. COASTAL PROCESSES (CP)

The overarching goal of the CP Program is to understand and predict the behavior of coastal systems through interdisciplinary research, in order to advance science, address public concerns, and support coastal management. Efforts will be focused on four primary fronts: 1) conducting collaborative research on the form, function and evolution of the coast; 2) facilitating interdisciplinary coastal processes research in northeastern NC; 3) developing undergraduate and graduate curriculum; and 4) serving as an advisory and outreach resource for managers and citizens of the State. Note these foci are well-aligned with the UNC CSI mission, addressing all emphasis objectives.

More specifically, the CP Program is presently focused on a few, key research endeavors and related education and outreach efforts. For example, there is much attention in the State and around the world on storm impacts and sea-level rise; CP efforts are largely concentrated on understanding these and related concerns. Furthermore, it is important that objective, relevant research informs policy and management decisions, so collaborations and interactions with NC managers are being fostered and expanded. Over the next few years, we will pursue more complex, interdisciplinary projects in collaboration with other UNC CSI programs.

While research and engagement in northeastern NC can and will be emphasized, ultimately, the CP Program aims to understand coastal processes fundamentally, and therefore, national and international projects and interactions are also required. CP scientists are already well connected to personnel from entities across the State, including but not limited to the Army Corps of Engineers, NC State University, UNC - Chapel Hill, Western Carolina University, UNC Wilmington, Albemarle-Pamlico National Estuarine Program, and the Division of Coastal Management. Additionally, CP research is ongoing along the Southeast U.S., in the Gulf of Mexico, and offshore New Zealand, Papua New Guinea and Antarctica, involving many national and international scientists. But, collaborations and projects both locally and globally will need to be enhanced and expanded for CP Program growth and success. Our plan to develop an active research, outreach, and educational program on coastal processes can capitalize on UNC CSI's ideal access to the coast. The Outer Banks and the Albemarle-Pamlico estuarine system are extremely dynamic and under significant natural and anthropogenic stress, and therefore, require immediate and focused scientific attention. Development continues to change the coupled human-natural system, and there is obvious potential for major storms to dramatically perturb the landscape, its functional balance, and the dependent community. A major challenge and opportunity is to educate and engage coastal stakeholders with differing viewpoints in the work about this unique system. It is our goal to examine the coast in an unbiased fashion and provide valuable data and scientific insights for all to consider.

Background and CP Program Activity since 2012

A program focused on coastal processes with activity in the northeast has existed in some form since before UNC CSI's inception. Dr. Stan Riggs and colleagues have a long and distinguished history and body of work relevant to the NC Coast. UNC CSI supported Walsh and Corbett's work through the Field Operations activity of UNC CSI for many years. However, with a commitment from ECU, in January 2012, the Coastal Processes Program was formally introduced and Drs. Reide Corbett and J.P. Walsh began as Interim Co-Program Heads to more rapidly grow the program and build State-wide connections for research and other activities. Corbett and Walsh are both faculty from the Department of Geological Sciences and the Institute for Coastal Science and Policy at ECU. Their history of work in the northeast makes this team not only familiar with the complex history and dynamics of much of the NC coast, but also are well-acquainted with most of the researchers involved in studying this region.

Since starting in January, they have had three new research projects focused on coastal dynamics funded and have several other proposals pending. Papers on various process aspects are in preparation or in various stages of review, and several graduate students are actively engaged in related CP efforts. During the 2012 summer, much effort was made to develop undergraduate coursework to hopefully begin at UNC CSI next summer. However, the most immediate issue facing the CP and other programs is the opening of the new campus and the set-up of the laboratories. The purchasing of equipment, creation of policies and communication to colleagues and interested persons around the State makes for an incredible opportunity and an exciting time for all UNC CSI personnel as we prepare the new campus to serve as an archetypal research and education resource for the State.

Prior to 2012, CP was merged with the Coastal Engineering and Ocean Energy (SCE+OE), and efforts by Michael Muglia were largely oriented towards coastal ocean observing in collaboration with Dr. Harvey Seim (UNC Chapel Hill) and the U.S. Army Corps of Engineers Field Research Facility. Today, ocean and estuarine observing remain an important part of the CP Program, and as a result there is strong connection to the SCE+OE Program. Similarly, our other research (e.g., hazards, shoreline and sediment dynamics) connects us strongly to the work in the other UNC CSI programs. Consequently, the CP Program is well-integrated across UNC CSI and the State.

Scientific Impact

An example of the relevant research undertaken by this program and how we are working for the benefit of our State can easily be seen in our ongoing partnership with the NC Division of Coastal Management. As part of a nearly 6-year program, Corbett and Walsh, along with several students, created a digital shoreline for the nearly 12,000 miles of NC's estuarine and Atlantic coast. This critical data set was possible only through partnerships between ECU, NC DCM, NOAA, RENCi, and now UNC CSI. The new digital shore measurements provide a baseline for future change along the coast of NC, including shoreline erosion, vegetation change, and coastal development. Analysis of the NC shoreline is continuing, and this research has stimulated other research funded by NOAA, APNEP and the SALCC, much of which is in collaboration with scientists and managers in the Southeast (FL, GA, and SC).

Future

In the UNC CSI Strategic Plan, there is much detail about the variety of research, teaching and service initiatives planned in the CP Program. A brief synopsis is provided here to illustrate how CP plans to grow. Our research will be contract and grant driven, and proposals will focus on coastal hazard issues (e.g., shoreline change, sea-level rise), sediment dynamics, recent geologic history, and coastal observing and monitoring. Research on deltaic and groundwater processes will remain an area of research strength and emphasis, and graduate student research at UNC CSI will be an important component of the CP Program. Academically, we hope to grow field-oriented courses at the graduate and undergraduate levels. Initially, summer courses will be developed, but we feel fall and spring courses are important to enable faculty to largely remain at UNC CSI (and not commute multiple days per week). To this end, we hope we can find an effective means of having students from across the UNC System and beyond take classes from/at UNC CSI over the calendar year. Additionally, we plan to offer field/lab modules for visiting undergraduate/graduate classes from UNC System schools as well as initiate the Coastal Field Trip Weekend Extravaganza, an event to bring coastal research-oriented faculty and students from across the System to UNC CSI and the Outer Banks area for collaboration and camaraderie. Finally, we will engage managers and the public by hosting seminars, short courses, and an educational website.

Resources

All of the rooms below are used in addition to the single and double offices (120 and 230 sq. ft., respectively) housing CP personnel:

- Radioisotope and Geochemical Lab (388 sq.ft.) A lab space used for wet chemistry and other chemical activities and analyses.
- Coastal Ocean Operations Lab (514 sq.ft.) A lab space for water filtering, instrument calibration, computer mathematical analyses and modeling and cold sample storage.
- Sediment Examination Lab (514 sq.ft.) A lab space for core processing, analysis of sediment properties and microscope work.
- Electronics and Data Processing Room (291 sq.ft.) A room for equipment set-up and testing and data processing and analyses.
- GIS Lab—Main Building (337 sq.ft.). A shared space for the production of maps and charts and for geospatial analysis in support of CP projects.
- GIS & Remote Sensing Lab—Main Building (572 sq.ft.). A shared space used for the preparation of remote sensing projects and data processing, interpolation, and presentation.
- Mission Ready Room—Marine Services Building (374 sq.ft.). A shared space used in advance of field work. Used for last minute equipment staging and preparation.
- Data Analysis Lab—Marine Services Building (245 sq.ft.). A shared space used immediate following on-water field work on multi-day projects.

EQUIPMENT

CSI

- Precision Balance (0.1 mg)
- Balance (10 mg)
- Ro-Tap and sieve kit (2)
- Drying Oven (2)

Chest Freezer - large 25 ft³
 Acces. for Alpha Octet
 DSA-1000 and software
 Centrifuge - rotor x 2
 Muffle Furnace
 Hot plates (2)
 Sedigraph
 Light microscope (2)
 Large lab refrig
 COST \$116,000 (CSI Building Funds)

Precision Balance (0.1 mg)
 Balance (10 mg)
 Ro-Tap and sieve kit
 Glassware - misc.
 Vacuum pump for Alpha Octet
 Hot plates (2)
 Stir Plate (2)
 Filtering manifold and pump
 Pipette analysis - 12 sets (5)
 COST \$22,600 (ECU ICSP Funds)

ECU

Gamma Detectors (5)
 Alpha Counter (2)
 Beta Counter
 Liquid Scintillation Counter
 RaDeCC (2)
 RAD7
 Grain-size analyzer (Sedigraph)
 Xray
 Digital Xray panel
 Microwave digestion system
 ICP-OES
 UV Spectrophotometer
 Ion Chromatograph
 Water Purifier
 Balances (1 precision, 2 others)
 Stir Plates (4)
 Hot Plates (4)
 Glassware, misc. supplies
 Freeze dryer
 High-end Computers (5)
 Balloon Aerial Photo System
 Pumps (submersible, peristaltic, etc.)
 Laptops (~8, rugged/regular)

Gust Erosion Chamber
 Vectors (4)
 PC-Aquadopps (2)
 Aquadopps (3)
 AWAC
 OBSs (5)
 WQM
 FLNTU
 Water quality sensors (5)
 Reson 8101 Multibeam
 TSS MAHRS Motion Ref Unit

COST \$1,263,800 (Start-up, NSF MRI, NSF NZ, Other)

Personnel.

Name	Title and department/college	Role
D. Reide Corbett	Professor/Geological Sciences & Institute for Coastal Sciences and Policy, ECU	Co-Program Head - Coastal Processes
Michael Muglia	Research Associate/PhD Student/UNC CH	Field Operations/Ocean Observing
J.P. Walsh	Associate Professor/Geological Sciences & Institute for Coastal Sciences and Policy, ECU	Co-Program Head - Coastal Processes

Provide current number and general description of undergraduate students, graduate students, and post-docs involved with the Activity. Do not list individual students or post-docs.

3 undergraduates, 4 graduate students, 1 post doc

Research, Teaching, Public and Professional Service

Table D1. Research

Project title	PI/CoPIs – include institution	Sponsor	Amount	Dates
Collaborative Research: Submarine Groundwater and Freshwater Inputs Along the Western Antarctic Peninsula	David Corbett	National Science Foundation	\$ 344,037	8/2012 – 7/2015
Vulnerability Assessment for Coastal Counties and Developed Islands	David Corbett, J.P. Walsh	Skidaway Institute of Oceanography	\$ 73,479	8/2011-7/2013
Advanced Regional and Decadal Predictions of Coastal Inundation for the U.S. Atlantic and Gulf Coasts	David Corbett	University of Pennsylvania	\$ 30,370	9/2011-7/2013
Initiating a New Collaboration between East Carolina University and Universiti Malaysia Terengganu: Post-Glacial Variations in the East Asian Monsoon	Stephen Culver; David Corbett; Walter Curtis; Eduardo Leorri Soriano; David Mallinson; Siddhartha Mitra; John Walsh; Melody Bentz; Cindy Evans; Dare Merritt	National Science Foundation	\$ 49,974	1/2012 – 6/2013
RAPID: Collaborative	John Walsh; David	National Science	\$ 58,498	7/2011 –

Research: Signature of the 2011 Flooding on the Mississippi Subaqueous Delta	Corbett; Siddhartha Mitra; Melody Bentz; Cynthia Harper	Foundation		6/2013
A Collaborative Proposal: Formation and Preservation of Fluvial and Marine Depositional Events, Waipaoa River Margin, New Zealand	John Walsh; D. Corbett	National Science Foundation	\$ 384,874	8/12009 – 7/2013
Restoring access to diadromous fish habitat and linkages to forage-fish biomass in the North Atlantic Large Marine Ecosystem	R. Rulifson; J.P. Walsh	NOAA	\$40,030	10/2012 – 9/2014
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	Southeast Atlantic Landscape Conservation Cooperative	\$271,861	10/2012 – 9/2014
Regional Engagement Center for Coastal Systems Informatics and Modeling (C-SIM)	T. Allen, J.P. Walsh, D. Corbett and others	RENCI, State of NC	\$ 200,000	7/2011 – 6/2013

Non-Degree Credit Instruction

Workshop/Instruction title	Dates offered	Instructor(s) and Affiliation(s)	Brief description of instruction (1 sentence)	Enrollment Figures Total/on-site/distance edu
Sea Level Rise Science and Planning Needs in NC	5/22/2012	Corbett - CSI/ECU	Identify sea level rise adaptation information needs of key end-users	38/38/0

Public Service, Outreach and Community Engagement

Middle School Career Day	N/A	Corbett	Middle School Students	80
NCSU international PhD coastal field trip - Geological Background and Coastal Hazards of the Outer Banks		Corbett, Walsh	PhD Students	25
UNC CH/ECSU IDEA Summer Science Institute program – field-based presentation/programming; Geological Background and Coastal Hazards of the Outer Banks		Corbett, Walsh	High school students	20
Blue Heron Bowl - A "Jeopardy-like" competition for high school students focused on Oceanography.		Corbett, Walsh	High school students	100

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	Corbett, ECU	Scientific expertise
Chair, Albemarle-Pamlico National Estuary Program – Science & Technical Advisory Council	2012-present	Corbett, ECU	Scientific expertise, organize/lead quarterly meetings
Div of Marine Fisheries, Strategic Habitat Area Advisory Committee – Region 2	2011	Corbett, ECU	Scientific expertise related to Pamlico Sound, Neuse River and Pamlico River Estuaries
NC CRC, Hazard Committee - Sea Level Rise	2010	Corbett, ECU	Member of committee asked to provide most up-to-date scientific information on sea level rise in NC
Duke University of NC Oceanographic Consortium	2001-present	Corbett, Walsh, ECU	Advisory group for R/V Cape Hatteras
Various journals and agencies	Ongoing	Walsh, Corbett, ECU	Reviewing of journal articles and proposals

Outputs and Impacts

Publications

Authors in bold are students and post-docs advised by Corbett/Walsh (only includes those publications published in 2012 or pubs that had some involvement with CSI staff prior to 2012)

- Eulie, D. J.P. Walsh, D.R. Corbett, 2012. High-Resolution Measurements of Shoreline Change and Application of Balloon-Aerial Photography, Albemarle-Pamlico Estuarine System, NC, USA. *Limnology and Oceanography: Methods*. In Press.
- Parra, J. G., Marsaglia, K. M., Rivera, K., Dawson, S., & Walsh, J. P. In press. "Provenance of sand on the Poverty Bay shelf, the link between source and sink sectors of the Waipaoa River sedimentary system," Revised and resubmitted to *Sedimentology*.
- Culver, S.J., R.L. Camp, J.P. Walsh, B.W. Hayward, D.R. Corbett, C.R. Alexander. Distribution of Foraminifera of the Poverty Continental Margin, New Zealand: Implications for Sediment Transport. *Journal of Foraminiferal Research*. In Press.
- Culver, S.J., Mallinson, D.J., Corbett, D.R., Rouf, A.A., Noor, A.M.S., Yaacob, R., Whittaker, J.E., Parham, P.R. 2012. Distribution of foraminifera in the Setiu Estuary and Lagoon, Malaysia. *Journal of Foraminiferal Research*. 42 (2) 109-133.
- McGann, M., E.E. Grossman, R.K. Takesue, D. Penttila, J.P. Walsh, and R. Corbett, 2012. Arrival and Expansion of the Invasive Foraminifera *Trochammina hadai* Uchio in Padilla Bay, Washington. *Northwest Science*. 86(1) 9-26.
- Mohan, J.A., R.A. Rulifson, D.R. Corbett, 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.
- Cowart, L., Walsh, J. P., & Corbett, D. R. (2011). Analyzing Estuarine Shoreline Change: A Case Study of Cedar Island, NC. *Journal of Coastal Research*, 6 (5), 817-830.
- Grand Pre, C., S.J. Culver, D.J. Mallinson, K.M. Farrell, D.R. Corbett, B.P. Horton, C. Hillier, S.R. Riggs, S.W. Snyder and M.A. Buzas, 2011. Rapid Holocene Coastal Change Revealed by High Resolution Micropaleontological Analysis, Pamlico Sound, NC, USA. *Quaternary Research*. 76, 319-334.
- Kemp, A.C. B.P. Horton, S.J. Culver, D. R. Corbett, O. van de Plassche, W. R. Gehrels and B.C. Douglas, 2009. The timing and magnitude of recent accelerated sea-level rise (NC, USA). *Geology*. 37, 1035-1038.
- 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, NC, in Kelley, J.T., Pilkey, O.H., and Cooper, J.A.G., eds., *America's Most Vulnerable Coastal Communities: Geological Society of America Special Paper 460*, p. 43–71, doi: 10.1130/2009.2460(04).
- Smith C.G., Culver, S.J., Mallinson, D.J., Riggs, S.R. and Corbett, D.R., 2009. Recognizing former flood-tide deltas in the Holocene stratigraphic record, Outer Banks, NC, USA. *Stratigraphy*. 6 (1) 67-78.
- Kemp, A.C., B.P. Horton, D.R. Corbett, S.J. Culver, R.J. Edwards, O. van de Plassche, 2009. The relative utility of foraminifera and diatoms for reconstructing late Holocene sea-level change in NC, USA. *Quaternary Research*, 71, 9-21, doi: 10.1016/j.yqres.2008.08.007.

List non-refereed publications

(only includes those since 2012 or pubs that had some involvement with CSI staff prior to 2012)

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, NC. In *The Effects of Noise on Aquatic Life*, eds. A. N. Popper & A. D. Hawkins, 169-171. New York: Springer.

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, NC. White Paper published by East Carolina University, 10 p.

Riggs, S.R., Culver, S.J., Ames, D.V., Mallinson, D.J., Corbett, D.R., and Walsh, J.P. 2008. NC's Coasts in Crisis: A Vision for the Future. White Paper published by East Carolina University, 26 p.

Culver et al. 2008. Global Warming and Coastal NC. White Paper presented to Sen. Marc Basnight by East Carolina University, 32 p.

Technical Outputs

NCCOHAZ – Walsh, Corbett, Allen, Crawford/ ECU The North Carolina Coastal Hazards Decision Portal is a web site that communicates coastal hazards research to the public . <http://www.coastal.geology.ecu.edu/NCCOHAZ>

NCDCM – Digital Shoreline – Walsh, Corbett/ECU A GIS dataset/map of the entire NC shoreline (>10,000 miles) that was created as part of a collaboration with the NC Division of Coastal Management.

D. OTHER ACTIVITY

UNC CSI, GOING FORWARD:

This narrative is a compilation of efforts by everyone at UNC Coastal Studies Institute. Some have been working at UNC CSI for many years. Some have just started. All of them can be credited with being pioneers and founding members of UNC CSI. All have contributed mightily to the intellectual, organizational, and physical development of the Institute.

All of us believe in the strength, intellectual merit, and dynamism of multi-disciplinary, inter-institutional work, and to that end, this spring and summer, with all program leaders in place and the advent of the new campus in sight, the team undertook the development of the next five year strategic plan. It states “UNC CSI, in partnership with our constituents--academic and coastal communities -- will work in the following strategic directions, which are consistent with UNC Our Time, Our Future and approved by the Board of Directors, September 2012.”

- 1) Link northeast NC, its cultural and environmental assets, with the research community, regionally to internationally.

Through research and education, we will:

- Advance awareness of the internationally significant rich maritime heritage of the Outer Banks through research and education.
- Position NC to access and market renewable ocean energy potential. Link new technological development to educational programming in the university, community colleges and private sector economic development opportunities.
- Enhance NC communities' knowledge about environmental stewardship; sustainable adaptation strategies; environmental, economic, and sociological risks associated with climate and sea level change; and facilitate relevant community-oriented, scientific, place-based decision-making.

- 2) Engage northeastern NC communities in university educational opportunities.

- Strengthen public education content with research grade information and well –constructed curriculum.
- Improve learning effectiveness with experiential, hands - on programming.
- Utilize cutting edge technologies to enhance opportunities for learning and research.
- Collaborate with our academic, federal, state, and community partners to integrate and enhance educational opportunities utilizing their/ our collective expertise.
- Develop course curriculum utilizing regional and UNC CSI assets.

- 3) Continue to endeavor to create an administrative operating environment which enables efficiency, team work, opportunities for interdisciplinary, collaborative, responsive, cutting edge, place - based, research and education on issues of importance to coastal communities, regionally and world-wide.

- Develop policies for space management, faculty and staff appointments, research management, and curriculum coordination to enable nimble response and management of resources to support strategic directions.
- Develop budget, staffing and administrative operational procedures to support an open integrative, synthetic, coordinated research, curricular, and educational environment.

There are significant strengths to the inter-institutional organizational construct. It enables the development of intellectual synergies, implementation efficiencies, and programmatic effectiveness. Conversely, there are also notable challenges to accomplishing our mission and fulfilling the strategic plan.

The multi-institutional construct is powerful knowledge and concept generator. Routine, incidental or organized interactions between public educators, economists, engineers, ecologists, and archeologists generate knowledge that cannot be anticipated nor manipulated except through constant exposure and access. The evolution of intellectual capital, both formal and informal, draws on the resources of the community seamlessly—allowing all to have the same opportunity to grow, learn, stretch—without having to make the sometimes-awkward effort to find that conversation, opinion, or knowledge—it is easily available—organic.

Organizationally, the opportunities for coordinating curriculum and moving student across/ between campuses, for quickly forming teams and responding to research and community needs, or for being able to support anyone in the UNC system without a mountain of paperwork is the ideal, but in reality, does not exist. We need practical business operations and uniform agreements to support these consistently needed services.

This will require consistencies in management (regardless of lead institution) to support positions, equipment, operations, and the elimination of unnecessary and duplicative parallel processes implemented by each campus partner. We need an unglamorous effort of defining the business operations and processes that will allow coordination / collaboration with multiple campuses and ensure a perspective that is to the benefit of all marine programs.

Specifically;

- Joint appointments need to be able to supervise/hire/perform employee evaluations for staff regardless of home campus,
- Joint appointments need to have their time and effort reporting coordinated with relevant campuses,
- PI's need to be able to manage their funds at the administrative campus for the institute and credited for work at their home campus,
- We need an established system for sharing of indirect cost on grants and contract across the university,
- Personnel at UNC CSI need access to financial reports/ budget transfers/budget development,
- Need a method for inter-institutional transfer from one institute to another for cost recovery, and
- A method to cross list curriculum, register students, collect fees and share the revenue accordingly.

The need for the university to use its marine science centers as portals for the delivery of education and research is paramount. The coast is at the nexus of crisis and on the edge of great potential with issues such as sea level rise, climate change, insurance costs, energy diversification, biotechnology, environmental health, and cultural heritage, that if left unattended, will have statewide impacts or be opportunities lost to others. The university can provide impactful, place-based research, experiential learning and service to these communities through a coast-wide collaboration of the UNC coastal and marine science centers..

The directive for UNC CSI to create a multi-institutional and multi-disciplinary institute has revealed system-based programmatic and administrative challenges which must be overcome in order for UNC universities to collectively and synergistically work together to enable UNC to attain a greater niche in national and international coastal research.

Administrative Personnel

Name	Title and department/college	Role
Nancy White	Executive Director	
Marie Magee	Business Officer	
Kimberly Armstrong	Administrative Associate	
Robert McClendon	Interim Director of Operations	

State Allocated Revenue

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Federal					
State (not including university)		2,154,978	2,200,448	2,002,177	2,000,000

Institution (e.g. University)	659,583	756,652	719,839	722,905	4,493,609
Foundation	38,765*	76,546*			
Other*			20,000		
Total	659,583	2,911,630	2,940,287	2,725,082	6,493,609

Allocations of State Revenue:

University:

-UNC Coastal Studies Institute Annual Operations Budget:

FY10 \$659,583

FY11 \$665,423

FY12 \$624,726

FY13 \$627,651

FY14 \$4,398,355 projection includes 2013-15 UNC Expansion Budget and operations of the new campus.

Other:

-Recruitment and Retention Funds: University funding for Public Policy Program Head position (1/2 position funding):

FY11 \$91,229

FY12 \$95,113

FY13 \$95,254

FY14 \$95,254

-State Legislature: NC Renewable Ocean Energy Program

FY11 \$2,000,000

FY12 \$2,200,448

FY13 \$2,002,177

FY14 \$2,000,000 (projections)

Expenses

Source	FY10 (\$)	FY11 (\$)	FY12 (\$)	FY13 (\$) Current	FY14 (\$) Projected
Personnel		218,830	380,849	476,378	
Programmatic		74,271	63,803		
Physical infrastructure			180,556		
Maintenance and operation		66,722	94,492	97,039	
Equipment (>\$5,000)		208,805	233,086		
Other Direct Costs*		102,168	1,124,440	1,428,620	
Indirect Costs					
Total		670,796	2,077,226	2,002,037	

NC Renewable Ocean Energy Fund:

FY11- First year of funding for NC Renewable Ocean Energy Fund – structure and development of TAC and research initiatives. Personnel cost include dual employment of Program Head and graduate/post doc students at NCSU.

FY12-Personnel includes dual employments with UNC-CH, NCSU; graduate and post doc students from NCSU; relevant % of administrative support by personnel at CSI.

Other Direct Cost includes research projects with universities (NCSU, UNC-CH, UNCC and NCA&T) and professional research/services contracts.

Infrastructure Cost: Development of Research Building and infrastructure at Jennette's Pier.