UNIVERSITY OF NORTH CAROLINA
A SYSTEM OF HIGHER LEARNING

Report to the President:
Coastal and Marine Science Review and Recommendations

Submitted by Christopher S. Brown
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UNC General Administration

July 23, 2014 (revised October 3, 2014)

Many individuals contributed to this review. While it is not practical to name them all here, the following people contributed significantly: Dan Baden, Reide Corbett, Maurice Crawford, Dave Eggleston, Chris Finelli, Rick Luettich, Deb Mosca, Laura Taylor, Courtney Thornton, Nancy White, Susan White, Jonathan Womer, and Rob Young. Other contributors to the process are named in the relevant appendices.

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Goal 2: In accordance with UNC 400.5[R] regulation on centers and institutes and directives from UNC General Administration, East Carolina University and the Coastal Studies Institute (CSI) should jointly develop and execute (sign) an MOU delineating the specific aspects of integration and full oversight of CSI by ECU.

Goal 3: Engage MBCOI in the development of a taxonomic structure that all UNC institutions could use in future efforts to categorize coastal and marine assets and expertise.

Goal 4: Invite coastal and marine contacts to use common coastal and marine science data tags from the MBCOI-developed taxonomy to identify equipment, datasets, core laboratories and other resources in the REACH NC Resource Finder and research interests in REACH NC expert profiles.

Goal 5: Encourage campus advancement and business officers to explore opportunities for private fundraising and/or self-liquidating construction for housing at locations at Wanchese, Morehead City, and Wilmington.

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Goal 8: Form group of interested faculty to further examine and interpret the survey responses and define the potential for including existing master's courses in an exchange and for developing existing master's courses for distance-delivery.

Goal 9: Support ECU and UNCW in the planning and establishment of a new doctoral degree program within the existing academic planning process.

LEADERSHIP

Goal 10: Task the North Carolina Sea Grant with planning and implementing an annual statewide conference to address relevant and timely topics of interest to a variety of stakeholders.

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Background

At the request of University of North Carolina (UNC) President Tom Ross, the UNC Vice President for Research and Graduate Education began in 2012 an extensive review of the coastal and marine activities within the UNC system. The charge for the review was:

> "…to ensure that we are operating as efficiently and effectively as possible without any unnecessary redundancy and in a manner in which our programs demonstrate their complementary nature. We are interested in determining if there is need for structural changes to insure maximum collaboration, coordination, and positioning of UN C as an academic and research leader in this area. We also need to articulate clearly the work that is happening at each University and at each coastal location."

At UNC's request, the American Association for the Advancement of Science (AAAS) Research Competitiveness Program convened a four-member panel of experts to assist in the review. Participating campuses (ECU, ECSU, NCSU, UNC-CH, UNCW and WCU) created detailed self-studies encompassing academic degree programs, centers and institutes, and other relevant department or unit level activities. The AAAS panel reviewed programmatic self-studies in preparation for January 2013 site visits to coastal facilities at Wilmington, Morehead City, and Wanchese. As outlined in the AAAS final report (Appendix A), the panel found that UNC's marine-related programs are formidable with many forward-looking elements upon which to build and did not identify any areas of obvious redundancy or overlap in activities. The panel favored system-wide efforts to package and market marine-related activities to enhance the visibility and accessibility of these assets. This report was shared with the UNC Board of Governors in June 2013.

In August 2013, UNC GA convened a two-day workshop with key system leaders to examine the recommendations of the AAAS report and determine a path forward. As follow-up to the workshop, four working groups were formed to explore collaborative opportunities in the following areas:

- Activity/asset inventory (Appendix B);
- Undergraduate programs (Appendix C);
- Graduate (master's level) programs (Appendix D);
- Reinvention of a coastal and marine consortium (Appendix E).

In addition to the working groups, more targeted approaches were taken to address the following collaborative opportunities:

- Evaluation of operational efficiencies between UNC Chapel Hill and NC State's Morehead City research centers (Appendix F);
- Exploration of joint doctoral degree program(s); and
- Shifting full oversight of the Coastal Studies Institute to East Carolina University.

In this report, we offer ten actionable goals in the three broad categories of operations, academic programs, and leadership based upon the recommendations of AAAS, the working groups, and other strategic conversations. Goals are consolidated at the end of the report with an estimate of timelines, resources needed, and responsible parties.

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Operations

NCSU and UNC-Chapel Hill Research Centers in Morehead City

In June 2014, Jonathan Womer led a team from the UNC GA Finance office in conducting an operational assessment of neighboring research facilities in Morehead City run by NC State's Center for Marine Science and technology (CMAST) and UNC Chapel Hill's Institute for Marine Science (IMS). Data on fixed assets, facilities operating costs, space utilization, contracts and grants, and other areas of operations were collected for analysis in advance of site visits June 11-12, 2014. The aim of the assessment was to identify additional areas of collaboration and efficiency within the assets and administrative and research components of the programs. The report is attached as Appendix F.

The assessment revealed three major areas where efficiencies could be gained. First, CMAST and IMS could merge and operate as a joint research center with a shared vision, master plan and director. This approach should help address several issues raised in the AAAS report and site self-assessments, including uncertainty surrounding the mission and operation of CMAST, lack of a central brand in Morehead City, facility utilization, and boat and dorm management.

Second, and related, is the opportunity to fill CMAST with high value occupants. An estimated additional $100,000 to $280,000 in rental income could be realized. For example, CMAST currently houses County Cooperative Extension Service staff providing a wide range of education and outreach activities for the community but are less tightly coupled with the CMAST mission. On the other hand, the Shellfish Sanitation and Water Quality Section of the Division of Marine Fisheries currently rent space four miles away. IMS and CMAST researchers could realize synergistic collaborations through co-location of this group in CMAST.

Third, an area with the potential for savings, although less substantial, is administrative efficiencies around shared custodial services, machine shops, boat pool and storage solutions.

Goal 1: The President will ask NCSU and UNC Chapel Hill Chancellors and appropriate Vice Chancellors to engage in planning for a single jointly operated research center in Morehead City and present recommendations within six months.

Coastal Studies Institute relationship to East Carolina University

ECU has depth and diversity in its coastal programs that are well-regarded in the UNC System. The Coastal Studies Institute (CSI) has the inter-institutional mission and connections to draw on students and faculty from across the UNC system. As such, both CSI and ECU are dynamic organizations capable of developing and disseminating knowledge about coastal issues, and the two organizations have already developed significant and effective partnerships. Three of CSI's five programs (Public Policy, Maritime Heritage, and Coastal Processes) are currently directed by ECU faculty. In addition, the CSI director, Dr. Nancy White, is on ECU's faculty in the Department of Biology, and ECU is the current fiscal agent for CSI's personnel, business, and facilities services. ECU's Dive and Water Safety program provides CSI with diving and vessel support. Last, and likely the most compelling element of the collaboration is that CSI, its partners, and ECU have expertise in areas that are critically germane to

coastal communities not only in northeast NC but internationally and can be leveraged collaboratively to find solutions to the critical issues facing the coast.

The facts suggest that deepening this relationship— via formal integration of the two organizations with a Memorandum of Understanding (MOU)— will enhance their collective effectiveness, more efficiently utilize resources, create a more impactful entity for both organizations and the UNC system, and increase scientific and practical contributions to the coastal region and to the people of North Carolina.

Goal 2: In accordance with UNC 400.5[R] regulation on centers and institutes and directives from UNC General Administration, East Carolina University and the Coastal Studies Institute (CSI) will jointly develop and execute (sign) an MOU delineating the specific aspects of integration and full oversight of CSI by ECU.

Activities and Assets Inventory

This working group agreed upon a charge to "Develop a plan for a comprehensive inventory of relevant coastal and marine activities and assets (people and capital) in the state that ensures accessibility, links to other activities, and is regularly updated." Additionally, this working group called for a plan to "Identify resources, team members, and a timeline for build-out of inventory and its ongoing maintenance." Their full report can be found in Appendix B.

Expertise and assets are currently tracked in different and disconnected ways, including through REACH NC, the Marine BioTechnologies Center of Innovation (MBCOI), and individual institutions. A unified, cross-institutional inventory is desired to improve communication and collaboration. The workgroup recommended that MBCOI was well-suited to execute such an inventory process. UNCW has offered a small contract to MBCOI to inventory some of their campus assets, and we recommend waiting to learn from the outcomes of that process before making additional investment. We recognize the need, however, to inventory select information in the near future in order to facilitate academic collaborations such as inter-institutional course registration and graduate faculty status. We advise addressing those two specific needs at this time rather than investing in a "project manager" to build a larger inventory, as this working group suggested was needed. Other immediate opportunities involve utilization of REACH NC to make assets and expertise in coastal and marine science more discoverable. MBCOI could play a vital role in the creation of a taxonomy that could be used system-wide for the categorization of coastal and marine assets and expertise.

Goal 3: Engage MBCOI in the development of a taxonomic structure that all UNC institutions could use in future efforts to categorize coastal and marine assets and expertise.

Goal 4: Invite coastal and marine contacts to use common coastal and marine science data tags from the MBCOI-developed taxonomy to identify equipment, datasets, core laboratories and other resources in the REACH NC Resource Finder and research interests in REACH NC expert profiles.

Housing

The AAAS report, the working groups on Undergraduate and Graduate (Master's) programs, and Morehead City efficiency report each cite lack of housing across all coastal sites as a significant challenge to collaborative research and enhanced engagement of students at the coast.

Goal 5: Encourage campus advancement and business officers to explore opportunities for private fundraising and/or self-liquidating construction for housing at locations at Wanchese, Morehead City, and Wilmington.

Academic Programs

Undergraduate Programs

This working group agreed upon a charge to "Draft proposals for developing academic collaborations that include experiential learning and other delivery methods, which will enhance Coastal and Marine programs and increase accessibility to these programs across all 17 UNC system campuses." The working group developed three ideas, including a "semester at the coast" program to be offered during fall or spring semesters; a semester online course with a field component; and a summer course. Their full report is included as Appendix C.

The working group proposed a 12-18 credit hour "semester at the coast" program that includes hybrid courses (web-based with 2-3 day field experiences at site offering the course). The program would allow 5-10 students at the sophomore or junior level and from each participating institution (20-40 students total) to live near and learn at each of the facilities for a semester. The working group considered the realities and challenges, including the need to attract a sufficient number of students to fill a core of coastal courses and the need for a dedicated group of faculty committed to teaching and joint-scheduling courses on a recurring basis. Collaboration can help overcome these two hurdles, which has made single institutions reluctant to commit resources to semester programs at the coast. Lack of housing at all sites is also a considerable challenge (see Goal 5). Costs to implement the program would include a program coordinator to orchestrate its development, some course buyout for participating faculty, and graduate assistantship for TAs. This idea has significant potential in terms of coordinating and marketing existing assets in the UNC system but would not be viable without considerable investment of resources and time.

Goal 6: Identify and invest planning funds for a UNC "Semester at the Coast".

Master's Programs

This working group agreed upon a charge to "Draft proposals for developing academic collaborations at the Master's level that include experiential learning at coastal facilities and use of current technologies (e.g. online learning) that will enhance coastal and marine programs and increase accessibility to these programs across the 16 UNC system campuses." This working group focused on graduate committee

membership, short courses, fieldtrips, potential for MOOCs, and inter-institutional course registration. Success of short courses and field trips in large measure depends upon the availability of housing for students and faculty at all partnering sites across the coast. The full report is included as Appendix D.

Two areas are ripe for immediate action. The first is the facilitation of approval of faculty to have graduate committee status across institutions. Currently, a multi-institutional arrangement exists between NCSU, UNC-CH and Duke where graduate faculty from any of the institutions can serve at any other institution without any procedural request. "One-off" agreements are believed to be in place between other programs or institutions (such as UNCG and NC A&T). The working group was interested in a "marine graduate faculty consortium" to facilitate graduate faculty membership among programs, an opportunity that exists across multiple discipline areas in addition to marine science. For this reason, we recommend starting the conversation more globally at the Graduate Dean level rather than creating another unique multi-campus agreement to serve a niche need.

Goal 7: With UNC Graduate Council, explore the potential to create a system-wide "marketplace" approach for graduate faculty status approvals in coastal and marine sciences.

The second area to explore now is inter-institutional course registration, for which the existing UNC Exchange model holds significant promise. The group surveyed coastal and marine faculty at ECU, NCSU, UNC-CH, and UNCW to obtain a more clear sense of the potential. Some of the findings from the 95 responses were:

- 42% identified at least one course they were currently teaching that could be part of an exchange. Forty-five courses were listed in total.
- Of the 45 possible courses listed to be offered on the exchange, only 14 are currently offered on-line; 31 would have to be developed for on-line delivery.
- Respondents most often cited release time, TA help, and technical support as the resources needed to develop and deliver a course through the exchange model.
- 31% believed their existing master's curriculum had gaps that could be met through courses available at other UNC institutions; 53% did not know if their existing master's curriculum had gaps or not that could be met through other campus's courses.
- 80% indicated a course inventory would be extremely or very useful.

Goal 8: Form group of interested faculty to further examine and interpret the survey responses and define the potential for including existing master's courses in an exchange and for developing existing master's courses for distance-delivery.

Doctoral Programs

Prior to the Coastal and Marine Science review, ECU had submitted documents requesting establishment of a PhD in Economics (with a focus on risk management/natural hazards). UNCW had submitted a request to plan a PhD in Coastal and Marine Science. These efforts were postponed pending the completion of this review as well as the Board of Governor's mission review in February 2014.

The AAAS assessment did not deal directly with the requests for these doctoral degree programs but generally suggested that "barriers to academic collaboration present a challenge for realization of the true potential for the UNC system to deliver a superior marine science curriculum." The BOG mission review report did not comment directly on the proposed PhD in Economics at ECU, as the proposed program was not in conflict with the institution's mission. The BOG mission review report did, however, suggest that UNCW should be able to participate in inter-institutional doctoral programs that complement areas of institutional strength.

As a result, ECU and UNCW have begun planning a joint doctoral degree program that will be based on the existing Coastal Resource Management PhD in place at ECU. That existing degree program has four tracks in geosciences, estuarine ecology, maritime history, and policy/social sciences. UNCW faculty would be able to contribute in several of these tracks. ECU economics faculty will likely also be participating in the policy/social science track. They have articulated a goal to complete all planning and approvals within twelve months.

Goal 9: Support ECU and UNCW in the planning and establishment of a new doctoral degree program within the existing academic planning process.

Leadership

This working group agreed upon a charge to "Draft a proposal for a new coastal and marine consortium that includes its mission, justification, members, scope of duties, resources needed or those available, as well as a timeline for consortium creation, review, and initiation." The full report is included as Appendix E.

This working group developed a roadmap for a new North Carolina Coastal and Marine Consortium, comprised of UNC institutions and Duke, to support and coordinate coastal and marine programs within the state. They reiterated the need for a well-defined structure and purpose and for such a consortium to be clearly articulated across the state and supported at the highest administrative levels, as well as on-the-ground. Initial goals included serving as a communication vehicle, promoting continued excellence, promoting education, outreach and training opportunities, providing effective and efficient operations and facilities, and engaging with coastal populations, businesses, local government, and the State.

At this time, it is premature to develop a formalized, structured consortium. That said, it is important to maintain system-wide and statewide communication channels on issues of importance and opportunities for collaboration. As a multi-campus center of the UNC system, North Carolina Sea Grant is well positioned to provide leadership for an annual conference that can foster these communication channels at relatively low cost until such a time as a more coordinated leadership group is deemed necessary.

Goal 10: Task the North Carolina Sea Grant with planning and implementing an annual statewide conference to address relevant and timely topics of interest to a variety of stakeholders.

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Timelines and Responsible Parties

GOAL	Responsible/ Consulted	Completion	Funding Required	Notes
Goal 1. NCSU & NC-CH engage in planning for a single jointly operated research center in Morehead City.	R: Brown C: Folt, Woodson, VCs	Report 5/31/15	None	President Ross makes request to Chancellors
Goal 2. ECU and CSI develop and execute (sign) an MOU delineating the specific aspects of integration.	R: Brown C: N. White, Mitchelson, Griffin	11/30/14	None	MOU development and bylaws modification require Presidential approval.
Goal 3. Engage MBCOI in the development of a taxonomic structure that all UNC institutions could use to categorize coastal and marine assets and expertise.	R: Thornton C: Mosca, Sankaran	2/1/15	~$20,000	Funding source – UNC-GA
Goal 4. Invite coastal and marine contacts to use common coastal and marine science data tags from the MBCOI-developed taxonomy to identify equipment, datasets, core laboratories and other resources in REACH NC.	R: Thornton C: Sankaran, Mosca	3/1/15	None	Depends upon successful Shibboleth integration for seamless login to expert profiles.
Goal 5. Explore the opportunities for private fundraising for housing across the entire coast.	R: Brown C: Campus dev. officers	6/30/15	None	Considerable legwork exists. Goal #1 will impact approach for Morehead City.
Goal 6. Identify and invest planning funds to take the "Semester at the Coast".	R: Thornton C: Finelli	8/1/15	~$39,000 for course buyout	Funding source – UNC-GA .
Goal 7. UNC Graduate Council explores creation of a system-wide "marketplace" for graduate faculty status approvals in coastal and marine sciences.	R: Thornton C: Graduate Council	8/1/15	None	Effort would benefit areas beyond coastal/marine science; has SACS implications
Goal 8. Define the potential for including existing master's courses in an exchange and for developing existing master's courses for distance-delivery.	R: Thornton C: Corbett, Rascoff, O'Hara	8/1/15	None	Must fit with direction of larger e-learning strategy for exchanges
Goal 9. ECU and UNCW plan for joint PhD in Coastal/Marine Science.	R: Thornton C: Battles, Mitchelson	App. A 12/31/14	None	Estimate 12 months from Appendix A submission to program approval
Goal 10. Task the North Carolina Sea Grant with implementing annual statewide conference.	R: Brown C: S. White	First meeting 4/15	~$20,000 to plan and implement first meeting	Funding source - NC Sea Grant and UNC GA

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Appendices

Appendix A: AAAS Independent Review of the University of North Carolina System Marine and Coastal Activities

Appendix B: Working group report on assets and inventory

Appendix C: Working group report on undergraduate programs

Appendix D: Working group report on graduate (master's) programs

Appendix E: Working group report on leadership

Appendix F: Operational Efficiency Report on UNC@Morehead City

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Appendix A: Independent Review of the University of North Carolina System Marine and Coastal Activities, June 2013

Independent Review of the University of North Carolina System Marine and Coastal Activities

A report prepared for
Thomas W. Ross
President

The University of North Carolina

Conducted by the American Association for the Advancement of Science (AAAS)
Research Competitiveness Program

AAAS
ADVANCING SCIENCE, SERVING SOCIETY

Executive Summary

At the request of the University of North Carolina System General Administration (UNC-GA), the American Association for the Advancement of Science's (AAAS) Research Competitiveness Program undertook a comprehensive review of the marine and coastal programs within the UNC System. This report, based on that review, includes findings and recommendations that are meant to guide the UNC System as it seeks to leverage strengths and maximize impact of its marine-related program assets. In North Carolina, marine-related activities are important to the State's economy, both in traditional sectors like recreation and tourism, fisheries, hazard resilience, and marine heritage, and in emerging areas like wind energy and marine biotechnology. UNC System faculty members are leaders in areas such as marine biotechnology, wind energy, coastal sustainability, marine aquaculture, climate change and marine ecosystem health.

The review comes at a time of significant transition particularly for public institutions of higher education nationwide. This transition is driven to some degree by new technology that has enabled alternative modes and means of information delivery. But it is also driven by tight budget environments and heightened scrutiny aimed at ensuring effective use of resources. Assessing the capacities of programs, and in this case marine-related programs, that have a System-wide footprint, will help to remove barriers to cross-system programmatic synergies. This in turn will help to re-define the North Carolina experience for students.

Perhaps the most significant outcome of this review will be to better position the UNC system to compete in the changing academic landscape[1]. The UNC System's marine-related programs have many forward-looking elements and best practices upon which to build. A system-wide effort to package and market the marine–related activities would enhance the external visibility and accessibility of these assets, which, when considered *in toto,* are formidable.

Comprising much of the breadth of marine and coastal sciences in the UNC System, a total of 26 units, referred to as "UNC Activities," were included as part of this review[2]. These units constitute entities such as departments, centers, institutes, interdisciplinary degree programs, or other programs that the UNC viewed as relevant and significant to coastal and marine sciences in the State. At the start of this review, UNC-GA requested institutional self-studies which resulted in the capture of teaching, research and outreach services that were being conducted by UNC Activities in marine science. The content and depth of each of the self-studies varied, reflecting differences in mission, vision, resources, and capacity for marine science work at the institutions. In total, 8 self-study documents were generated (one from each of the six universities; these each had multiple Activities), the UNC Coastal Studies Institute, and the NC Sea Grant, which were then reviewed by a national panel of marine and coastal sciences experts convened by AAAS. The AAAS panel conducted a week-long site visit to interview faculty and administrators representing each of the UNC Activities and visited three cities along the coast, Wilmington, Morehead City, and Manteo, touring facilities at each

[1] "They never saw it coming." *Science* 339 (2013)

[2] This AAAS report includes a review of programs administered by the following institutions: East Carolina University (**ECU**), Elizabeth City State University (**ECSU**), North Carolina State University (**NC State**), University of North Carolina-Chapel Hill (**UNC-CH**), University of North Carolina – General Administration (**UNC-GA**), University of North Carolina at Wilmington (**UNCW**), and Western Carolina University (**WCU**).

location. In its deliberations, the panel considered the marine-related programs from a system-wide perspective using both the self-study documents and insights gathered from the site visits, presentations made by the units, and in-person interviews.

The AAAS panel soon determined that the UNC System has an extraordinarily rich assemblage of intellectual assets, facilities and capabilities that underlie research, education and outreach related to the coastal North Carolina marine environment, and more broadly to the regional, national and global environment. The word "assemblage" is used deliberately here because it appears that, historically, the planning and support of programs has been largely "siloed" within institutions. The treatment of the programs in a more holistic and coordinated way, while still retaining institutional identity, presents a significant opportunity for North Carolina to amplify the collective impact and increase national recognition of its marine-related programs.

In North Carolina, the marine and coastal programmatic activities are hosted at institutions spanning the spectrum of institutional cultures, missions and Carnegie classifications[3]. Each UNC activity fills a unique niche, consistent with the institution's culture and mission, to serve a distinct set of stakeholders. Most significantly, the AAAS panel did not identify any areas where there was obvious redundancy or overlap in programs. Rather, the various marine activities of the UNC System comprise a rich and diverse assemblage, the potential of which can be fully realized through improved coordination and collaboration.

Grassroots collaborations do exist in several areas of the UNC System. However, these interactions tend to be between individuals or focused on specific project areas. What is lacking is a level of coordinated stewardship with full participation at the unit level that takes advantage of a comprehensive, "big-picture" view and can foster interactions among programs. With this level of coordination, the UNC Activities can function more strategically and work to more systematically develop opportunities that transcend individual programs, projects, and institutions. The benefit will be the System's enhanced competitiveness in the marine-related programs, manifested in a coordinated brand that helps with recognition of system-wide assets, opportunities for enlarging and diversifying the research portfolio and new ways to control costs.

The AAAS panel offers 14 recommendations to improve coordination of UNC Activities that might then translate to better recognition of the strengths of the UNC marine-related activities both internally and externally. These recommendations are intended to be constructive and advisory. The mechanisms to effect changes administratively should be determined by UNC-GA. Four overlapping and complementary topic areas are identified to promote better leverage and efficiency across the UNC system: Statewide Planning and Coordination, Reducing Barriers for Research and Academic Collaborations, Marine Science Activities Planning and

[3] The relative emphasis an institution of higher education places on research and undergraduate and graduate education defines its cultural landscape and is dictated by its mission. Insights into the cultural traditions at institutions of higher education can be gained from the Carnegie Foundation for the Advancement of Teaching's classifications (http://www.carnegiefoundation.org), which attempt to categorize colleges and universities according to their highest or most dominant degree awarded (Associates, Bachelors, Masters, Doctoral) and the level of their research activity (Research Universities with average, high, and very high research productivity). In addition, to these generic labels, institutions have their own special cultural traditions.

Communication, and Other. Each of these recommendations is further detailed in Part I of the report.

Most of the recommendations below will not require great commitments of new fiscal resources, but they will require a common focus, clear leadership, more coordination and a commitment *by all of those involved*. The AAAS panel is convinced that if these recommendations are embraced, North Carolina will be in a leadership role nationally in marine-coastal research, education and service.

STATEWIDE PLANNING AND COORDINATION

RECOMMENDATION 1: The UNC GA should provide greater leadership and coordination of UNC System Activities. As a first step, UNC-GA should build on information in the self-studies as well as other sources to maintain and disseminate an up-to-date inventory of programs and activities. This effort should be complemented by the establishment of milestones and measurement and reporting of outcomes for all participating units.

RECOMMENDATION 2: The UNC System should commission studies on the economic valuation of coastal ecosystem services and natural capital as well as the direct and indirect economic benefits of marine science and technology activities. Such information should be used to communicate the economic value of North Carolina's coastal environment and the role of the UNC System in providing vital understanding, education and outreach to support the wise use and stewardship of natural resources as well as stimulating local, regional and statewide economies through marine science and technology investment.

RECOMMENDATION 3: The UNC System should foster the development of a clear brand or identity for the major marine-related assets and programs, building on the results of Recommendations 1 and 2. For example, with reasonable investment, marine science assets in the Morehead City-Beaufort area could easily be packaged as a national center of excellence. Also, one can imagine the "Marine Research Triangle Partnership" involving UNC-CH's IMS, NC State's CMAST and the Duke University Marine Lab (located in Beaufort), as a natural extension of the Research Triangle Park brand.

REDUCING BARRIERS FOR RESEARCH AND ACADEMIC COLLABORATIONS

RECOMMENDATION 4: The UNC System should foster stronger and more integrative research collaborations and focus more attention to communicating to the public the economic and societal benefit that such research is able to produce.

RECOMMENDATION 5: The UNC System should encourage efforts to remove barriers to academic collaboration.

RECOMMENDATION 6: The UNC System should encourage development of a coordinated online or hybrid course curriculum in marine science to leverage the breadth of activities offered throughout the State. These courses could be a component in a common, shared degree program in marine science (at the Master's or Ph.D. level), and would help maximize the use of teaching resources in the State without requiring duplication in hiring.

RECOMMENDATION 7: The UNC System and individual institutions should foster undergraduate research and encourage efforts to ensure that undergraduate and graduate student mentoring is sufficiently valued and rewarded.

RECOMMENDATION 8: The UNC System should consider building and maintenance of dormitories to foster residential academic programs at the three coastal locations (Wilmington, Morehead City, and Manteo) and to facilitate statewide participation in coastal field studies. More broadly, the UNC system is encouraged to consider a more proactive approach to regular maintenance and upkeep of coastal facilities (including equipment) in conjunction with overall capital improvement schedules.

MARINE SCIENCE ACTIVITIES PLANNING & COMMUNICATION

RECOMMENDATION 9: Leaders of UNC Activities should develop unit-level strategic plans that articulate explicitly with strategic planning by their home institutions and by the UNC System. These plans should include benchmarks and quantitative metrics and use the self-study reports as a starting point. Periodic assessments should be undertaken to monitor progress.

RECOMMENDATION 10: Leaders of UNC Activities should develop and execute a systematic and coordinated communication plan.

RECOMMENDATION 11: Leaders of UNC Activities should recognize and fully utilize the well-developed communication and outreach capabilities of North Carolina Sea Grant and the Coastal Studies Institute.

RECOMMENDATION 12: Leaders of UNC Activities should encourage the use of modern communication and social media technology to improve inter-unit communication and to enhance the curriculum at both the undergraduate and graduate levels.

OTHER

RECOMMENDATION 13: The UNC System should encourage all units to develop fund-raising strategies and plans in coordination with their home institutions, enhance external development programs and to engage external advisory committees and boards.

RECOMMENDATION 14: The UNC System should actively encourage and facilitate coordination of diversity initiatives for students and faculty in marine science.

Many excellent programs, centers and institutes can be found within the UNC System. With appropriate coordination, collaboration, communication, and support, these assets can achieve even more than they already do and provide the state with additional significant return on its investment.

The recommendations in this report are intended to support the UNC GA's ability to facilitate a culture of cross unit coordination and one that leads to a reduction in barriers to the mechanisms that would enhance it. Acting upon the recommendations of this report can result in improvements in both programmatic efficiencies and effectiveness. The panel suggests that

the UNC GA establish and determine the ground rules, but not manage the details. For example, significant program enhancement and efficiencies could be achieved if UNC Chapel Hill and NC State collaborate on operating a shared dormitory facility in Morehead City. The development of a joint master's or doctoral program, and shared coursework at any level, would expand opportunities for students without incurring significant additional personnel and operational costs. A shared system to manage vessels and equipment could both improve efficiencies and expand access of these resources to a wider user base. Shared approaches to public relations, development, and student recruitment could strengthen these activities while at the same time making more efficient use of personnel and operations budgets. The AAAS panel is convinced that if these recommendations are embraced and fulfilled at all levels, North Carolina can be in a leadership role nationally in marine-related research, education and service.

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Section I:
AAAS Panel's Major Findings and Recommendations

Introduction and Context

The University of North Carolina (UNC) System has marine-related[4] programs located throughout the State, from the western mountains to the coastal plain. To understand better the breadth and depth of these activities and to explore their possible synergies, the UNC General Administration (UNC-GA) commissioned the American Association for the Advancement of Science's (AAAS) Research Competitiveness Program to undertake a comprehensive review of the marine-related programs within the UNC System. The AAAS panel focused on developing recommendations that are meant to guide the UNC System as it seeks to leverage strengths and maximize the impact of its marine-related program assets. In total, 26 units, referred to as "UNC Activities," were included as part of this review, illustrating the breadth of marine and coastal sciences in the UNC System. These units constitute entities such as departments, centers, institutes, interdisciplinary degree programs, or other programs that the UNC viewed as relevant and significant to coastal and marine sciences in the State[5].

The review comes at a time of significant transition particularly for public institutions of higher education nationwide. This transition is driven to some degree by new technology that has enabled alternative modes and means of information delivery. But it is also driven by tight budget environments and heightened scrutiny aimed at ensuring effective use of resources. Assessing the capacities of programs, and in this case marine-related programs, that have a System-wide footprint, will help to eliminate redundancies and remove barriers to cross-system programmatic synergies. This in turn will help to re-define the North Carolina experience for students. However, perhaps the most significant outcome of this review will be to better position the UNC system to compete in the changing academic landscape[6]. The UNC System's marine-related programs have many forward-looking elements and best practices upon which to build. A system-wide effort to package and market the marine–related activities would enhance the external visibility and accessibility of these assets, which, when considered *in toto,* are formidable.

The ocean is important whether you live on the coast or in the heartland. It covers 71% of the Earth's surface and contains 97% of the planet's water. The ocean drives our weather and climate through the global transfer of heat and water. The organisms in it generate much of the oxygen we breathe. And, nationally, more than 90,000 miles of shoreline support a $60 billion recreation and tourism industry. In addition, the ocean supports a $60 billion annual seafood industry and a $20 billion recreational fishery and contains approximately $8 trillion in oil and gas reserves as well as extensive capacity for offshore wind energy. Ninety five percent of the nation's commerce travels through U.S. ports[7]. In North Carolina, marine-related

[4] The word "marine" is used throughout this report, but in reality, the AAAS panel is referring to a much broader purview that includes, coastal, estuarine, and related systems. It also covers diverse areas from the environmental sciences, to veterinary medicine, to social sciences and beyond. A comprehensive list of the activities in the review is provided in the Appendix.

[5] This AAAS report includes a review of programs administered by the following institutions: East Carolina University (**ECU**), Elizabeth City State University (**ECSU**), North Carolina State University (**NC State**), University of North Carolina-Chapel Hill (**UNC-CH**), University of North Carolina – General Administration (**UNC-GA**), University of North Carolina at Wilmington (**UNCW**), and Western Carolina University (**WCU**).

[6] "They never saw it coming." *Science* 339 (2013)

[7] http://www.oceanleadership.org/ocean-policy-legislation/ocean-leadership-policy-priorities/

activities are important to the State's economy, both in traditional sectors like recreation and tourism, fisheries, hazard resilience, and marine heritage, and in emerging areas like wind energy and marine biotechnology. UNC System faculty members are leaders in areas such as marine biotechnology, wind energy, coastal sustainability, marine aquaculture, climate change and marine ecosystem health.

At the start of this review, the UNC-GA requested institutional self-studies which resulted in the capture of teaching, research and outreach services that were being conducted by 26 distinct UNC Activities in marine science. The content and depth of each of the self-studies varied, reflecting differences in mission, vision, resources, and capacity for marine-related work at the institutions. The self-studies were then reviewed by a national panel of marine and coastal sciences experts convened by AAAS. The members of the review panel are listed below (bios are included in the Appendix):

- Christopher F. D'Elia, Dean and Professor, School of the Coast and Environment, Louisiana State University
- Jacqueline Dixon, Dean and Professor, College of Marine Science, University of South Florida
- Steven E. Lohrenz, Dean and Professor, School for Marine Science and Technology University of Massachusetts-Dartmouth
- Nancy Targett, **(Chair)** Dean and Professor, College of Earth, Ocean, and Environment, University of Delaware

For this task, AAAS, together with the UNC-GA, developed a charge that focused on opportunities and leveraging across the UNC System (see Appendix). The AAAS panel conducted a preliminary assessment of each of the UNC Activity's capabilities and gaps, based on the questions from the AAAS charge. These preliminary findings laid out a foundation for the AAAS panel to conduct a week-long site visit to interview faculty and administrators representing each of the UNC Activities. The team visited three cities along the coast, Wilmington, Morehead City, and Manteo, touring on-site facilities at each location. In its deliberations, the panel considered the marine-related programs from a system-wide perspective using both the self-study documents and insights gathered from the site visits, presentations made by the units, and in-person interviews. At the end of the site visit, the AAAS panel briefed the UNC-GA VPR with its preliminary findings and recommendations. This report reflects a further discussion and refinement of those views.

This section of the report includes high-level findings and recommendations that emphasize opportunities for coordination across the UNC System (Question 3 of the AAAS Charge, see Appendix). Part II of this report includes further review of the UNC Activities, reflecting the panel's impression of how the units contribute to the totality of marine and coastal sciences in the State and where there are gaps (Questions 1 & 2 of the AAAS Charge).

North Carolina's Culture for Marine Science

In North Carolina, the marine and coastal programmatic activities are hosted at institutions spanning the spectrum of institutional cultures, missions and Carnegie classifications[8]. Each UNC activity fills a unique niche, consistent with the institution's culture and mission, to serve a distinct set of stakeholders. Marine programs at research-intensive universities such as UNC-CH and NC State contribute to our understanding of coastal hazards and resilience, marine ecosystem health, climate change, marine applications of food science and veterinary medicine. Benefits from these efforts accrue to the UNC System as a result of the national visibility of the work (publications in journals like *Science*, *Nature*, and *PNAS* for example; research dollars to the University) and the local impact of having nationally-acclaimed experts that are available to consult with State resource managers, legislators, or businesses. The research also translates into unique learning opportunities for students.

Marine and coastal programs at teaching-intensive institutions serve to educate the next generation of citizens to think broadly about environmental issues. UNCW, in particular, has embraced marine science as the signature theme for the entire university, and is explicitly reflected in traditional disciplinary areas (e.g., Departments of Physics & Physical Oceanography, Biology & Marine Biology, and Chemistry & Biochemistry). UNCW engages students, particularly at the undergraduate and master's level (and at the Ph.D. level in Marine Biology), in a significant experiential-learning process that builds on faculty research and innovative partnerships (e.g., Marine Biotechnology). Other teaching-intensive units also incorporate hands-on student experiences into their marine-related programs. ECU seeks to be an instrument of regional transformation and its marine-related emphases are in areas that are particularly important for the coastal state of North Carolina, including coastal science and policy, coastal resource management (including a Ph.D. program in this area), sustainable tourism and maritime heritage. At WCU the marine-related emphasis is concentrated in the study of developed shorelines. This program has national visibility and extramural funding in addition to strong undergraduate engagement in the analysis of data and production of data products such as the storm surge viewer or the beach nourishment viewer. ECSU's program, while small, collaborates successfully with other institutions both inside and outside of North Carolina to enhance opportunities for its students. As a historically-black college, ESCU offers the added dimension of serving under-represented groups and a pool of students interested in the field.

Marine-related programs like North Carolina Sea Grant and the UNC Coastal Studies Institute (CSI) fall outside of the Carnegie classification because they are not academic entities per se, but they serve a valuable role in translating science to the benefit of North Carolina stakeholders. NC Sea Grant and UNC CSI have a cross-state presence and perspective.

[8] The relative emphasis an institution of higher education places on research and undergraduate and graduate education defines its cultural landscape and is dictated by its mission. Insights into the cultural traditions at institutions of higher education can be gained from the Carnegie Foundation for the Advancement of Teaching's classifications (http://www.carnegiefoundation.org), which attempt to categorize colleges and universities according to their highest or most dominant degree awarded (Associates, Bachelors, Masters, Doctoral) and the level of their research activity (Research Universities with average, high, and very high research productivity). In addition, to these generic labels, institutions have their own special cultural traditions.

It was apparent to the AAAS review panel that the marine-related programs within the state have self-selected into niches that largely complement each other rather than compete. More effective coordination of these already strong and diverse cross-state efforts could significantly strengthen them all and enhance the UNC System's competitiveness in this area; truly a "win-win-win" opportunity for the programs, the home institutions, and the system.

Strategic Thinking and Opportunities for the UNC System

Overview

The UNC System has an extraordinarily rich assemblage of intellectual assets, facilities and capabilities that underlie research, education and outreach related to the coastal North Carolina marine environment, and more broadly to the regional, national and global environment. The word "assemblage" is used deliberately here, because it appears that historically, the planning and support of programs has been largely "siloed" within institutions. The treatment of the programs in a more holistic and coordinated way, while still retaining institutional identity, presents a significant opportunity for North Carolina to amplify the collective impact and broaden recognition of its marine-related programs. Such a situation often exists in state university systems because they are large complex organizations composed of individual campuses with multiple and typically competitive leaders.

The coordination has already started organically in several areas of the UNC System. Grassroots collaborations do exist. Interactions do occur among the institutions, programs and laboratories at various levels including research and shared facilities (see Part II). However, these interactions tend to be between individuals or focused on specific project areas. What is lacking is a level of coordinated stewardship that has full participation at the unit level and also takes advantage of a comprehensive, "big-picture" view that can foster interactions among programs. This coordination need not be onerous, but it does require buy-in.

In undertaking this assessment, the UNC System has taken a critical step toward adapting to the changing academic landscape. Effecting change requires strong and committed leadership at all levels. The benefit will be the System's enhanced competitiveness in the marine-related programs, manifested in a coordinated brand that helps with recognition of system-wide assets and opportunities for enlarging and diversifying the research portfolio. It should also help North Carolina's competitiveness in vying for large federal center grants. This is really an opportunity for win-win solutions from which everyone can benefit.

The AAAS panel did not identify any areas where there was obvious redundancy or overlap in programs (see section titled *The Degree to Which UNC Marine Activities Overlap*, p. 33). Rather, the various marine activities of the UNC System comprise a rich and diverse assemblage, the potential of which can be fully realized through improved coordination and collaboration.

This section of the report outlines steps to improve coordination of UNC activities that might then translate to better recognition of the strengths of the UNC marine-related activities both internally and externally.

In summary, four overlapping and complementary topic areas are identified to promote better leverage and efficiency across the UNC system: Statewide Planning and Coordination, Reducing Barriers for Research and Academic Collaborations, Marine Science Activities Planning and Communication, and Other. Each topic area is linked to a set of recommendations.

State-wide Planning and Coordination

• **Building on Self Studies**

RECOMMENDATION 1: UNC GA should provide greater leadership and coordination of UNC System Activities. As a first step, UNC-GA should build on information in the self-studies as well as other sources to maintain and disseminate an up-to-date inventory of programs and activities. This effort should be complemented by the establishment of milestones and measurement and reporting of outcomes for all participating units.

The self-studies are an important first step in understanding the breadth and depth of UNC System-wide assets. Next, the UNC System should develop a better understanding of the potential system-wide synergies by mapping the inventoried assets in a comprehensive way. This will highlight strengths and identify gaps and facilitate decisions to ensure that desired outcomes are being met and that programmatic impacts are being measured in a comprehensive way. With a better understanding of the breadth of the assets one can enhance system-wide competitiveness and impact.

• **Economic Value of North Carolina's Coast**

RECOMMENDATION 2: The UNC System should commission studies on the economic valuation of coastal ecosystem services and natural capital as well as the direct and indirect economic benefits of marine science and technology activities. Such information should be used to communicate the economic value of North Carolina's coastal environment and the role of North Carolina's system of higher education in providing vital understanding, education and outreach to support the wise use and stewardship of natural resources as well as stimulating local, regional and statewide economies through marine science and technology investment.

Programs within the UNC System provide vital understanding, education and outreach to support the wise use and stewardship of important coastal resources. Development of an economic valuation of the coast using traditional "neoclassical" market-based economics and also "biophysical" economics based on the valuation of ecosystem services and natural capital would put the UNC System in a much stronger position to demonstrate how its marine-related programs are of strategic importance to the people of North Carolina and beyond. Studies in other states have demonstrated that attracting a workforce with required skills is essential to commercialization and the development of new products derived from the marine sector[9]. Clear linkages to economic and educational impacts are essential to gain needed support in the business community and of other stakeholders. North Carolina Sea Grant is already doing a superb job translating science into economic benefit for the people of North Carolina and could be a significant resource in accomplishing this task (see below).

• **Branding**

RECOMMENDATION 3: The UNC System should foster the development of a clear brand or identity for the key marine-related programs, building on the results of Recommendations 1 and 2. For example, with reasonable investment, marine science assets in the Morehead City-Beaufort area could easily be packaged as a national center of excellence. Also, one can

[9] Barrow, Clyde; Loveland, Rebecca; and Terkla, David, "Sailing into a Strong Future: The Massachusetts Marine Science and Technology Industry" (2005). MassBenchmarks. Vol. 7, No. 4, pp. 15-21: http://scholarworks.umb.edu/econ_faculty_pubs/24

imagine the "Marine Research Triangle Partnership" (MRTP) involving UNC-CH's IMS, NC State's CMAST and the Duke University Marine Lab (located in Beaufort), as a natural extension of the Research Triangle Park brand. The founding documents of the Research Triangle Park indicate that it is to be an engine for prosperity for the entire state, and MRTP could be a natural extension benefitting all.

The AAAS review panel was extremely impressed with the expertise and capabilities of North Carolina's marine-related activities. Excellent facilities are available for them. However, when someone in the public thinks about ocean sciences, he or she inevitably identifies leading institutions such as Woods Hole, Scripps, and perhaps a few others. Few professionals, even those in the marine sciences, would identify Morehead City as a national center of excellence, except perhaps for the researchers located there. The UNC System has a wonderful prospect to develop a better identity for key marine resources. For example, Morehead City is truly an exceptional and important center of marine and coastal research at the national scale. The AAAS review panel visited the campuses of NC State's Center for Marine Sciences and Technology (CMAST) and UNC's Institute of Marine Sciences (IMS). Despite the close physical proximity of these two units and also Carteret Community College (CCC), and clear evidence that they cooperate in many ways, to the person driving down Arendell St. (US 70), they seem to be unrelated and distinctly independent entities. Why not try to give it a visual identity for what it really is: *a national powerhouse in marine science, research, education and outreach*? With some master planning and relatively little landscape architectural work and signage, a clear visual identity could be given to this significant campus as an integrated unit. This alone would make a powerful statement that would be very positively received by the local community in particular.

In addition, the coastal laboratory facility assets of the UNC System aggregate into three geographic clusters: Wilmington, Morehead City-Beaufort, and Manteo. The UNC System could create a virtual presence for its marine-related assets by aggregating and integrating them on a web site. The foundation for such a web portal appears to already exist in the form of a website focused on Coastal and Marine Sciences in North Carolina (http://ncmarinescience.com/). This portal could provide easy, comprehensive access to individuals trying to find a particular expertise, looking for specific projects, or trying to find course offerings in marine and coastal science.

Reducing Barriers for Research and Academic Collaborations

The AAAS review panel felt that the assemblage of UNC marine Activities, while encompassing impressive depth and breadth in marine-related research and education, lacked clear coordination and a statewide strategic vision for its marine and coastal endeavors. This apparent lack of coordination is an impediment to the ability of marine programs to advocate and communicate not only with higher levels within the administration of higher education and political leadership, but also to the general public.

- **Research Collaborations**

RECOMMENDATION 4: The UNC System should foster stronger and more integrative research collaborations and focus more attention to communicating to the public the economic and societal benefit that such research is able to produce.

The AAAS review panel heard about a number of ongoing research collaborations between the institutions and this is an area that should be encouraged to expand. The broad range of expertise across the UNC system presents an opportunity for developing highly competitive partnerships. Apparently, under President Bowles, the system office solicited responses previously for inter-campus collaborative research activities with the expectation of funding, but a lack of resources prevented this program from being realized. This unfortunately has resulted in skepticism about such efforts. The fact that the current external review was commissioned without an expectation of new resources is actually helpful. This should cause institutions to focus on stewardship of critical core capabilities instead of just worrying about jostling for new ones. Certainly system-wide collaboration could be framed around resources, the maintenance of current resource levels as well as attempts to secure new resources from the State of North Carolina or from other sources external to North Carolina.

Collaborative research efforts could also lead to increased efficiencies and support within the research enterprise for grant writing, patents and licensing, technology commercialization, and shared computational facilities.

• **Academic Collaborations**

RECOMMENDATION 5: The UNC System should encourage efforts to remove barriers to academic collaboration. For example, the UNC System could facilitate academic interaction by removing barriers that currently inhibit student and faculty exchange across institutions. Steps could include:

- selected course offerings across the system that might be targeted or designated as system-wide courses,
- common degree programs (Master's or Ph.D. level) with one or more degree-granting lead institution(s) but participation by other institutions (the Maryland MEES Program is an example).

All of these would help to facilitate articulation within the UNC System.

RECOMMENDATION 6: The UNC System should encourage development of a coordinated online or hybrid course curriculum in marine science to leverage the breadth of activities offered throughout the State. These courses could be a component in common, shared graduate degree programs in marine science, and would help maximize the use of teaching resources in the State without requiring duplication in hiring.

The AAAS review panel saw an opportunity for sharing the wealth of marine science expertise in the State through online courses and the use of technology in the curriculum. One opportunity would be to offer hybrid courses, with the bulk of the content offered online combined with a field component offered at the coastal marine stations.

• **Enhanced graduate and undergraduate experiential learning and field studies**
RECOMMENDATION 7: The UNC System and individual institutions should foster undergraduate research and encourage efforts to ensure that undergraduate and graduate student mentoring is sufficiently valued and rewarded.

For all the programs, it is clear that marine science activities provide enhanced hands-on learning and research experiences for undergraduates. The UNC System needs to assess the importance of experiential learning within the context of its strategic plan and then foster it as appropriate, encouraging recognition and compensation for faculty involved in it.

RECOMMENDATION 8: The UNC System should consider building and maintenance of dormitories to foster residential academic programs at the three coastal locations (Wilmington, Morehead City, and Manteo) and to facilitate statewide participation in coastal field studies. More broadly, the UNC system is encouraged to consider a more proactive approach to regular maintenance and upkeep of coastal facilities (including equipment) in conjunction with overall capital improvement schedules.

The coastal marine science activities offer unique facilities for focused research experiences (summer classes, semester-on-the-coast, etc.). Investment in dormitories at each coastal marine science region (UNCW-CMS in Wilmington, UNCCH IMS and NC State's CMAST in Morehead City, and UNC CSI in Manteo) has been suggested as a way to increase short course enrollments and provide living quarters for guest investigators. Institutions in the same region (e.g., CMAST and IMS in Morehead City) should be encouraged to coordinate or share dormitory facilities. And, while this does demand additional resources, it would significantly enhance these signature programs for North Carolina.

Marine Science Activities Planning and Communication

• **Strategic Planning**
RECOMMENDATION 9: Leaders of UNC Activities should develop unit-level strategic plans that articulate explicitly with strategic planning by their home institutions and by the UNC System. These plans should include benchmarks and quantitative metrics and use the self-study documents as a starting point. Periodic assessments should be undertaken to monitor progress.

All marine-related units should have strategic plans that clearly articulate their mission, vision, and values. Such plans should be developed with the involvement of external advisory boards, committees and councils. These plans should aggregate up to support the strategic plan of the units' home institution as well as the System's overall strategic plan. Outcomes should be directly related to these plans. Benchmarks and milestones, supported by quantitative metrics, will help to measure progress.

As a neutral broker, the System can facilitate the success of the unit strategic plans by encouraging inter-unit coordination and communication occur. Each unit should designate an individual charged with "administrative outreach" to other units, and identify an internal communication team with the responsibility to marshal resources and work with the System and other units. These efforts can complement and enhance existing assessment activities now

undertaken as part of the accreditation process required by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC).

• **Strengthening Internal and External Communication**
RECOMMENDATION 10: Leaders of UNC Activities should develop and execute a systematic and coordinated communication plan.

There is a need for these leaders to see that a system-wide synergy does not need to compromise a unit's fidelity to its home institution. Cultivating such system-wide synergies ensures future competitiveness and North Carolina is better prepared than many to meet that challenge. However, this will require a critical assessment of the current structures, sun-setting those that are not achieving meaningful outcomes and initiating new joint efforts that have bottom up and system buy-in (see additional discussion in Section II: The Degree to Which UNC Activities Coordinate). This may need to be facilitated by someone without institutional affiliation (for example, someone at the system level who is perceived as a neutral broker). The value of clear, coherent, and integrated picture of marine science in North Carolina to both internal and external audiences cannot be overstated (see section titled *The Degree to Which UNC Activities Coordinate*, p. 31).

To facilitate system-wide oversight, enhanced communication is essential at all levels: within institutions, among institutions and between individual institutions and the System Office. A coordinated communication plan needs to be developed and executed to achieve better internal and external recognition of marine related assets within the UNC System. Relevant parties should come together to determine a course of action to accomplish this in a way that does not interfere unnecessarily with unit autonomy or prevent a healthy level of measured inter-unit competition. Regular system-wide meetings to continue coordination and communication should be undertaken in the future. The AAAS review panel sensed that there was general, although not universal, willingness or even eagerness throughout the System to enhance communication and interaction, so now the time is right to do this.

Coordination of efforts related to public outreach could have system-wide benefits. Understandably, each institution has invested most of its efforts in its own public relations activities and must focus on its own priorities. Some programs were doing a commendable job in external communications, while others were less effective in that area. A signature brand that transcended institutions and drew people to a single portal to investigate the wide range of UNC System assets would clearly advantage all. The traditional modes of entry into UNC System assets would still operate but, the portal would provide the System-wide overview. The website http://ncmarinescience.com/ provides a conceptual example for this type of portal. The adage that "a rising tide raises all boats" is applicable in that enhancing the visibility of marine programs, and developing a vision of a coordinated network of interrelated efforts would be a powerful message.

• **Utilization of North Carolina Sea Grant and the Coastal Studies Institute (CSI)**
RECOMMENDATION 11: Leaders of UNC Activities should recognize and fully utilize the well-developed communication and outreach capabilities of North Carolina Sea Grant and the Coastal Studies Institute.

Two units within the purview of the AAAS review seem to be underutilized for the capabilities they offer to the entire system. The first is North Carolina Sea Grant, which has a formal communications program and also has resources to bring faculty, students and staff together for workshops, meetings and large events. Sea Grant might be engaged to coordinate a biennial "all-hands" meeting. UNC CSI has remarkable facilities for video production and editing. In some ways, this new unit is searching for a broader identity beyond the obvious goal of serving a regional field-going facility need. Partnering with Sea Grant on communicating coastal issues and UNC System solutions may be one such mission element, and the visible and strong presence of Sea Grant at UNC CSI suggest that that might occur.

• **Communication Technology**

RECOMMENDATION 12: Leaders of UNC Activities should encourage the use of modern communication and social media technology to improve inter-unit communication and to enhance the curriculum at both the undergraduate and graduate levels.

More use could be made of currently available technological resources to foster meetings via interactive video, web hosted technology, Skype, etc. Social media are critical for communicating with younger audiences. A communication strategy should be developed for marine-related programs within the UNC System. Such efforts are especially critical given the geographic separation of facilities within and across institutions.

Other

• **Development**

RECOMMENDATION 13: The UNC System should encourage all units to develop fundraising strategies and plans in coordination with their home institutions' development office to enhance external development programs and to engage external advisory committees and boards.

Many public universities have begun the transition to a more private university budget model. Partnerships with local industries and organizations are critical. The AAAS panel recognized that most UNC Activities could enhance their external fundraising through gifts. Enhancement of the fundraising enterprise goes hand-in-hand with outreach to the local communities. The AAAS panel recognized the excellent job North Carolina Sea Grant was doing with respect to public outreach. Sea Grant can be an asset in development of community relationships that may translate into successful development efforts.

• **Diversity Initiatives**

RECOMMENDATION 14: The UNC System should facilitate coordination of diversity initiatives for students and faculty in marine science.

With better coordination, the marine science activity at Elizabeth City State University has the potential to provide a pool of underrepresented minority students to the research-intensive programs in the State. Other additional efforts to involve minority students should be undertaken.

A lack of diversity of faculty and students is also a challenge faced by the majority of the UNC marine programs as well as for geosciences across the country. As noted in a recent report by

the American Geophysical Union[10], "the geosciences continue to lag far behind other sciences in recruiting and retaining diverse populations." Many of the programs lacked any well-defined plans for enhancing the diversity of their students, staff and faculty. This is a glaring omission and should be clearly articulated in future strategic planning efforts.

[10] Velasco and Velasco (2010) EOS Transactions of the American Geophysical Union Vol. 91. pages 289-296

Conclusions

The State of North Carolina is fortunate to have the intellectual capital of the UNC System to address its marine-coastal concerns and prospects. UNC System capabilities are formidable, both in terms of human resources and facilities. The UNC System has world-class institutions of higher education that participate in marine-related research from local and regional to global scales; strong State-based programs that excel in education and outreach; and non-academic programs that connect the institutions to stakeholders. In addition, the UNC System has the advantage of broad geographic presence throughout the State of North Carolina.

Many excellent programs, centers and institutes can be found within the UNC System. With appropriate coordination, collaboration, communication, and support, these assets can achieve even more than they already do and provide the state with additional significant return on its investment. The AAAS panel has offered fourteen recommendations that might be considered to help implement a more impactful and cohesive system-wide effort in the marine-coastal topic area. Most of these recommendations will not require great commitments of new fiscal resources, but they will require a common focus, clear leadership, more coordination and a commitment *by all of those involved*. The AAAS panel is convinced that if these recommendations are embraced and fulfilled at all levels, North Carolina will be in a leadership role nationally in marine-related research, education and service.

Section II:
An environmental scan of University of North Carolina Coastal and Marine Activities

Major Strengths or Unique Capabilities Supported by the UNC Activities

The AAAS panel expected to find significant strengths and capabilities supported by the campus activities throughout the UNC System, and it did. The following section offers highlights of unit strengths and their impacts.

The collective impacts of UNC coastal and marine activities extends from the transformative experiential student learning catalyzed by marine-related research at all institutions regardless of size and mission, to the research and faculty expertise that is a resource for national and state stakeholders (resource managers, business leaders, etc.), to specific positive economic outcomes, both fully realized (e.g., RecText, Surge Viewer, Surf Viewer, hybrid striped bass aquaculture), and potential (e.g., MARBIONIC, offshore wind energy, flounder aquaculture). Looking at the impacts and outcomes from marine-related activities as a whole, it is readily apparent that there is a strong case to be made for the importance of UNC-System research and education to the state and nation. A quantification of the economic value of North Carolina's coastal ocean to the State (e.g., fisheries, ecosystem services that enhance hazard resilience, tourism, etc.) would help to put the value of these efforts into context for the State.

Marine-related assets are found throughout the State of North Carolina. Along the coast there are three primary locations with ready access to the sea and where substantial laboratory and field research teams exist: Wilmington, Morehead City-Beaufort, and Manteo.

- **Wilmington.** UNCW labels itself North Carolina's Coastal University. In addition to the marine focus of the Center for Marine Science, coastal and marine themes are woven through the natural sciences, as well as through humanities, arts, and social sciences. It has a strong emphasis on experiential learning (primarily at the undergraduate and Master's level and also a Ph.D. in marine biology) that is facilitated by its proximity to dedicated research sites and to state-of-the-art laboratories and equipment. There is a rich cross-university curriculum that also includes inter-institutional partnerships such as the environmental science/environmental engineering 3+2 options with North Carolina State, articulation agreements with several North Carolina community colleges, international agreements with academic institutions, and internship opportunities with non-academic entities (e.g., state agencies, aquaria). Faculty members are dedicated and the leadership is forward looking. UNCW is looking to build capacity through additional innovative programming at levels that begin with K-12 (e.g., Marine Quest) and extend to partnerships between the MARBIONIC program and the Cameron School of Business (joint MBA postdoctoral fellowship) and to potential joint Ph.D. programs. Their focus is strategic with well-developed goals. The development of the Campus for Research Entrepreneurship, Service, and Teaching (CREST) is a potential game changer and has already resulted in significant uptick in grant support. UNCW has proposed the North Carolina Alliance in Marine Science (NC AiMS). In concept, this is the kind of collaborative partnership that would help to leverage the UNC-System's significant marine-related institutional assets in a coordinated and synergistic way.

- **Morehead City-Beaufort.** This area of the coast is home to the coastal lab facilities for UNC-CH and NC State and proximate to the Duke University Marine Laboratory. The central location along the coast provides convenient access to a large portion of state

waters and habitats. In addition, this area of the coast is home to several marine-related government labs.

- **UNC-CH Institute for Marine Sciences (IMS).** Located in Morehead City, IMS has 11 residential faculty (9 tenure track, 2 non-tenure track), who have stellar records of research (funding and publications) and service (federal, state, and local initiatives). The faculty members are engaged in research around questions that address three of the great societal challenges: the ability of people to live at the coast (hazards, sea-level rise), quality and safety of our water supply (ecosystem health and function, human health), marine resource development and sustainability (living and non-living resources, science-guided policy and protections). They are well-integrated into UNC-CH marine-related research activities, with most holding joint appointments in the Department of Marine Science on the main campus. In addition, the IMS-based faculty members have strong collaborations with other North Carolina institutions and marine-related activities. IMS faculty members actively participate in graduate education. Since IMS is not a degree granting entity, students matriculate through departments on the UNC-CH campus. IMS faculty are also active in other aspects of education, contributing to field, classroom, independent research, and capstone activities for UNC-CH students and more broadly for undergraduates from other institutions who participate in the NSF REU (Research Experience for Undergraduates) program in marine science that is based at IMS. The on-site seawater facilities are a significant plus and add to the breadth of research that can be conducted at the lab. These are shared with researchers at NC State-CMAST (located less than a mile away). IMS is also home to a state-of-the-art North Carolina Biotechnology Center-funded molecular training facility to train water quality professionals in molecular techniques. IMS has dormitories to serve visitors (faculty/students), although they need to be refurbished.

- **North Carolina State University (NC State)-Center for Marine Science and Technology (CMAST).** CMAST has a beautiful facility in relatively close proximity to Carteret Community College, North Carolina State Government Labs, and IMS. They have resident faculty from three colleges (Agriculture and Life Sciences, Physical and Mathematical Sciences, and Veterinary Medicine) spanning 6 departments as well as individuals from North Carolina Sea Grant and North Carolina Extension. The group is diverse and yet well-integrated with evidence of innovative partnerships on display throughout the building (the NCMSEP posters were particularly effective at presenting topical synergies). The leadership is forward looking with plans for growth that were well articulated and coincident with the NC State overall strategic goals. The focus at CMAST is on Ocean Health and Sustainability (One Health: healthy environment, healthy animals, healthy people). The presence of a marine animal veterinary science program and a food safety program make this site unique in the UNC System.

  CMAST is coordinating NC State's plans to add several new faculty in coastal and marine sciences through the university's program in faculty excellence and to develop a semester-at-the-coast program that will further enhance student

engagement via hands-on learning. To support the latter, CMAST has developed plans to add a dormitory/guest house.

- **Manteo.** The UNC Coastal Studies Institute (UNC-CSI) is a multi-campus research, education and outreach partnership that provides institutional context and operational capability for collaborative research and programming in northeast North Carolina with marine-related activities housed throughout the State. It is located in a brand new building that includes state-of-the-art facilities. UNC-CSI can offer place-based, experiential learning and research opportunities in a unique coastal environment that are coordinated for inter-institutional programming that can augment traditional campus-based experiences. UNC-CSI is still undergoing some growing pains as it develops a business plan to sustain itself into the future.

In addition to the coastal sites, North Carolina is home to five institutions with marine-related activities and one, North Carolina Sea Grant that spans the State from the coasts to the Research Triangle.

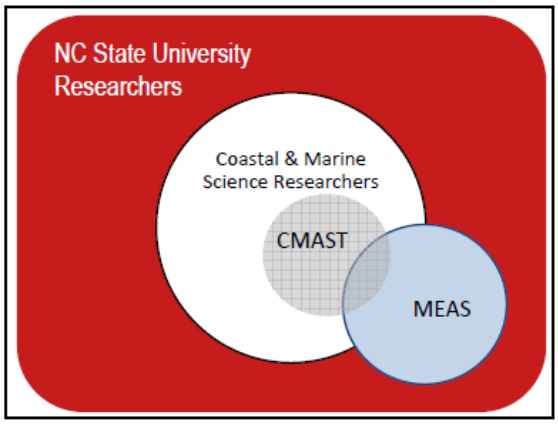
- **East Carolina University (ECU).** The focus at East Carolina is largely regional in keeping with their goal of being a "*national model of regional transformation.*" The Institute for Coastal Science and Policy (ICSP) aggregates together faculty shared with the Departments of Anthropology, Biology, Economics, Engineering, Geography, Geological Sciences, Sociology, and Recreation and Leisure Studies to bring a multidisciplinary perspective (natural sciences and social sciences) to marine-related issues. Marine-related education at ECU is focused primarily on coastal resource management, sustainable tourism, natural hazards, and maritime heritage/archaeology. All of these programs have strong partnerships internal and external to ECU and there is good placement of students. There is also a Coastal-Maritime Council within ICSP that coordinates the 50+ ECU faculty members and administrators who have interests in coastal science and policy, and provides overall advice to the Institute.

- **Elizabeth City State University (ECSU).** ECSU is a Historically Black College and University (HBCU) and offers degrees at the baccalaureate and masters level to a diverse student body. This is the only HBCU in the State to offer an undergraduate marine science program and it could provide a pool of qualified under-represented students to the other State marine activities. Marine-related activities at ECSU have three components: 1. the marine environmental science program itself; 2. undergraduate research experiences in ocean, marine, and polar science; and, 3. the Center for Remote Sensing of Ice Sheets (CReSIS). Much of the responsibility for the program is shouldered by Dr. Maurice Crawford, who is carrying a 4/4 teaching load, supervising undergraduate research projects, writing proposals, and trying to carry out a limited research program. ECSU has been very effective at establishing partnerships with other institutions (examples include CReSIS and DREAMS-Diversity in Research and Environmental and Marine Sciences-activities). Interestingly, most of the partnerships are external to North Carolina leaving significant scope for growth within North Carolina.

- **NC State University (NC State).** NC State Vice Chancellor for Research, Innovation and Economic Development Dr. Terri Lomax provided an excellent representation of how the marine programs were positioned within NC State. There is an opportunity to use

this type of visualization at other institutions and to then aggregate them to give a clearer and more comprehensive picture of marine-related activities in the North Carolina System.

Marine-related activities at NC State occur on the coast at CMAST but also in the Department of Marine Earth and Atmospheric Sciences (36 faculty) as well as in other departments across the university that are broadly categorized as Coastal and Marine Researchers (faculty from 14 units crossing 7 colleges). MEAS has a program that is well integrated across the geosciences from earth to atmospheric systems. It has significant depth and breadth in the area of predictive computational modeling of marine systems, alone or coupled to other components of the Earth System. The non-MEAS marine related activities are significant. Notable assets include the NC State Center for Applied Aquatic Ecology (CAAE) under the direction of Dr. JoAnn Burkholder that provides water quality research information to policy makers and the Program for Sustainable Coastal Engineering (SCE) and Ocean Energy (OE) which is based in at UNC-CSI in Manteo.



The relationship of marine science researchers at NC State. (Figure provided by Dr. Terri Lomax, NC State Vice Chancellor for Research, Innovation, and Economic Development)

- **UNC-Chapel Hill (UNC-CH).** There are three marine-related units within UNC-CH: The Department of Marine and Atmospheric Science (MASC), Institute of Marine Science at the coast, and the Marine Sciences Program (MSP). All have faculty that function at a research-intensive level. The 13 tenure track and 3 research faculty in MASC are located in state-of-the-art space in the new UNC Science Complex (Venable Murray Hall). There is a strong and ongoing relationship with IMS faculty facilitated via video technology which links IMS with the main campus and via shared students and research. MASC clearly aligns with the primary elements of the UNC-CH strategic plan, touching on 4 of the 6. Marine-related faculty members at UNC-CH extend beyond MASC (including Departments of Biology, Geology, Environmental Sciences and Engineering, and Mathematics; the Institute for the Environment and the Renaissance Computing Institute). They have established collaborative relationships with each other and with other NC academic institutions. These include shared institutional appointments and cooperative academic programs (e.g., Ph.D. with UNCW). Shared state-of-the-art facilities at UNC-CH include the Joint Fluids Lab, the Aquarium Research Center, the Trace Metal Clean Room and the ICP-MS with laser ablation. In addition to partnerships

within and between North Carolina academic institutions, UNC-CH marine related faculty also partner with non-academic entities such as federal and State government agencies and the private sector. This enhances their impact.

- **Western Carolina University (WCU).** Marine science activity at WCU is focused on the Program for the Study of Developed Shorelines (PSDS) run by Dr. Rob Young and Dr. Andy Coburn. This strongly-branded, widely-recognized program, transferred from Duke to WCU in 2006. It is focused on coastal processes, particularly the science underlying coastal processes, and on how to develop and communicate science-based management recommendations to resource managers and to the public. The program is externally funded with excellent partnerships and produces data products widely sourced by the media and other public entities. The program leaders include undergraduates in their research programs and in the development of data product and publication outputs (e.g., sea level rise adaptation plans for the National Park Service and NOAA, coastal impact plans for dam removal in the Elwha River Dam, and maintenance of multiple large data bases for coastal processes such as the storm surge viewer and the beach nourishment viewer). PSDS program leaders are also engaged in significant service to federal, state, and local communities on issues related to coastal processes. At WCU, the PSDS has also expanded into areas beyond simply coastal processes, but related to its geological foundation. It is a tremendous resource for students at WCU and at Duke and it would be beneficial if it was promoted more conspicuously as an opportunity for students throughout the system.

- **North Carolina Sea Grant (NCSG).** NCSG is a federal, state, university partnership that engages North Carolina institutions through research, education, and extension projects to foster science-based decisions about the use and conservation of marine resources. Its administrative base is at NC State in Raleigh but it has staff located at UNCW, CMAST, and UNC-CSI, thereby functioning as a bridge that links many of the UNC System's marine-related activities. It facilitates inter-institutional engagement, acts as an "honest broker" to translate research to application, and has a rapid funding mechanism that can be used to address critical issues that arise. In addition, it supports a North Carolina Coastal Resources Law, Planning, and Policy Center on the NC State and UNC-CH campuses. NCSG is nationally recognized for its excellence, consistently ranking at or near the top of the 32 SG College Programs by NOAA Sea Grant National Office reviews. The program provides North Carolina with identifiable impacts and offering significant return on dollars invested. It has strong partnerships across North Carolina in academic and non-academic sectors.

Major Challenges Limiting the Impact of UNC Activities

The AAAS panel recognized that the UNC marine-related activities were facing challenges common to many other programs across the country, in addition to some that were unique to the specific circumstances of individual institutions. The changing face of higher education across the country as well as looming budget challenges are felt by all higher education institutions, and are particularly acute for marine-related programs that depend so heavily on external funding to support research and graduate education. Many state-funded universities are recognizing that they are morphing into state-located universities as their percentage of state funding drops. Public universities can either recognize the changing fiscal environment or face prolonged financial stress, deteriorating quality, and eventual decline ("death by a thousand cuts"). Adapting to the changing landscape requires strong leadership and strategy to replace state revenues with alternate sources of funding, as well as efforts to control costs in innovative and unprecedented ways.

The marine-related activities within the UNC system have tremendous potential to be able to not only weather this difficult period, but position themselves strategically to adapt and evolve to new ways of doing business and serving research, educational and societal missions. Perhaps one the greatest obstacles to achieving this goal for the UNC marine programs is the lack of clear coordination and a statewide strategic vision for marine science. This has implications for the visibility and branding of marine science in North Carolina that is necessary for effective advocacy and communication within the UNC system, but also for communication with political and public sectors. The lack of leadership and coordination is also an impediment to effectively leveraging the depth and breadth of expertise and facilities across the UNC system to enhance capabilities to secure external funding and attract investment. In the remainder of this section, the AAAS panel considers challenges associated in the areas of people, equipment and facilities (as per the AAAS charge) as well as other areas identified by the panel.

People (teams, PIs, students, post docs). As noted under *Strengths* in the previous section, the researchers that the AAAS panel met were committed and dedicated. The various programs possess a broad range of individual talent, experience, and expertise and the faculty are true assets. Having said this, not all programs were "equal" in the sense that some programs such as WCU and ECSU have only a small number of faculty members in marine or environmental science programs serving a relatively large number of students. The UNC System may wish to examine whether strategic additions in faculty to these programs could yield benefits for broadening participation and enhancing diversity in marine science programs as well as Science, Technology, Engineering, Mathematics (STEM) education in general. Such programs may also have value as "feeder" schools for graduate programs elsewhere in the State. In addition to WCU and ECSU, UNCW also noted concerns about the number of faculty required to meet the teaching demands for their degree programs. Based on national trends, attrition due to faculty retirement is likely to be a challenge for all programs and something each program should consider in developing strategic plans for hiring new faculty at the institutional level as well as across the UNC system as a whole.

Finally, there were recurring themes in the self-studies about the challenges of recruiting and funding graduate students. Unlike some other professional programs, marine science programs traditionally provide support for their students, who are routinely expected to work on ongoing research projects. The ability to offer financial support is a major benefit to efforts to recruit

and retain high-caliber students. As funding becomes more constrained, so too will support for graduate students and institutions will have to expand and diversify the sources and strategies for funding students. This must necessarily involve efforts to secure funding for students through competitive educational grants, involvement of students in undergraduate teaching as teaching assistants, cooperative programs with private or public sector entities, and part-time students in employment situations that permit them to devote the necessary time to be successful in a degree program. Programs that explore alternative course delivery options (on-line, night and weekend course delivery, etc.) that are more accessible to the part-time or professional student should also be encouraged.

With regard to recruitment, the AAAS panel was provided with insufficient information to comment much about activities either at the institutional or system levels. Yet recruitment is a growing challenge as programs find themselves increasingly in competition not only with other marine programs, but with other fields as well. This is another example of how leadership at the UNC system level could benefit the entire UNC marine science effort through coordinated recruiting and branding of the marine science activities statewide.

Equipment. As was already noted, the nature of marine science research necessitates the use of expensive and highly-specialized equipment and analytical instruments. The various UNC coastal sites as well as their parent marine programs at the home institutions have an impressive inventory of state-of-the-art equipment and instruments. An emerging challenge faced by marine institutions in general is how to acquire and maintain such items and achieve an optimal level of use. The AAAS panel found very different strategies for dealing with expensive equipment used in marine-related research in the UNC system. On one end of the spectrum, UNCW openly shares its equipment with other users in the UNC System in return for reimbursement for supplies. Maintenance of the equipment is supported through return on indirect funds. Other institutions such as IMS operate their equipment as cost centers. Clearly, this is another area where inter-institutional coordination to facilitate shared use of expensive and highly-specialized equipment may be beneficial. Obviously, there are challenges to these types of arrangements, and different business models (e.g., UNCW or IMS) may be more or less appropriate to specific situations. However, UNC leadership might want to consider identifying centers of excellence for certain types of analytical capabilities that can serve multiple institutions where feasible. Strategies for coordinated asset development and usage will make UNC more competitive especially in an uncertain science funding climate. For example, as funding for start-up packages and major research instrumentation becomes more difficult to obtain, innovative thinking around partnerships will be necessary for universities across the nation.

Research Support Facilities. Facilities, especially research facilities, are expensive to operate and maintain and such costs are being scrutinized heavily as university budgets face rising costs and declining revenues. Additionally, while some facilities are relatively new and in excellent conditions (e.g., new buildings on UNCW campus, UNC CSI), other sites such as the IMS facilities are showing signs of age. Moreover, it was communicated to the AAAS panel that maintenance of the IMS facilities and possibly other sites are not part of system-wide or university capital improvement plans, leaving the burden of maintenance to fall on the individual laboratory. This is an unsustainable situation and the UNC system is encouraged to consider a more proactive approach to regular maintenance and upkeep of coastal facilities in conjunction with overall capital improvement schedules.

Two areas for which there was strong interest from UNC Activities were a functional coastal vessel and for dormitory space at coastal facilities. The retirement of the R/V *Cape Hatteras* was an external decision on the part of the National Science Foundation, which withdrew its support due to declining usage of vessels in the R/V Cape Hatteras class as well as considerations of its age and capability[11] [12]. This loss hampers the ability of UNC marine programs to provide both faculty and students readily available at-sea experience. An alternative that seemed to have considerable support was to acquire a smaller and more versatile moderate size catamaran vessel that could still maintain the needs of both research and educational activities. The AAAS panel encourages the UNC System to examine whether the operation of such a vessel could be financially sustainable given the multiple potential users within and outside the system of such a vessel within North Carolina as well as the external user community.

The need for dormitory space at coastal facilities was another area of common interest. Such facilities seem justifiable given the growing need to engage undergraduates in marine science as well as providing housing for graduate students, faculty and visitors conducting research at coastal sites. Summer experiences for undergraduates are perhaps one of the most effective ways to enhance the visibility of the marine programs across the State and garnish public awareness and support for these activities.

Other. The UNC system has various academic programs at the Bachelor's, Master's and Ph.D. levels. While a detailed assessment of each goes beyond the scope of the AAAS charge, it is recognized that academic programs are a critical aspect of the UNC marine programs. Despite their importance to the core mission of the various institutions, barriers to academic collaboration present a challenge for realization of the true potential for the UNC system to deliver a superior marine science curriculum. Various approaches to break down these barriers have already been suggested including system-wide courses, system-wide degree programs at the Master's or Ph.D. level, and distance learning and on-line delivery. Such activities may also help to overcome the challenges inherent in the geographic separation between the institutions as has been noted previously.

Even with these changes, an even greater challenge may be a reluctance on the part of some institutions to embrace such initiatives. The AAAS panel found that some individuals were reluctant to change the way their programs operate. In contrast, others were enthusiastic about this.

Another challenge seen by the AAAS panel was the lack of a system-wide communication strategy and clear branding for UNC marine science activities. For example, it was previously suggested that a branding of the UNC marine science activities as the "Marine Triangle

[11] Declining fiscal resources and increasing operational costs plague UNOLS (the University-National Oceanographic Laboratory System – www.unols.org) which operates our nation's research vessels. The loss of the vessel in North Carolina reflects an increasing challenge to maintain seagoing activities nationally. This situation is expected to get only worse in the future, as discretionary budgets get squeezed even further and as the cost of fuel continues to rise.

[12] "A Sea Change for U.S. Oceanography." *Science* 339 (2013)

Partnership" analogous to the Research Triangle in Raleigh/Durham might be advantageous. Communicating the unique qualities of each institution and the breadth and depth of facilities, infrastructure and expertise would be a powerful message.

The Degree to Which UNC Activities Coordinate

Substantive research collaborations already exist among institutions at the principal investigator level. Opportunities for coordination at the inter-institutional level have been discussed and include academic activities (system-wide courses, degree programs, on-line courses and distance learning) as well as messaging and public relations, and facilities and infrastructure.

The AAAS panel notes that attempts to develop coordinating councils in the past were apparently hampered by "turf" issues or lack of engagement. Over the years, a number of advisory boards, task forces and working groups have formed. In general, faculty impressions were that these entities had limited impact and some faculty expressed skepticism about these past efforts and their effectiveness. The North Carolina Alliance in Marine Science (NC AiMS) has been proposed by the Chancellor of UNCW to align marine programs in North Carolina, but whether other campuses buy-in to this is unclear.

The Marine Science and Education Partnership includes UNC-CH-IMS, NCState CMAST, Duke University Marine Laboratory, East Carolina University, NOAA, North Carolina Sea Grant and various community colleges, public school systems and other state and county agencies. This program appears to have merit, but excludes some programs and there was little information provided about it or its accomplishments.

One area of promising coordination was the relationship between the Marine Biotechnology in North Carolina (MARBIONC) and the Marine Bio-Technologies Center of Innovation (MBCOI) both at UNCW. These entities bring together researchers with private sector entities to support business incubator and economic development efforts around marine biotechnology initiatives. Another positive example of coordination was the Duke-UNC Oceanographic Consortium (DUNCOC), which was a multi-institutional consortium with the mission of operating the research vessel *Cape Hatteras*. The R/V *Cape Hatteras* has since been retired, and the fate of DUNCOC is uncertain. Thus, while some examples of coordination exist, the scope of these entities appears to be limited to specific thematic areas and none of them has a comprehensive mission.

Areas where coordination may be particularly advantageous include shared use of facilities. Some sharing of facilities is already occurring in specific situations, but much more can be achieved. Doing so, will not only achieve economies and leverage funding, but it will also increase impact. UNC Chapel Hill IMS houses space for North Carolina State CMAST in their seawater lab facility. A new coastal vessel would serve multiple users within the UNC system. This is especially important given the recent retirement of the R/V *Cape Hatteras*.

As was previously noted, the expansion of dormitory facilities that could house students from the main campuses at the coastal sites was a common theme across all the institutions. Summer programs at IMS and CMAST are constrained by dormitory space. In addition, educational programs at UNC CSI would also benefit from summer housing. This seems to be an obvious area where coordination and shared use of facilities would be beneficial.

While all institutions were engaged in outreach activities to some extent, some programs stood out. UNCW had various interactions with other institutions including student internships at state, federal and non-profit agencies. The Marine Quest program at UNCW is a receipt-

supported activity providing experiential learning opportunities for graduate, undergraduate and K-12 students. UNCW CMS was proactive in integrating marine science into various programs on the main campus. The summer programs at IMS, CMAST, and CSI could all be expanded. Another strong program was the Program for the Study of Developed Shorelines at WCU.

A major obstacle in coordination will be leadership. If any one institution appears to be taking the lead, other institutions may see this as a threat to their independence and stature related to marine science. Accordingly, leadership will be a challenge and a clear vision must be communicated as to what is the goal of this effort, what are the benefits, and how governance will be shared among the various institutions. Some agreement on how leadership for specific areas will be allocated among the institutions may be one approach for gaining acceptance of this concept. Limits to fiscal resources will always exist, and may even get worse. All entities must strive to work together to minimize costs and maximize benefits.

The Degree to Which UNC Marine Activities Overlap

The AAAS panel saw in each of the institutions a unique set of strengths and capabilities. Overlap in the expertise and research foci were minimal based on the self-studies and interviews with the UNC partners. While it could be argued that having three different coastal sites is duplicative, the case has been made that each of these coastal facilities is located in distinct geographic regions of the State and also serve different purposes. For example, the oyster research being done at UNCW and IMS involved differences in research priorities and each of these activities served a regional need to support the oyster fishery.

As already discussed, many of the marine institutions shared in the operation of the R/V *Cape Hatteras* prior to its retirement. Rather than overlap, this vessel provided a common platform that accommodated multiple and different uses specific to not only the UNC institutions, but to external users from across the country as well. All the marine programs would benefit from having a shared coastal vessel for example, and this would be consistent with the model used to operate the R/V *Cape Hatteras* by a consortium. Thus, such a model for vessel operation would increase efficiency and provide a more effective use of the vessel.

Dormitory facilities on the coast could also potentially be expanded and shared among institutions. This seems most logical in the case of CMAST and IMS, which are neighbors and both have need of student and faculty housing. These organizations already share seawater facilities so the shared operation of a dormitory is a logical extension.

The AAAS panel found that the academic programs exhibited unique strengths and curricular emphases. The panel still encourages the UNC System to examine the feasibility of a system-wide Ph.D. as other forms of academic collaboration and coordination. This would serve to ensure minimal overlap in the future as well as provide access to students to a wider range of options.

In summary, the AAAS panel did not identify any areas where there was obvious redundancy or overlap in programs. Rather, the various marine activities of the UNC System comprise a rich and diverse assemblage, the potential of which can be fully realized through improved coordination and collaboration.

Appendix: UNC Activities Included in This Review

Universities and Activities

The following institutions and Activities submitted self-studies for inclusion in the AAAS review.

East Carolina University

- Institute for Coastal Science and Policy
- PhD Program in Coastal Resources Management
- Program in Maritime Studies
- Other Centers and Programs
    - PhD in Economics
    - RENCI@ECU
    - Center for Sustainable Tourism
- Departments with Significant Coastal Components
    - Geological Sciences
    - Biology
    - Geography
    - Other: COAS minor

Elizabeth City State University

- The Marine Environmental Science Program
- Undergraduate Research Experience in Ocean, Marine, and Polar Science
- Center for Remote Sensing of Ice Sheets

North Carolina State University

- Department of Marine, Earth, and Atmospheric Science
- Center for Marine Science and Technology
- Coastal and Marine Science Faculty

University of North Carolina at Chapel Hill

- Department of Marine Sciences
- Institute of Marine Sciences

University of North Carolina General Administration

- University of North Carolina Coastal Studies Institute*
- North Carolina Sea Grant College Program*
- Water Resource Research Institute*

University of North Carolina at Wilmington

- Center for Marine Science
- MARBIONC (Marine Biotechnology in North Carolina)
- Department of Biology and Marine Biology
- Department of Chemistry and Biochemistry
- Department of Environmental Studies
- Department of Geography and Geology
- Department of Physics and Physical Oceanography
- Department of Public and International Affairs
- Watson College of Education

Western Carolina University

- Program for the Study of Developed Shorelines

* Inter-institutional Institutes/Programs of the UNC System

Appendix: AAAS Panel Member Biographies

Review Panel Members

Dr. Christopher F. D'Elia earned his A.B. in Biology from Middlebury College, his Ph.D. in Zoology from the University of Georgia, and did postdoctoral work at UCLA and at the Woods Hole Oceanographic Institution. Prior to joining Louisiana State University in July 2009 as Professor and Dean of the School of the Coast and Environment, he was Associate Vice Chancellor for Academic Affairs for Research and Graduate Studies and Professor of Environmental Science & Policy and Marine Science at the University of South Florida St. Petersburg. There he also directed the International Ocean Institute-USA and the Center for Science and Policy Applications for the Coastal Environment and served from 2007- 2008 as Interim Vice Chancellor for Academic Affairs. He has also held professorships in Biological Science and Public Administration and Policy and was Vice President for Research & SUNY Research Foundation Operations Manager at the University at Albany, SUNY. From 1977-1999, he was a Professor at the Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science. He served as Director of the Maryland Sea Grant College Program of the University System of Maryland from 1989-1999. He has held appointments as the Ruth Patrick Distinguished Scholar in Aquatic Science at the Academy of Natural Sciences (Philadelphia), as the Director of the Biological Oceanography Program at the National Science Foundation in Washington, D.C. and as Provost and Vice President for Academic Affairs at the University of Maryland Biotechnology Institute. Dr. D'Elia has held numerous research grants and has authored or coauthored over sixty scientific publications on the nutrient dynamics of estuaries and coral reefs, and on science policy. He is a Fellow of the American Association for the Advancement of Science and has served on numerous advisory panels to the National Science Foundation and other federal, state and private funding agencies. He was elected to membership in the Cosmos Club, Washington, DC, in 1994. Dr. D'Elia is a former President of the Estuarine Research Federation and former Chair of the Board of Directors of the Council of Scientific Society Presidents. He has chaired the Mid-Atlantic Regional Marine Research Board and the Public Affairs Committees of the Ecological Society of America and of the American Society of Limnology and Oceanography. He has served twice as President, and as Co-Chair of the External Relations Committee, of the Sea Grant Association. He has been a member of the Scientific and Technical Advisory Committee to the Chesapeake Bay Program and has been Co-Chair of the Legislative Committee of the Commission on Food, Environment and Renewable Resources and Co-Chair of the Board on Oceans and Atmosphere of the National Association of State Universities and Land Grant Colleges (NASULGC), and a member of the Executive Committee of the NASULGC Council on Research Policy and Graduate Education. He has been a member of the Board of Directors of the Hudson River Foundation since 1998 and also served as Chairman of the Executive Board of the Science Center of Pinellas County until from 2007 - 2009. He is serving a second 3-year term as a member of the U.S. National Committee for the Intergovernmental Oceanographic Commission of UNESCO representing the Coastal and Estuarine Research Federation. He is also a board member and Chair of the Southeastern Universities Research Association's (SURA) Coastal and Environmental Research Committee, a member of the Board of Directors for the Baton Rouge Symphony Orchestra, a principal and former chair of the Gulf of Mexico University Research Collaborative and the Louisiana University Gulf Research Collaborative, and serves as Principal Investigator of the LSU component of the USDI South Central Climate Science Center.

Dr. Jacqueline Dixon is Dean of the College of Marine Science at the University of South Florida. She obtained her B.S. and M.S. degrees in geology from Stanford University in 1981 and 1983 and her Ph.D. in geochemistry from Caltech in 1992. Her academic career began as an Assistant Professor in Marine Geology and Geophysics at the University of Miami's Rosenstiel School of Marine and Atmospheric Science in 1992. She is an internationally recognized leader in her field of igneous geochemistry with 36 published articles in top-ranked journals, including *Nature*. Her research specialties are mantle geochemistry and submarine volcanism. Specifically, her research focuses on the role of volatiles, mainly H_2O and CO_2, in the generation and evolution of mantle melts. She received an Early Career award in 1997 for excellence in research and education. In 2007, a premier journal in her field (EPSL)

acknowledged one of her papers as one of their top-50 most cited articles. Prior to her arrival at the University of South Florida in 2011, she served one year as Interim Dean of the College of Arts and Sciences at the University of Miami, three years as Senior Associate Dean for the Life and Physical Sciences in the College of Arts and Sciences, and five years as Director of the undergraduate program in Ecosystem Science and Policy. She was recently elected as a Trustee of the Consortium for Ocean Leadership. She is a member of the American Geophysical Union, the Geochemical Society, the International Association of Volcanology and the Earth's Interior, and the American Association for the Advancement of Science.

Dr. Steven E. Lohrenz is Dean and Professor of the School for Marine Science and Technology (SMAST) at the University of Massachusetts Dartmouth. Prior to becoming Dean of SMAST, Steve served as Chair of The University of Southern Mississippi (USM) Department of Marine Science, located at the NASA John C. Stennis Space Center. He received a B.A. in biology and chemistry from the University of Oregon (1978) and a Ph.D. in biological oceanography (1985) from the Massachusetts Institute of Technology-Woods Hole Oceanographic Institution Joint Program, and was a National Research Council post-doctoral fellow at the Naval Ocean Research and Development Activity (now part of the Naval Research Laboratory). His research extends across various themes of biological oceanography including phytoplankton physiology, community structure, ecology, primary production, biogeochemical cycling, and terrestrial-ocean interactions. His current work also includes applications of optics and remote sensing in the study of biological and biogeochemical patterns and processes in aquatic environments. He has authored or co-authored more than 60 papers in refereed literature and participated in more than 50 research cruises. He is a Contributing Editor for Marine Ecology Progress Series. He currently serves on the Board of Directors of the Northeast Regional Association Coastal Ocean Observing System and is Councillor-at-large of the Oceanography Society. He is a Trustee for the Consortium for Ocean Leadership, and is chair of the Consortium's Ocean Observing Subcommittee. He was formerly co-chair of the Board on Oceans and Atmosphere of the National Association of State Universities and Land Grant Colleges (now the Association of Public and Land Grant Universities). He has served on numerous other advisory groups including the Carbon Cycle Science Working Group (2009-2011) and the Ocean Carbon and Biogeochemistry Steering Committee (2006-2011), and the NASA Geostationary Coastal and Air Pollution Events (GEO-CAPE) Satellite Mission Science Working Group (2011-present). He is a member of the American Geophysical Union, the American Society of Limnology and Oceanography, the American Association for the Advancement of Science, the Optical Society of America, and the Oceanography Society.

Dr. Nancy Targett (Chair) is Dean of the College of Earth, Ocean, and Environment (CEOE) at the University of Delaware and Director of the Delaware Sea Grant College Program. During her tenure as Dean she has broadened the focus of her college to include Geological Sciences, Geography, Environmental Science and Environmental Studies in addition to the Marine Science and Policy Programs that were always the core of the college. The college turned 40 in June 2010 and what began as the Graduate College of Marine Studies, now, 40 years later, has both an undergraduate and graduate presence and is well-integrated into the fabric of the University. In 2008 she chaired a task force that developed a curriculum that would ensure that students received a truly multidisciplinary exposure to the issues in environmental science, while still getting the depth of disciplinary content necessary to be successful. The result was a cross-college multidisciplinary program established in September 2009 that is training tomorrow's environmentally-focused leaders. To model environmental sustainability and provide a platform for research efforts aimed at catalyzing the offshore wind sector, she built a utility-scale (2 MW) wind turbine at the Lewes campus. The turbine provides enough green energy to cover all of the campus' electrical needs. CEOE has a world-wide footprint with research programs that extend across the globe from the upper atmosphere to the land to the bottom of the ocean. Four years ago, Nancy initiated collaboration with Xiamen University and their College of Marine and Environmental Science. That effort now includes a dual Ph.D. degree program in Oceanography and has catalyzed interactions with XMU beyond CEOE such as the recently established Confucius Institute located at UD.

Nancy just completed her term (2010-2013) as chair of the Board of Trustees for the Washington D.C.-based Consortium for Ocean Leadership, a 96 member group of academic institutions, industry and NGOs with a focus on ocean issues. She is also an Aldo Leopold Leadership Fellow. A past officer of the International Society of Chemical Ecology, she has served on numerous editorial boards and been appointed to various national and regional scientific councils and committees. She has served on the National Academy's Ocean Studies Board and chaired or been a member of several of its study committees. She has also served on the Mid-Atlantic Fisheries Management Council and chaired the science and statistics committee and several species committees. Nancy is a past officer of the Sea Grant Association and currently serves as its treasurer. She lives in Sussex County. There she was a founding board member of the Jefferson School, an independent day school located in Georgetown, Delaware, and of the Sussex Academy of Arts and Sciences, a charter middle school also located in Georgetown, Delaware. She served terms as chair for both boards. She also served as a member of the board of St. Thomas More Academy High School in Magnolia. Currently she is a member of the boards for the Greater Lewes Foundation and for Cadbury Continuing Care.

AAAS Staff

Dr. Rieko Yajima is a Project Director with the AAAS Research Competitiveness Program (RCP), where she has led over 35 projects providing clients with technical assistance for improved research, development, and innovation strategies. Her expertise is in evaluating the outcomes and impacts of scientific research, as well as planning and implementing programs for strengthening research capacity and competitiveness. She recently led a comprehensive evaluation of the Marine Microbiology Initiative: a 10-year, $145-million effort to answer fundamental questions about the immense diversity of marine microorganisms and their roles in ocean health, funded by the Gordon and Betty Moore Foundation in Palo Alto. Rieko has organized symposia on emerging interdisciplinary topics for the AAAS annual meeting on research collaborations between artists and scientists, as well as the science behind delicious food. Trained as a biochemist, Rieko received awards for her Ph.D. research on RNA enzymes and has published over 10 research and review articles on the molecular structure and function of protein and RNA enzymes. Prior to AAAS, she was also a Science Policy Fellow at the National Academy of Sciences in Washington, D.C..

Appendix: Charge to the AAAS Review Panel

Charge for the AAAS Review

of the University of North Carolina Coastal and Marine Science Activities

(FINAL)

1. Understand the impacts of UNC coastal and marine science Activities.
    a. What are the most significant impacts in the following areas?
        i. Teaching and Instruction
        ii. Public Service, Outreach and Community Engagement
        iii. Professional Service
        iv. Research
        v. Economic Development
    b. How does the quality of the Activities compare to similar Activities elsewhere?
    c. To what extent have impacts been realized locally, regionally, nationally, and/or internationally?

2. Identify opportunities for coordination, leverage, and avoidance of unnecessary duplication of effort or resources.
    a. What major strengths or unique capabilities are supported by the Activities?
        i. People (teams, PIs, students, post docs)
        ii. Specialized equipment
        iii. Research support facilities
        iv. Connections to key stakeholders or resources
        v. Other
    b. What major challenges or gaps limit the impact of the Activities?
        i. People (teams, PIs, students, post docs)
        ii. Specialized equipment
        iii. Research support facilities
        iv. Connections to key stakeholders or resources
        v. Other
    c. To what degree do the Activities currently coordinate with each other?
        i. Is the level of coordination appropriate?
        ii. What mechanisms are used for coordination?
        iii. What could be done (institutionally or system-level) to enhance coordination?
    d. To what degree do the Activities overlap with each other?
        i. What is basis of overlap (e.g., research area, resource allocation, student recruitment, etc)?

ii. Is the level of overlap appropriate?
iii. Are there un-necessary redundancies?
iv. What could be done (institutionally or system-level) to minimize un-necessary redundancies?

3. What must be done, institutionally or at the system level, to maximize the impact North Carolina's coastal and marine science Activities?
    a. In the next 5 years, what are the most significant opportunities that could be pursued by the Activities, either individually or collectively?
        i. What key success factors are needed (financial resources, infrastructure, people, collaboration, etc.)?
        ii. What barriers or gaps of knowledge would need to be overcome?

Appendix: Site Visit Agenda

UNC Marine Science Activities Review & Site Visits
Master Schedule
Sunday January 27 – February 1, 2013

Sunday, January 27

6:00 pm – Dinner in Wilmington, Overview/Welcome with Dr. Chris Brown, UNC GA

Venue:

Manna
123 Street
Wimington, N.C 28401Tel 910 763-5252
http://mannaavenue.com/

Attendees:

Dr. Christopher F. D'Elia
Louisiana State University

Dr. Jacqueline Dixon
University of South Florida

Dr. Steven Lohrenz
University of Massachusetts

Dr. Nancy Targett
University of Delaware

Dr. Rieko Yajima
AAAS, Washington, DC

Center for Marine Science (CMS)
Marvin K. Moss Lane
Wilmington, NC

Monday, January 28, 2013

8:15-8:30 a.m.	Chancellor Miller, Provost Battles	Welcome remarks
8:30-10:00 a.m.	***Presenters*** Chris Finelli, Lynn Leonard, Sue Kesios, Jack Hall Academic I: Intro. Marine Quest, BS Oceanography, BS Marine Biology, applied learning, undergraduate research and scholarship, future	
10:00-11:30 a.m.	***Presenters*** Chris Finelli, Joan Willey, Mark Imperial Academic II: MS Marine Science, MPA Coastal Ocean Policy, MS Marine Biology, PhD Marine Biology, graduate research and scholarship, future	
11:30-12:30p.m.	***Presenters*** Dan Baden, Jeff Wright, Becky Porterfield MARBIONC: Marine biotechnology, millennium campus model, MBA Business of Marine Biotechnology, future	
12:30-1:30 p.m.	LUNCH	
1:30-2:30 p.m.	***Presenters*** Dan Baden, John Morrison CMS: core facilities, enabling activities, mariculture operations, marine alliance, ship, future.	
2:30-4:00 p.m.	Western Carolina	
4:00-5:00 p.m.	Tour	

Point of Contact:

Daniel G. Baden, Ph.D.
William R. Kenan Distinguished Professor of Marine Science, and
Director UNCW Center for Marine Science
5600 Marvin K. Moss Lane
Wilmington NC 28409

--Drive to Morehead City--

Institute of Marine Sciences
3431 Arendell Street
Morehead City, NC 28557-3301

Tuesday, January 29, 2013

8:00 a.m. MS Review Committee Arrive @ IMS

8:00 – 8:30 a.m. Greeting by IMS Director, Rick Luettich & brief IMS Tour

8:30 – 10:30 a.m. UNC IMS

10:40-12:40 p.m. UNC Department Marine Science

12:45- 1:30 p.m. Lunch

1:30 - 3:00 p.m. ECSU

3:10 - 5:10 p.m. NC Sea Grant

IMS Points of Contact

*Deanna Napier	Receptionist / Admin Assistant	252-726-6841 x120	mdgood@email.unc.edu
Melynie Conner	Admin Assistant	252-726-6841 x 121	connorma@email.unc.edu
Jean Stack	Admin Lead	252-726-6841 x123	cstack@email.unc.edu
Rick Luettich	Director	252-726-6841 x137	rick_luettich@unc.edu

*In charge of logistics on 1/29/2013

Point of contact:
Rick Luettich
UNC Chapel Hill Institute of Marine Sciences
Mobile (252) 342-6437
rick_luettich@unc.edu

Center for Marine Sciences and Technology (CMAST)
303 College Circle
Morehead City, NC 28557

Wednesday, January 30

Location:
Center for Marine Sciences and Technology (CMAST)
303 College Circle
Morehead City, NC 28557
Tel. 252 222-6302

Program:

I. CMAST Review & Discussion (0830—1010)

A. Overview by Dr. David Eggleston (Professor & CMAST Director) (12 mins)

B. CMAST Faculty Roundtable introductions (18 mins)

(i) College of Veterinary Medicine (Drs. Craig Harms, Suzanne Kennedy-Stoskopf, Michael Stoskopf)

(ii) College of Agricultural & Life Sciences (Drs. Jeff Buckel, David Green, Pat McClellan-Green)

C. QA with AAAS Review Team (30 mins)

D. Break (20 mins)

E. AAAS Review Team Discussion (closed) (20 mins)

II. Department of Marine, Earth and Atmospheric Sciences (MEAS) (1020-1150)

A. Overview by Dr. Walt Robinson (Professor & Department Head) (10 mins)

B. MEAS Faculty Presentations (20 mins)

(i) Dr. Roy He, Physical Oceanographer

(ii) Dr. Nicholas Meskhidze, Atmospheric Chemist

C. QA with AAAS Review Team (30 mins)

D. Break (20 mins)

E. AAAS Review team Discussion (closed) (20 mins)

III. Lunch 1200-1300 (second floor foyer)

IV. NC State University (non-CMAST & non-MEAS) (1300-1440)

A. Overview by Dr. Dave DeMaster (Professor & Chair of Marine Science Faculty) (10 mins)

B. NCSU Faculty Presentations (20 mins)

(i) Dr. Margery Overton, Civil Engineer

(ii) Dr. Joanne Burkholder, Marine Ecologist

C. QA with AAAS Review Team (30 mins)

D. Break (20 mins)

V. Summary & Synthesis of NCSU Activities (1450-1600)

A. Overview by Dr. Terri Lomax (Vice Chancellor for Research, Innovation & Entrepreneurship) (15 mins)

B. QA with AAAS Review Team (25 mins)

C. AAAS Review team Discussion (closed) (20 mins)

Meeting Ends at 1600

Point of contact:

David B. Eggleston
Director, Center for Marine Sciences and Technology
North Carolina State University
303 College Circle
Morehead City, NC 28557
Mobile 919-632-1720
(252) 222-6301 (o)
eggleston@ncsu.edu

--Drive to Manteo—

UNC Coastal Studies Institute (UNC CSI)
850 NC Highway 345, Wanchese, NC 27981

January 31, 2013

Research Building Room 262

Room 250 reserved for panel discussion sessions

8:00 Arrival	
8:15 - 8:30	Welcome UNC CSI Chair of Board of Directors, Michael Kelly
8:30 – 10:00	UNC CSI First session (1.5 hrs)
10:00 - 11:15	Break and Tour of UNC CSI Facilities
11:15 -12:45	UNC CSI Second session (1.5 hrs) Three hours total as prescribed in the advisory
12:45 – 1:15	Lunch
1:15 - 3:15	ECU Block 1 (2 hrs) Ditto
3:15 - 3:30	Break
3:30 – 5:30	ECU Block 2 (2 hrs) Ditto
5:30 - 6:00	Break and Conference Time for Panelists

Point of contact:

Nancy White, UNC CSI Executive Director

Direct Line: 252-475-5408
Cell: 252-414-7757

UNC Coastal Studies Institute (UNC CSI)
850 NC Highway 345, Wanchese, NC 27981

February 1, 2013

Research Building Room 262
Room 250 reserved for panel discussion sessions

8:00 a.m. Panel Meeting

11:00 a.m. Lunch

12-noon Departure

Point of contact:

Nancy White, UNC CSI Executive Director

Direct Line: 252-475-5408
Cell: 252-414-7757

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Appendix B: Activity and Asset Working Group Report

Executive Summary

The **Inventory of Activities and Assets Workgroup** found significant variability across the represented institutions as to how assets/resources are managed/tracked. The team concluded that a comprehensive system was warranted to best reflect the breadth and depth of the marine science program within the UNC system. It is the recommendation of this workgroup that dedicated resources should be supplied to develop and maintain the inventory and that the Marine Bio-Technologies Center of Innovation (MBCOI) was most suited for such a task.

Background

Upon the request of UNC President Tom Ross, an extensive review of the UNC marine science program was conducted in 2013 by members of the American Association for the Advancement of Science (AAAS). Seven UNC campuses as well as NC Sea Grant were asked to submit summaries of their marine-related programs for review by the AAAS committee:

1. East Carolina University (ECU)
2. Elizabeth City State University (ECSU)
3. North Carolina State University (NCSU)
4. University of North Carolina at Chapel Hill (UNC-CH)
5. University of North Carolina General Administration (UNC-GA)
6. University of North Carolina at Wilmington (UNCW)
7. Western Carolina University (WCU)

Site reviews were conducted at coastal locations in Wilmington, Morehead City, and Wanchese. Upon completion of the reviews, 14 recommendations were presented to the UNC-GA to improve coordination of UNC Activities that might then translate to better recognition of the strengths of the UNC marine-related activities both internally and externally. Of these, the top recommendation was for UNC-GA to "provide greater leadership and coordination of UNC System Activities," and "to build on information in the self-studies as well as other sources to maintain and disseminate an up-to-date inventory of programs and activities."

Following a two-day workshop with key leaders from each of the institutions, the UNC-GA reprioritized the needs into four workgroups, each with their own "Strawman Charge":

1. **Reinvention of a Consortium Workgroup**. Members of this workgroup represent the Directors of the four UNC coastal facilities/laboratories as well a representative from each campus, including ECSU, ECU, NCSU, UNC-CH, UNCW, and WCU. Duke University is included in this workgroup. Also included are representatives of the Duke Marine Lab and Duke University main campus. The workgroup will be co-chaired by Susan White, Director of North Carolina Sea Grant and Chris Brown, UNC-GA.

2. **Inventory of Activities and Assets Workgroup**. Members of this workgroup represent the campuses and the coastal facilities and were drawn from volunteers and/or those who were

suggested by individuals who participated in the August 2013 retreat. This group is co-chaired by Rob Young, WCU and Deb Mosca, MBCOI.

3. **Undergraduate Programs Workgroup**. Members of this workgroup represent each campus as well as coastal labs. Many members were drawn from volunteers, while some were suggested by workgroup participants. A general principle for populating the workgroup was to have reasonably even/similar representation across units.

4. **Graduate (Masters Level) Programs Workgroup**. Members of this workgroup represent each campus as well as coastal labs. Many members were drawn from volunteers, while some were suggested by workgroup participants. A general principle for populating the workgroup was to have reasonably even/similar representation across units.

The **Inventory of Activities and Assets Workgroup (IAAW)** was tasked with developing a plan for a comprehensive inventory of relevant coastal and marine activities and assets (people, datasets and capital) in North Carolina that would ensure accessibility, links to other activities, and be regularly updated. As part of that charge, the team was to identify resources available to implement the workplan and propose team members for build-out of inventory, ongoing maintenance, and a timeline for completion. The following describes the recommendations of the IAAW.

Introduction

The IAAW defines assets as people (and associated expertise) as well as specialized equipment/facilities which includes those freely available for collaborative projects as compared to some which have restricted availability but may encourage outreach for collaborations. In addition, it was agreed that the description/presentation of such assets should be considered with respect to the target audience. For example, a member of the scientific community looking for specific expertise to facilitate their research would want more detailed information than the general public. Similarly, an administrative body such as the UNC-GA might want additional descriptors of outcomes such as asset development and revenue generation to support their request for funding to the legislature. Hence, any 'inventory' should be capable of answering a variety of questions pertinent to the end users' interests.

As noted by the AAAS committee, dissemination of an up-to-date inventory of marine programs and activities would greatly strengthen recognition of UNC's marine science program within NC as well as across the country and world. Since a centralized system to capture assets from each institution does not currently exist, it is recommended that the UNC–GA implement the proposed plan to enable NC to be recognized as a world class research area for marine science.

Current Tools

Numerous websites, data collection, and organizations exist that collect/disseminate information on marine-related assets. For example, REACHNC is in the process of assembling public information on research activities in NC through its proprietary software. However, there is not an easy way to extract 'marine-related' research as a whole. The Marine Bio-Technologies Center of Innovation (MBCOI) has launched its own effort to collect, assess, and enter marine related assets into a user friendly searchable database and is working with REACHNC to extract their information directly.

Each institution has processes in place for collection of at least some types of asset data. However, it varies greatly across the UNC system and often is initiated manually as opposed to automatic updates. Attached is an Excel file that describes existing tools, programs, and websites that can be accessed to retrieve the data and how it may be used to inform different audiences. However, for many of the tools, it is not easy to extract those data relevant to marine sciences and one must be knowledgeable in searching those resources.

Recommendations

Going forward, it would be helpful to identify which institutional tools are capable of 'nested' searches and ensure that appropriate identifiers (e.g. "marine related" asset- personnel, expertise, facility, etc.) are present or can be added. Addition of a unified, cross-institutional inventory system that would allow stakeholders to easily identify assets throughout the state would work hand in hand with the goals of the **Consortium Workgroup** to improve communication and collaboration. Such a resource to address expertise is already being implemented by REACHNC and MBCOI is partnering with them to enhance retrieval of data on 'marine-related' assets to supplement its own effort to capture detailed inventory of marine-related expertise and technologies.

The members of this workgroup felt strongly that MBCOI is best suited to execute such an inventory process given its success in developing and implementing a process to capture marine assets throughout NC. By expanding the scope of its "inventory process" to include all information related to marine related assets, i.e. expertise, technologies, facilities, etc., MBCOI would be able to provide a unified source for both internal and external users. In order to be successful, additional resources from UNC-GA would be required to dedicate a person to the expanded inventory process, establish the data capture process with each institution and then update information on a regular basis, preferably through an automatic download from the institutions' sources. Equally as important would be the identification of a champion at each institution with the commitment and resources to assist with the export/capture of the data. This person would serve as a 'project manager" for their institution's cooperation and collaboration.

Conclusions

The workgroup agreed that such an inventory would be very helpful and likely increase collaboration not only within the state but externally as well. If made available to external parties as well, it might be able to help develop and sustain facilities through cost recovery charges, especially in the area of expertise and technologies available for development. Most important, it would serve to enhance NC's presence as a major force in the field of marine research.

Members	Title/Affiliation
Deb Mosca, MBCOI, co-chair	Chief Executive Officer
Rob Young, WCU, co-chair	Program Director, Study of Developed Shorelines
Jack Thigpen, NCSG	Sea Grant Program Extension Director
Terri Kirby Hathaway, ECU and CSI	Marine Education Specialist, Sea Grant Program

John McCord, CSI	Education Programs Coordinator
Robert McClendon, CSI	Interim Director, Academic Operations
Nathan Richards, ECU and CSI	Assoc. Prof, Dept. of History, & Program Head, Maritime Heritage
Lynn Leonard, UNCW	Department Chair and Professor, Geography and Geology
Paul Liu, NCSU	Associate Professor, Marine, Earth and Atmospheric Sciences
Chris Marten, UNC-CH	Distinguished Professor, Marine Sciences
Neils Linquist, IMS	Professor, Chemical Ecology
Jonathan Womer, UNC GA	Associate Vice President for Finance and Economic Analysis
John Morrison, UNCW	Assoc. Director for Academic Planning, Center for Marine Science

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Appendix C: Undergraduate Programs Working Group Report

In 2013, The University of North Carolina General Administration (UNC-GA) undertook a comprehensive review of the marine and coastal programs within the UNC System. UNC-GA engaged the American Association for the Advancement of Science's (AAAS) Research Competitiveness Program to help it assess the impacts of UNC coastal and marine science activities, identify opportunities for coordination, avoid unnecessary duplication of effort or resources, and identify opportunities to maximize the impact of North Carolina's coastal and marine science activities. This review concluded that coastal and marine programs in the UNC system provided a wide diversity of expertise and educational opportunities without unnecessary redundancy. Despite this general finding, the reviewers further suggested that coastal and marine programs in the state could be enhanced through improved coordination, collaboration, and support. The report, the institutions' self-studies and other materials can be found here (http://www.northcarolina.edu/research/initiatives/CoastalandMarineSciences.htm)
In a response to this review, UNC GA has organized four workgroups to consider opportunities for expanding collaboration in four primary areas: reinvention of a marine and coastal sciences consortium; undergraduate programs; graduate programs; and creating an inventory of marine and coastal science assets in the state. The Undergraduate Program Workgroup was charged with drafting proposals for developing academic collaborations that include experiential learning and other delivery methods, which will enhance Coastal and Marine programs and increase accessibility to these programs across all 17 UNC system campuses.
To this end, the workgroup drafted proposals in the following broad areas:

1. a 'semester at the coast' program to be offered during fall or spring semesters
2. a semester online course with field component
3. a summer course

Those proposals are presented below for your consideration. For each programmatic area, the workgroup considered the following principles:

1) proposed programs should not dilute or otherwise negatively impact existing programs;
2) proposed programs should not require significant new resources for implementation, although we recognize that any new initiative will not be without cost;
3) the autonomy of coastal facilities and campuses should be recognized, and development of cooperative programs does not preclude individual campuses from developing programs to meet the needs of their student populations.

Rationale - The statistics are staggering: 71% of the Earth is covered by oceans that hold 97% of all the water on the planet; there are more than 200,000 named species, and innumerable more unnamed species, in the oceans; the majority of protein consumed by humans is harvested from the ocean; more than half of the US population lives within 50 miles of the ocean; ocean-going ships carry 95% of the goods we trade with international partners; and one in six jobs is marine related. These data demonstrate the tremendous importance of our oceans to our climate, culture, and economy that is driving a large and growing interest among students in coastal and ocean sciences.
North Carolina has a long and diverse coastline, with economic impacts from fishing, tourism, ports, and other industries. Moreover, with low-lying coastal plains that are densely populated, hurricanes and sea-level rise pose significant risks that need to be understood. The UNC System has four excellent coastal marine science facilities (i.e., UNC CSI, NCSU CMAST, UNCCH IMS, and UNCW CMS) that support cutting-edge research and graduate education across the full geographical range of the NC coast. Select offerings for undergraduate students are also available at each site. These offerings range from

independent research experiences to full semester and summer programs to complete baccalaureate degree programs. Given the critical role of the oceans and coastal zones in all aspects of the human enterprise and growing demand for expertise in the marine sciences, it makes great sense to expand our coastal offerings for students. In particular, we emphasize developing experiential learning opportunities, which research demonstrates is far more effective for developing skills that are demanded by employers such as problem solving, communication, and evaluation. To achieve this goal, we believe it is time for the UNC institutions to work together to create new programs available to all UNC System students and possibly students from outside the state.

Program Title: UNC Semester at the Coast

Program Purpose and Audience: Because undergraduate degree programs rely primarily on formal coursework (vs. thesis-based graduate programs), it is difficult to resource and staff the number and diversity of undergraduate courses that would be needed to create a viable semester program at our coastal facilities. For example, undergraduate students must take 12-18 credits per semester to maintain full-time status and progress toward graduation. Therefore, to create a viable semester program at a single coastal facility requires the infrastructure, faculty, and staff to offer those credits. Similarly, to financially support that infrastructure and personnel, such a program would need to attract a sufficient number of students. As a result of the cost and risk involved, universities have been reluctant to commit scarce resources to support semester-long undergraduate programs at coastal facilities.

Successful, ongoing examples of semester-long marine programs for undergraduates demonstrate the range of possibilities that exist at the coastal facilities. For example, the two existing programs run as UNC Chapel Hill study abroad field sites, the Morehead City Field Site (MCFS) at IMS and the Outer Banks Field Site (OBXFS) at CSI, are intensive full-semester experiences that have historically been enrolled by UNCCH Institute for the Environment during fall semesters. Similarly, the relatively new "Summester at the Coast" program offered by ECU provides an opportunity for students from across the UNC System to participate in intensive field study during the summer. The great success of these programs highlights best practices that can be employed to further support undergraduate education at off-campus coastal facilities. These programs are especially well suited to provide focused, field-based experiences that are often transformational for participating students. Because of the intensive nature of the learning experience, these programs are optimal for relatively small groups of students able to devote a full semester away from the main campus. By contrast, because of their proximity to coastal habitats, UNCW, ECU and ECSU are able to offer complete baccalaureate major and minor programs that incorporate field-based experiential learning throughout matriculation. While these models can support a greater numbers of students, the learning experience is very different than that offered by the intensive MCFS, OBX, and Summester programs. All of these programs successfully expose students to the marine environment and to the skills required by employers, and each is helping to meet the increasing student demand for such field-based experiential learning. Unfortunately, even in aggregate these programs cannot meet the entire demand. We propose, therefore, a program that expands the capacity for undergraduate education at all coastal facilities while minimizing the risk and resource demand for any one facility.

For a Semester at the Coast program to succeed, it must surmount two critical challenges: 1) participation must be at a sufficient level to fill a core of coastal courses and 2) a dedicated group of

faculty must commit to teaching and joint-scheduling these courses on a recurring basis. To overcome these hurdles (particularly the enrollment), we believe collaboration between the institutions with coastal facilities would be the best recipe for sustainability and can provide the greatest breadth of opportunity for students. As noted in the AAAS report, each of the coastal facilities has a different coastal environment and subset of faculty with specialized strengths, so each can offer a different experience and opportunity for undergraduates. Therefore, we envision a Semester at the Coast program that is offered during the traditional academic year and allows students to reside and conduct independent research at one of the field facilities while taking courses via distance education offered at the other facilities. An integrated field trip would allow students to visit the other facilities without requiring extended rotations. This Program will allow 5-10 students at the sophomore or junior level to live near and learn at each of the facilities (20-40 students total) for a semester while completing a full course load and obtaining invaluable research experience.

Program Description: We believe that this experiential education program would be best designed for mid-level undergraduate students who are considering a career in a coastal/marine-related field or for natural science or other students looking for an affordable change of academic venue (i.e., a coastal experience). The courses in this program will involve online class lectures, field excursions and lab exercises, but also central to this experience is that all students will be expected to undertake a semester-long faculty-supervised research project (3 credits) involving data collection, analysis and report generation. These quantitative and communication skills are critical to success in STEM fields, including the marine sciences, and are among those most valued by employers.

We envision that as part of the Semester at the Coast, students would be expected to enroll in a total of 12-18 credits. Offerings will include a set of courses taught as hybrid classes (3 credits each) by each of the field sites (4 courses total, for a potential of 12 credits). Hybrid classes are those which blend learning using web-based, distance education with face-to-face instruction. These classes would use the significant distance education capability at the coastal facilities and may give students a better appreciation for the future of digital communication. Additionally, by using distance education technology, participating students will more easily gain exposure to different faculty and students. A multi-day field trip to each of the other coastal facilities would provide a hands-on experience and face-to-face interaction with instructors at other labs. Additionally, to provide more experiential training, at each of the facilities a focused “lab” (2 credits) will involve only the cohort of students at that field site, e.g., at UNC CSI, a field methods/lab class potentially involving geological and oceanographic data collection and analysis would be required.

Also, to add to this program and strengthen the UNC system as a whole, we feel a weekly seminar featuring UNC researchers should be offered, and Semester at the Coast students would be required to “attend” in person or virtually (for 1 credit). The physical location of speakers would rotate (e.g., 1st week of the month at UNCW, 2nd week of the month at CMAST….). As enrollment grows or interest dictates, it is conceivable that more flexibility can be allowed in the program, e.g., a student could take all classes at one location, but for successful initial development and to promote inter-institutional interactions, a required curriculum involving all the hybrid classes is recommended.

Program Element	Description	Credits
Hybrid courses	Web-based education courses (one taught by/at each field station) that include a short (2-3 day) on-site field experience at the course's home field site.	3 per course (6-12 total per semester)
Local Experiential Education Component	Specialized, semester-long "methods" training focused topics and skills of the field facility. This class would be required for all resident students at each field station.	2
Seminar	Rotating research seminar series offered through distance education system	1
Research	Independent research experience mentored by field station faculty.	3
Total credits for each student per semester		12-18

One of the challenges at all coastal locations is the limited availability of dorm space, with the possible exception of CMS which has dorms on the nearby UNCW main campus. It appears there are workable solutions in Manteo (for UNC CSI) and in Morehead City (for CMAST and IMS). Specifically, a nice dorm-like facility is available and currently being used by CSI visiting scientists and students, and accommodation space may be found at the Duke Marine Lab on Pivers Island, which is only a short drive from CMAST and IMS. An ideal improvement for better utilization of all coastal facilities is the construction of dorms. It is well known and noted in the AAAS Report that all coastal sites would become more accessible if dorms were added, and they could greatly enhance undergraduate education such as proposed here.

One possibility for expanding interest and involvement of campus-based faculty in the Semester at the Coast is to create a few semester or year-long teaching fellowships that would allow faculty to teach and conduct research at coastal field sites. These faculty members would be expected to teach a seminar course, but this would require additional resources and is not required for program development.
In sum, we believe the creation of the Semester at the Coast Program for the UNC system will be a significant enhancement to the undergraduate course offerings and will help build collaborations between the coastal faculty and foster a stronger, more integrated coastal and marine science community across the UNC system.

Program Benefits and Efficiencies: The program described increases undergraduate participation at all coastal facilities, while promoting cooperation among faculty members based at those facilities. The program capitalizes on existing resources (DE, housing, etc.) and employs best practices in undergraduate education (experiential learning). Cooperation among the coastal facilities allows us to build undergraduate capacity at all of them without any single facility having to absorb the entire cost and risk of an undergraduate program. Because this program draws 5-10 students to each of the four coastal facilities and spreads the teaching load among four universities, this program should have minimal impact on existing programs, while allowing continued growth of undergraduate programs at facilities that desire to do so.

Program Barriers: This program requires commitment from each university and UNCGA to provide faculty and resources to offer courses and support the experiential learning component. A common course schedule, tuition/fee structure, and mechanism to share SCH generation will need to be

developed for this program. It is likely that the new Language Consortium can provide a model for some of these issues. Programs and departments will have to determine whether and how credit will transfer from this program into existing majors and minors. Each participating unit will need to determine how to allocate faculty teaching for this program, either as on-load or as overload.

Program Resources

Extant: Each coastal facility is capable of sending and receiving DE instruction, supporting experiential learning, and housing a limited number of students.

Needed: This program will require a designated (3-5 years) Program Coordinator to orchestrate its development, manage logistics and scheduling, and an initial (2-3 years) set of core faculty will be needed to develop the courses and serve as local site coordinators. Some upgrades to DE facilities may be required at one or more coastal facilities. Funding to support labs and experiential learning will also be required until such time that tuition/fees could be used to offset these costs. If faculty teaching is done as overload, additional salary will be needed to cover that expense. Otherwise, course buy-out funding for faculty from involved departments is likely essential to enabling course and program development. Graduate assistantships will need to be provided to support participation by teaching assistants. It is critical that the development of this type of shared program does not drain resources (including personnel and SCHs) from existing degree programs that are meeting critical demand on main campuses.

Program Title: Semester Distance Ed Course with Optional Field Experience

Course Title: *Society and the Sea: An Undergraduate Online Seminar in Coastal-Marine Issues and Management with Experiential Opportunities*

Program Purpose and Audience: One avenue for expanding the impact and reach of coastal and marine programs is to offer students from across the State the opportunity to learn about and experience the diverse coastal habitats. Given the geographic distance of many UNC campuses from the coastal zone, distance education (esp. hybrid courses) offers the best opportunity for reaching the widest audience. We propose to create a multi-institutional, multi-disciplinary course on coastal and marine science and management that would take advantage of complementary institutional expertise and available distance learning technology and maximize awareness, access, and further opportunities for field-based experiences. We suggest initial development of an upper-division undergraduate seminar (3 credit hours).

Key components

- Develop and offer an online undergraduate seminar integrating the various UNC institutional strengths in a modular format focusing on coastal, estuarine, and marine resources; environmental and human dimensions of dilemmas; and management and policy solutions (coastal development, hazards, restoration, and adaptation.)
- Demonstrate the complementary expertise of UNC system marine and coastal science faculty by employing available technology using UNC Online, in a majority asynchronous modular format
- Embed active learning experiences in the field through short trips and virtual field trips within each module using available expertise and facilities

- Course available to undergraduates interested in coastal and marine science or management
- Enrollment open to marine and coastal science majors and minors within each institution
- Modest prerequisites to facilitate student participation
- Initial module examples (some or all of these may be selected for inclusion):
    - Habitat management and restoration
    - Drivers of change in the coastal zone
    - Coastal hazards, threats, and responses
    - Coastal-marine geospatial mapping, technology, and analysis tools
    - Coastal-marine resource management issues and methodology

Program Description: This course would be co-developed and led by core faculty across a number of universities (3-5 universities preparing modules) and made available to students in a variety of marine and coastal science-related majors from any UNC institution via a predominantly asynchronous, online distance education delivery medium. The definition of "coastal and marine" would be intentionally broad to facilitate student participation by majors without explicit marine emphases (e.g. biology, chemistry, environmental studies, geology, etc). This modular course would integrate complementary expertise from faculty and incorporate timely current events, scientific insights, management challenges, and policy debates. In addition, modules will incorporate a degree of optional field-based experiences, led by the offering institutions. Field experiences may include actual short field trips, real-time "virtual trips" guided by faculty (also asynchronously available), or the possibility of individual self-guided trips. Field education will generally take the form of a research and discovery mode, such as measurement and data collection.

Key components

- Course objectives will raise student knowledge and literacy in a targeted set of coastal and marine science and management issues (foci modules may vary year to year with current events, scientific advances, and faculty availability)
- Field trips will emphasize active learning, such as ground truth data collection (e.g., coastal atlas or remote sensing) or in situ ecological/organismic, chemical, or physical data collection and measurement
- In addition to actual field trip/s, the course will incorporate virtual field trip/labs, in real-time streaming guided trips broadcast from the field, w/ offline tasks and writing assignments (trips may be recorded for asynchronous access)
- Modules developed will be led by a small team from the participating universities
- Each module may have its own field trip component
- Field component may be optional with completion of alternative assignments
- Students need not participate in every field trip (at least 1 but up to 2-3 possible preferred)
- Appropriate and novel technology – Course will demonstrate and refine the best technology to integrate field/lab and asynchronous instruction. "Live" virtual field trips could be broadcast back to campuses. [e.g., 1) a "storm chase" faculty-led trip might showcase coastal storm meteorology, physical oceanography, observing systems and buoy data, and storm impacts; 2) a marine ecological science trip could follow a fisheries trawl and interview watermen or resource managers; 3) a management and policy trip might visit csites of contested coastal development and interview officials and local perspectives.]

- Participation by multiple university instructors from different institutions. Students from other universities w/o faculty would transfer credit.
-

Program Benefits and Efficiencies: This proposed course would identify and overcome impediments and present the path of maximum benefit and recruiting for the system as a whole with the least upfront cost. The course will attract not only existing coastal-marine academic students but also students from related disciplines. Learning from this course implementation, collaboration at other levels will also become more effective. In the short term, each university would identify an equivalency of this course or allow the course to transfer as elective credit. *We see this option as opening the door to an introductory course or even a menu of courses available to students.*

Key components

- Pedagogical, technological and inter-institutional successes could pave the way for a future lower division general education course across institutions (or even a MOOC)
- A successful course could attract more students to coastal and marine sciences and related majors and minors, leading to a larger coherent presence via UNC online and sustaining field-based semester and summer experiential learning
- Students doing the course on the exchange already pay their campus tuition and would not incur additional tuition costs
- Students would become more aware of and gain access to expertise at other institutions
- Offer an opportunity for more collaboration among faculty at multiple institutions
- Along with the Language Exchange, serve as a model for more inter-institutional collaboration, leading to enhanced efficiencies
- Provide an opportunity to raise awareness of coastal-marine issues among related majors
- Garner better public awareness and press through cooperation and marketing

Program Barriers

- Funding for field trips, video equipment, and streaming support
- course listings on individual campuses (alternative – offer at UNC online in one course designation)
- Coherent instructional atmosphere in the course; consistency and equity of recognition for offering the program; managed and marketed as a *joint* or *partnership* activity
- Smooth, portable, and coherent credit management (enrollment, access, assessment)
- Determination by each campus on how to accept transfer credit
- Determination by each campus of how to allocate faculty teaching in the course as on-load or overload
- Potential need to accredit/adjunct faculty if a single university is the home or manager of the course or if it is co-hosted by several universities.
- Need for full-scale marketing campaign of the course (advisors, dept heads, etc.)

Program Resources

- Extant
    - Existing majors and minors with student demand for such a course
    - Faculty available with complementary expertise; graduate assistants available for development and course assistance
    - System-wide DE infrastructure, e.g., UNC online and course exchange

    - Some institutions with outreach infrastructure could support field teaching technology needs (e.g., CSI)
- Needed
    - Instructional technology (especially media for virtual field trips. e.g., A/V, wi-fi hotspots, mobile application and cellular communication)
    - Funding for field trips (unless self-funded)
    - Allocated time for faculty to prepare and implement (TBD regular or additional teaching load)
    - Marketing needs, outreach
    - DE course development funding (grad assistant, summer faculty incentive or reassigned time)

Program Title: UNC System Summer Undergraduate Program in Coastal and Marine Sciences

Program Purpose and Audience: This program is targeted at undergraduate students from North Carolina and beyond who are interested in gaining comprehensive experiential education in coastal and marine science during the summer. The primary goal is to give these students a broad perspective on coastal issues by exposing them to a wide variety of classroom, laboratory, and field experiences. This effort will allow them to better understand and appreciate the complexity of coastal concerns, develop ways of addressing those concerns, and prepare them to be informed citizens and in some cases for graduate school and the job market. The secondary goal is to help meet the immense demand from UNC-system students for courses that satisfy the graduation requirement for experiential education.

A variety of summer courses are currently offered at all four of the UNC System coastal facilities (see Appendix for a listing), but the courses are not coordinated, and in some cases are offered at intermittent and irregular intervals, making it difficult for students to plan ahead and for those courses to develop a following. In addition, there are currently administrative barriers that restrict the number of summer transfer courses that students can apply toward their major or minor. Both of these problems are avoided by coordinating the curriculum under the umbrella of a UNC System Summer Program in Coastal and Marine Science.

Program Description: Below we provide a conceptual framework for a coherent, cooperative, and coordinated summer program across the system. Courses will be scheduled to fit into one of two sessions to maximize students' opportunity to cross-register throughout the summer. The specifics of the coordinated curriculum will be worked out based on input from faculty and administrators in the UNC-System Marine Sciences Community, and ultimately will depend on the availability of faculty, logistics, and student demand. Summer Program courses (especially those that are focused on experiential learning) will need to be approved by the Executive Curriculum Committee on each campus. Below, we list existing courses, and include one new course that provides students with a unique opportunity to study and experience three unique and contrasting North Carolina coastal environments in one six-week summer session.

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SUMMER COURSES AT THE NC COAST
Key: * proposed new course, * existing courses

First summer session (~mid-May—mid-June):

Ecology of the Carolina Coast (6)[1] [CSI, IMS, CMAST, CMS]
North Carolina Estuaries: Processes and Problems (3)[3] [UNC-CH & IMS]
The Atlantic Ocean and the Mid-Atlantic Coast (3)[2] [CSI]
Maritime Heritage of the Outer Banks (3)[2] [CSI]
Analysis Techniques and Methods of Coastal Ocean Research (3)[2] [CSI]
Managing Natural Resources (3)[2] [CSI]
Field Trip Lab Class (1)[2] [CSI]
Coastal Processes (5) [CMAST & CSI]
Coastal Ecology and Management (1) [CMAST & NCSU]
Research in Marine Sciences (1-3) [CMAST, CMS, CSI & IMS]
Service learning internship (1-3)[4]

Second summer session (~mid-June—mid-July):

Barrier Island Ecology and Geology (6) [IMS]
Methods in Marine Sciences (3) [CMAST]
Ocean Energy (3) [CSI]
Research in Marine Sciences (1-3) [CMAST, CMS, CSI & IMS]
Service learning internship (1-3)

[1] Proposed **new tri-location course** in which students spend two weeks at each of the three coastal facility locations, utilizing dorms at UNCW and ECSU (hotels at Morehead City/Beaufort for 2 weeks, or less). Enrollment can be maximized by rotating locations (i.e., 3 groups run concurrently in any one session, rotating among three locations; faculty at each site receive full credit for a whole course as they teach 3 consecutive groups (the same material) during a 6 week course. This is conceptually a new arrangement among the institutions, centers, and faculty.
[2]These courses are part of the "Summester at the Coast" program at CSI and sponsored by ECU. Students enroll in two 3-credit classes, and are encouraged to enroll in 1-credit field trip course.
[3]This is a "Maymester" class that includes two-weeks in Chapel Hill and one-week at IMS.
[4]Service learning internship: These are already offered at UNC-CH, and may be at other institutions too. There might be opportunities to develop APPLES service learning credit for students who want to serve as interns for National Oceanographic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), NC National Estuarine Research Reserve (NC NERR), the NC Aquaria (Pine Knoll Shores, Manteo, Ft. Fisher), the Maritime Museum, etc.

Program Benefits and Efficiencies: A coordinated UNC System-wide Summer Program in Coastal and Marine Sciences will greatly expand the number of *experiential* summer courses available to UNC System students during the summer with minimal input of new resources.

Most campuses in the UNC system require as a condition for graduation a course or credit-bearing activity that includes experiential education (e.g., original research, substantial fieldwork investigating

original problems using state-of-the-art methods, an internship assisted and supervised by faculty). An extensive and comprehensive curriculum of experiential coastal and marine courses, available during the summer session, will assist students in meeting this requirement and avoid unnecessary extensions to the time it takes to complete their degree.

Program Barriers: There are two barriers to this program. First, campus policies require that a majority of credits for a major/minor be earned at the degree-granting institution. This means that, for example, a UNC-Chapel Hill student who earned 6 credits taking marine sciences courses at CSI might only be able to use 3 of those credits toward his/her minor in Marine Sciences. This problem can be avoided by establishing an inter-institutional agreement (i.e., exchange system) that allows students at any UNC System campus to enroll in up to 12 hours of credit in UNC System Summer Program in Coastal and Marine Science.

Second, student housing is limited during the summer at off-campus field sites. Existing off-campus dormitory facilities, where they exist, are inadequate and substantially over-subscribed. Affordable hotels (~$150/week per student) are available, but clearly this is not ideal. Improved dormitory facilities at off-campus field sites are crucial to fully realize the benefits and efficiencies of the UNC System Summer Program in Coastal and Marine Science, and to attract out-of-state students and tuition receipts. Indeed, the Independent Review of UNC System Marine and Coastal Activities, commissioned by UNC System General Administration, recommended “building and maintenance of dormitories to foster residential academic programs” as a way to “significantly enhance these signature programs for North Carolina”.

Program Resources

a. **Extant:** See current listings of summer courses offered.
b. **Needed:** (1) Inter-institutional Agreement among UNC System campuses that would allow students to register for up to 12 hours of credit in the UNC System Summer Program in Coastal and Marine Science; (2) a program coordinator (3 months/year); (3) Summer Program courses (especially those that are focused on experiential learning) will need to be approved by the Executive Curriculum Committee on each campus based on specific agreed upon criteria. (4) a mechanism for allocating tuition receipts; (5) course development grants to provide resources for faculty to develop the new tri-location course; (6) modest advertising budget to attract students from outside North Carolina.

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ANNOTATED EXISTING SUMMER COURSE OFFERINGS
Current Course Offerings (only courses with experiential component involving UNC system coastal facilities are included):

Summer offerings in Marine Sciences at UNC-CH and IMS or CSI:

1. MASC 220- North Carolina Estuaries: Environmental Processes and Problems. 3 hours
   - Maymester; 1st and 3rd week in Chapel Hill, 2nd week at **IMS**
   - course is limited to 12 students
2. MASC 395- Undergraduate Research in Marine Sciences. 1-3 hours
   - Offered at either **IMS or Chapel Hill**

3. MASC 472- Barrier Island Ecology and Geology. 6 hours
   - Offered at **IMS** (sometimes joint with DUML) during a 6-week summer session.
   - course has not been offered regularly due to faculty staffing shortage (research obligations prevent summer teaching)
   - course is limited to 15 students
4. ENST490/ENST369 Ocean Energy
   - Offered in Maymester 2013 (ENST 490) and as a SSII short course (2013) at **CSI**

UNC-CH course schedule in 2014:

Maymester:	May 13 – May 30
Summer Session I:	May 13 – June 17
Summer Session II:	June 19 – July 25

Non-experiential courses (or experiential at places other than a UNC system facility):

i. MASC 101 – The Marine Environment. 3 hours (Chapel Hill)

Summer offerings in Marine Sciences at NCSU and CMAST or CSI:

1. MEA 459 Coastal Processes. 5 hours (last two weeks of May & first week of June)
   - Offered at **CMAST** with 3-day field trip to **CSI**
   - Offered off-schedule to accommodate housing opportunities at DUML
   - Course limited to 24 students
2. FW 314 Coastal Ecology and Management. 1 hour
   - One section meets one week during Summer Session I at **CMAST**
   - Course limited to 35 students
3. BIO, FW, MEA and ZO all offer independent study, research and internship credits
   - Offered at **CMAST or NCSU** in Raleigh (or any other field site where faculty are located)

NCSU course schedule in 2014:

Maymester: not official time at NCSU
Summer Session I: May 19 – June 24
Summer Session II: June 26 – August 1

Regularly offered summer non-experiential courses (or experiential at places other than a UNC system facility):

i. MEA 200 Introduction to Oceanography. 3 hours
   One section offered during first summer session at NC State University in Raleigh
   Course limited to 50 students
ii. MEA 210 Oceanography Lab. 1 hour
   One or two sections offered during first summer session at NC State University in Raleigh
   Each section limited to 24 students
iii. Various study abroad opportunities for NCSU credits.
   E.g. Bahamas Conservation Biology
   http://studyabroad.ncsu.edu/index.cfm?FuseAction=Programs.ViewProgram&Program_ID=3353&Type=O&sType=O

Summer offerings in Marine Sciences at ECU and CSI:

"Summester at the Coast" (ECU Courses):
Courses are for 4 weeks (see schedule below):

1. GEOL 2500: The Atlantic Ocean and the Mid-Atlantic Coast (3 credits)
2. GEOL 2501: The Atlantic Ocean and the Mid-Atlantic Coast Lab (1 credit)
3. HIST 2600: Maritime Heritage of the Outer Banks and the Adjacent Atlantic Ocean (3 credits)
4. GEOL 2600: Analysis Techniques and Methods of Coastal Ocean Research (3 credits)
5. ECON 2600: Managing Natural Resources at the Coast: Introduction to Economic and Sustainable Design Approaches (3 credits)

ECU course schedule in 2014:
Summer Session I: May 19 – June 24
Summer Session II: June 26 – August 1
Long Summer Session: May 19 – August 1
Summester @ Coast: May 21 – June 17 (course dates are "off-model")

Regularly offered non-experiential courses (or experiential at places other than a UNC system facility):

i. GEOL 1550 Oceanography. 3 credits. Offered in Summer I via distance ed.
ii. Most departments offer independent study, research and internship credits
   a. Offered at ECU or CSI (or any other field site where faculty are located).
iii. Various study abroad opportunities for ECU credits (http://piratesabroad.ecu.edu/) (e.g., Panama Marine and Terrestrial Ecology, Australia - Humans and the Environment).

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Summer offerings at WCU (none at NC coast):

1. Geol 140 – Environmental Geology / Geol 260 – Oceanography

   Course is an "Environments of the Bahamas" course that has a significant experiential learning component, is held at the Gerace Research Centre on San Salvador, and is taught in the summer every 2-3 years. The course falls under a different number depending on student needs. It is taught as a GEOL 140 course when the demand is from non-majors trying to fill a science liberal studies requirement, and is taught as GEOL 260 when the demand is from majors.

Summer offerings at UNCW and CMS:

Experiential Learning Courses offered in five departments surveyed
(Biology and Marine Biology; Chemistry and Biochemistry; Geography and Geology; and Environmental Studies)

COURSE #	CR	DESCRIPTION	Notes
291	Variable	Introductory Research[a]	Fr/So undergraduate research experience; offered on main campus and at CMS;
491	Variable	Directed Independent Study	Jr/Sr undergraduate research experience; offered on main campus and at CMS;
498	Variable	Internship	Off-site experiential learning for Jr/Sr
499	Variable	Honors Project	Senior thesis; offered on main campus and at CMS

[a] Oceanography and Physics do not offer 291.

Regularly offered non-experiential, traditional lecture/lab courses.

Department of Biology and Marine Biology

COURSE #	CR	DESCRIPTION	Max Enroll	Notes
BIO 312	4	Marine Botany Lecture & Lab	20	Marine Biology Core Course; Elective for Oceanography majors (Summer Session II)
BIO 357	3	Ichthyology Lecture	24	Marine Biology Core Course; Elective for Oceanography majors (Rare, Summer Session II)
BIOL 357	1	Ichthyology Laboratory	24	Marine Biology Core Course; Elective for Oceanography majors (Rare, Summer Session II);

BIO 362	4	Marine Biology Lecture & Lab	24	Marine Biology Core Course; Required for Oceanography majors (Summer Session I); Significant field component, Writing Intensive;
BIO 463	3	Coral Reef Ecology	12	Elective; Offered at CMS, 10 day Field Experience in Curacao (Summer Session I)

Department of Chemistry and Biochemistry

COURSE #	CR	DESCRIPTION	Max Enroll	Notes
CHM 101	4	General Chemistry 1 Lecture & Lab	24	Required for Marine Biology majors and elective for Oceanography majors (Summer Session I)
CHM 102	4	General Chemistry 2 Lecture & Lab	24	Required for Marine Biology majors and elective for Oceanography majors (Summer Session II)
CHM 211	3	Organic Chemistry 1 Lecture	24	Required for Marine Biology majors and elective for Oceanography majors (Summer Session I)
CHML 211	1	Organic Chemistry 1 Lab	24	Required for Marine Biology majors and elective for Oceanography majors (Summer Session I)

Department of Environmental Studies

COURSE #	CR	DESCRIPTION	Max Enroll	Notes
EVS 485	3	Natural Resource, Environmental, Tourism, Protected Land and Natural Heritage Management in Australia	12	Includes 25 day trip to Australia including coastal forest, estuaries, mangroves and Great Barrier Reef; Summer Session I
EVS 479	2	Introduction to Research Diving	12	Summer Session I
EVS 485	3	NC Coastal Issues and Experiences	12	Summer Session I
EVS 485	3	Island Ecology for Educators	12	Full term

Department of Geography and Geology

COURSE #	CR	DESCRIPTION	Max Enroll	Notes
GLY 120	3	Environmental Geology	24	Significant coastal emphasis
OCN 150	3	Introduction to Oceanography Lecture	24	Required course for Marine Biology majors and Oceanography majors
OCNL 150	1	Introduction to Oceanography Lab	24	Elective course for Marine Biology majors and Oceanography majors
GGY 230	3	Introduction to Weather and Climate	24	Elective course for Oceanography majors

Department of Physics and Physical Oceanography

COURSE #	CR	DESCRIPTION	Max Enroll	Notes
PHY 101	4	Elementary College Physics 1 Lecture and Lab	24	Required for Marine Biology majors and elective for Oceanography majors (Summer Session I)
PHY 102	4	Elementary College Physics 2 Lecture and Lab	24	Required for Marine Biology majors and elective for Oceanography majors (Summer Session II)

Members	Title/Affiliation
Chris Finelli, UNCW	Department Chair, Biology and Marine Biology
Maurice Crawford, ECSU	Assistant Professor, Biology
J.P. Walsh, ECU and CSI	Assoc. Prof., Geol. Sci., & Interim Prog Head, Coastal Processes
Martin Posey, UNCW	Interim Assoc Vice Chancellor of UG Studies
Tom Allen, ECU	Associate Professor, Department of Geography
Carrie Thomas, NCSU	Res. Professor, Marine, Earth and Atmospheric Sciences
Marc Alperin, UNC-CH	Associate Professor, Marine Sciences
Rachel Noble, UNC-CH, IMS	Professor, Institute of Marine Sciences
Benjamin Tanner, WCU	Associate Professor, Geology
Maggie O'Hara, UNCGA	Director of E-Learning
Laura Taylor, UNC GA	Academic Affairs, ACE Fellow

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Appendix D: Graduate Programs Working Group Report

Executive Summary

The **Graduate Programs Workgroup** was charged with developing academic collaborations at the Masters level to enhance Coastal & Marine programs across the UNC system. The group focused on enriching current programs through efficient and effective student-oriented courses and experiential opportunities, rather than considering new inter-institutional degrees. The workgroup developed 5 potential proposals that could improve inter-institutional educational opportunities for UNC faculty and students, including Graduate Student Committee Membership, new "issue-oriented" Short Courses, Field Trips, Coastal-focused MOOC, and Inter-institutional Course Registration. Although we found that some of these proposals (e.g., Inter-institutional Course Registration) were already available to students in the triangle, making them broadly available would enhance educational opportunities across the UNC System. We have provided a short proposal for each of these ideas as a possible way forward.

A Bit of Background…

In late 2012 through early 2013, an AAAS committee conducted thorough review of all Coastal & Marine related programs. The following campuses provided written summaries of their associated programs and presented this information to the AAAS committee:

- East Carolina University (ECU)
- Elizabeth City State University (ECSU)
- North Carolina State University (NCSU)
- University of North Carolina at Chapel Hill (UNC-CH)
- University of North Carolina General Administration (UNC-GA)
- University of North Carolina at Wilmington (UNCW)
- Western Carolina University (WCU)

Following this thorough review, a summary of which can be found here (http://www.northcarolina.edu/research/initiatives/CoastalandMarineSciences.htm), UNC General Administration hosted a planning retreat facilitated by the Small Business & Technology Development Center to identify specific actions and opportunities that would position the UNC Coastal and Marine enterprise for maximum success. From this retreat, four workgroups were initiated based on the areas deemed high priority:

- **Reinvention of a Consortium Workgroup**. Members of this workgroup represent the Directors of the four UNC coastal facilities/laboratories as well a representative from each campus, including ECSU, ECU, NCSU, UNC-CH, UNCW, and WCU. Duke University is included in this workgroup. Also included are representatives of the Duke Marine Lab and Duke University main campus. The workgroup will be co-chaired by Susan White, Director of North Carolina Sea Grant and Chris Brown, UNC-GA.

- **Inventory of Activities and Assets Workgroup**. Members of this workgroup represent the campuses and the coastal facilities and were drawn from volunteers and/or those who were suggested by individuals who participated in the August 2013 retreat. This group is co-chaired by Rob Young, WCU and Deb Mosca, MBCOI.
- **Undergraduate Programs Workgroup**. Members of this workgroup represent each campus as well as coastal labs. Many members were drawn from volunteers, while some were suggested by workgroup participants. A general principle for populating the workgroup was to have reasonably even/similar representation across units.
- **Graduate (Masters Level) Programs Workgroup**. Members of this workgroup represent each campus as well as coastal labs. Many members were drawn from volunteers, while some were suggested by workgroup participants. A general principle for populating the workgroup was to have reasonably even/similar representation across units. The workgroup will be co-chaired by D. Reide Corbett, ECU/UNC CSI and Courtney Thornton, UNC-GA.

The **Graduate Programs Workgroup** was charged with drafting proposals for developing academic collaborations at the Masters level, that include experiential learning at coastal facilities and use of current technologies (e.g., online learning), that will enhance Coastal & Marine programs and increase accessibility to these programs across all 16 UNC system campuses.

Members	Title/Affiliation
Reide Corbett, ECU/CSI	Professor; Geological Sciences and Coastal Processes Co-Program Head
Courtney Thornton, UNC GA	Associate Vice President for Research & Graduate Education
Antonio Rodriguez, UNC CH/IMS	Associate Professor, Institute of Marine Sciences
Mark Imperial, UNCW	Assoc. Prof. of Public and International Affairs
Joseph Luczkovich, ECU	Assoc. Prof., Department of Biology
Dan Kamykowski, NCSU	Professor, Marine Earth and Atmospheric Sciences
Gary Lackmann, NCSU	Prof. & Grad. Director, Marine Earth and Atmospheric Sciences
John Bane, UNC CH	Professor, Marine Sciences
Mike Durako, UNCW	Professor, Marine and Biology Dept.
Mo Gabr, NCSU	Professor, Civil, Construction & Environmental Engineering

Moving Forward…

Tasked with "...developing academic collaborations at the masters level...that will enhance Coastal & Marine programs", our workgroup agreed that we would do this while focusing on the NEED and what might be PREVENTING the creation of such programs. Through our early discussions, our workgroup developed 5 focus areas:

- Graduate Committee Memberships - enhancing inter-institutional collaboration
    - Make it easier
    - Streamline the system

    - Establish a system-wide faculty directory with areas of expertise
- Short Course taught at Marine Facility with specific focus (e.g., Alternative Energy; Ocean Instrumentation, etc.)
    - Likely taught in summer
    - Interdisciplinary – interface of science and society
    - Consider courses during regular academic year
- Short (1 or 2 day, weekend, etc.) Fieldtrips
    - Informal partnerships between faculty on campus and at coastal facility
    - Formal coursework
    - Other methods
- MOOC - Massive Open Online Course
    - Consider hybrid model
    - Can a field component be incorporated
- Inter-institutional Registration of Ocean & Coastal Courses
    - Broaden the current UNC-CH/NCSU/Duke partnership

A summary of each of these initiatives and insights into the possible implementations and challenges are presented below.

1. Graduate Student Faculty Advisory Committee Membership

Graduate faculty advisory committees play an important role in a graduate student's education. Active participation of graduate committee members provides valuable scientific input and increases mentoring and professional development opportunities. Graduate committees that include members external to a student's home institution can provide additional perspectives, and increase the chances of synergy between programs. By leveraging expertise across the broader university system, new collaborative opportunities and student thesis projects may be enabled. With remote communication technologies, graduate committee membership needn't involve time-consuming travel.

At the moment, some UNC institutions have easily-complied-with procedures for appointing faculty and other disciplinary experts to participate officially as graduate advisory committee members, while other institutions have more difficulty in engaging those from outside their own campus to participate in this way. We feel that there are at least two approaches to strengthening "outside-campus" faculty advisors for graduate students, as follows:

- The procedures given below are those presently in use at UNC-Chapel Hill and NCSU for including "outside-campus" advisors on graduate committees. The NCSU Graduate School Handbook describes the multi-institutional arrangement that allows graduate faculty from UNC-CH, UNC-G and Duke Univ. to serve on graduate student advisory committees without any procedural application or request by the outside-campus faculty member. Both sets of procedures are not only straightforward in their application, but they are also very encouraging in terms of bringing outside expertise into service on grad student committees. Adoption of similar procedures might be considered by most or all of the UNC campuses.

- A "Marine Graduate Faculty Consortium" could be established across the UNC system that would facilitate graduate faculty membership among marine academic programs in the system. We might look into how such a consortium might be structured and how it would function, and then see if there is consensus that this would be worthwhile. If implemented, it would be beneficial to have written agreements on the roles and responsibilities of graduate committee membership.

Examples of Current Procedures

UNC-Chapel Hill Graduate Student Committee Regulations
The following is from the UNC-CH Graduate School Handbook (handbook.unc.edu)

M.S. Committee Composition
A committee of at least three members approves any thesis required and administers any oral examination that may be given. A majority of the persons signing a master's thesis must be regular members of the UNC-Chapel Hill Graduate Faculty from the student's major academic program. Other members may be special appointees to the Graduate Faculty. The committee is approved by the academic program's director of graduate studies, after consultation with the student.

A student should have a faculty research advisor and a committee chair. One individual faculty member may serve in both roles if approved by the academic program. Both roles should be filled by regular members of the Graduate Faculty in the student's major academic program; however, at the request of the program and approval of The Graduate School, they may be fixed-term graduate faculty members or from another UNC-Chapel Hill program.

Ph.D. Committee Composition
A committee of at least five members is required. A majority of the members of a doctoral committee (and a majority of the people passing the student on an examination or approving a doctoral dissertation) must be regular members of the UNC-Chapel Hill Graduate Faculty from the student's major academic program. Other members may be special appointees to the Graduate Faculty. Doctoral programs are encouraged to include scholars from outside the program to serve as members of doctoral committees. The outside members may be selected from among scholars from other academic programs or from other institutions where scholarly work is conducted. The committee is approved by the academic program's director of graduate studies, after consultation with the student.

NC State Univ. Inter-institutional Faculty

The following is from the NCSU Graduate School Handbook
(http://www.ncsu.edu/grad/handbook/sections/1.3-grad-faculty.html#D)

D. Faculty from Other Institutions

Interinstitutional Faculty (Duke, UNC-Chapel Hill, UNC-Greensboro)

Faculty at Duke, UNC-Chapel Hill, or UNC-Greensboro who already have graduate faculty status are considered graduate faculty at NC State as well, inasmuch as they may sit on advisory committees (see Section 3.2). However, faculty in professional schools (e.g., medical, dental, nursing, or law schools) who are not graduate faculty at those institutions cannot serve as graduate faculty at NC State.

2. Short Courses

A series of new inter-institutional graduate-level short courses, taught at the marine facilities, will enhance marine science programs, increase accessibility of these programs across the UNC system campuses, and spur new cross-disciplinary research endeavors. In addition, these courses will increase use of the coastal labs and facilities by the various marine science academic programs and improve student awareness of opportunities within the UNC system. There is little overlap in faculty expertise and research focus across the various marine sciences programs throughout the state, which provides opportunity for collaboration on short-course topics that cross traditional disciplinary boundaries such as alternative energy, hazards, and coastal natural capital. The short courses could also focus on a new technique that graduate students from the various marine sciences programs need to use in their research. For example, Geographical Information Systems (GIS), geodetics, PAM Flourometry, and bioacoustics, are just a few topics with methods that cross disciplinary boundaries and are utilized in marine science programs across the UNC System. These new short courses will bring marine sciences graduate students from all UNC system campuses together for two weeks of intensive field-based study during the, maymester (two weeks), augustmester (two weeks) or summer term (four weeks). In addition to providing unique learning experiences for the students and better integration of the coastal labs into the wider UNC system community, the short courses will improve collaboration between faculty across the state, which will likely result in the creation of newly funded innovative cross-disciplinary projects.

Implementation: Need to determine which faculty are interested in developing such courses at the field stations. Determine focus of courses. Need to create a mechanism for students to sign up and get credit (off-model course; cross listing across universities, advertising, etc.). Will this be funded though course fees? Need to work out a way to allow these courses to count toward faculty teaching loads.

Challenges: There are some challenges associated with implementing these new courses that will require funding and new infrastructure. Students will need a place to stay and eat during their time at the coast. These classes will add to the faculty workload and possibly take time away from research endeavors. Faculty would be more likely to participate if this counted toward their academic teaching load. Experiential coastal and marine research involves boat costs, special training for diving, expenses associated with collecting data with the students to go

along with topics covered in class. Those costs can either be paid directly by the students or the host institution. If the additional expenses are passed on to the graduate student, then student participation will likely be small. The institutions within the UNC system have different academic calendars, which will present scheduling challenges.

3. Field Experiences

Need: Comprehensive graduate education in marine and coastal sciences requires more than just academic training in the classroom. Students need to have direct exposure to coastal and marine environments in order to gain a personal understanding of their structure, function, and responses to future impacts. Field trips and research cruises directed by UNC system faculty can provide the experiential learning opportunities that enrich marine science graduate education in North Carolina and contribute to enhanced management of our coastal resources. The UNC system, with its broad distribution of coastal facilities and vessel support, is uniquely able to provide students with hands-on learning experiences through the implementation of directed field trips and research cruises. Because of recent state and federal budget cuts, the capabilities of our coastal environmental and fishery management agencies to collect the array of data needed for optimal management and protection of North Carolina's coastal resources have diminished. The development of courses and field trips focused on a set of permanent sampling locations, established in cooperation with entities such as NOAA's North Carolina Sentinel Site Cooperative (NCSSC), could help fill these data gaps by providing valuable place-based information to coastal resource managers and policy makers while training students in the real-world skills necessary for science, management or policy-based careers.

Benefits: Field trips and research cruises are the best methods to enhance hands-on experiential learning for students. Field experiences provide students with direct interactions with the tools and techniques used in the study of coastal and ocean environments. This type of experiential learning will greatly benefit both marine and coastal science and policy graduate students as they become personally familiar with the diverse coastal environments of our region. Establishment of standardized sampling protocols, which may be applied to permanent coastal sentinel sites and cruise transects will benefit state and federal resource management agencies within North Carolina by providing long-term baseline environmental and biological data.

Implementation:

1. Generate a list of UNC coastal sites (CSI, IMS, CMAST, UNCW) and DUML that would be available to support field trips. For each site, list their facilities (dorms, labs, boats), resources (field sampling gear, environmental instrumentation, lab sample-processing capabilities) and technical support, which would be available for education purposes. Any charges should be stated and kept current.

2. Generate a list of current/potential coastal/marine field trip sites and research cruise opportunities across the UNC system campuses/labs.
    - Are these currently available on a regular basis?

- What grade level (K-12, undergraduate, graduate) is typically served?
- How many students can each serve?
- How open are these opportunities to students from other campuses?
- Contact staff of the NC National Estuary Research Reserves and NC Aquaria to explore field-trip opportunities.
  - Can the education specialists at these programs acts as local guides for some of the field trips?

3. Contact appropriate personnel within state and federal resource agencies to determine critical information and data needs that might be fulfilled through regular field sampling at UNC coastal sites. Explore opportunities for participation in the North Carolina Sentinel Site Cooperative or establishment of MOU's with specific coastal resource agencies to support institutional interactions and foster internship opportunities for providing hands-on real-world experience for students.

   - Determine spatial and temporal requirements, availability of standardized sampling protocols and equipment, most significant data gaps/needs (this could be a major constraint in arriving at a consensus as to what variables should be sampled, at what scales and at what frequencies).

   - Establish a set of permanent 'Sentinel Site' sampling locations (GPS-located with Benchmarks)
     - Salt Marsh
     - Barrier island
     - Beach dune
     - Surf zone
     - Rivermouth/Inlet/Coastal

   - Institute a set of standardized sampling designs and protocols for each site type
     - transects/quadrats/grid/point samples

   - Develop a standardized across-campus field guide with hierarchical sampling effort. Following is an example of how this might be approached:
     - Level I – Basic - all sites and all courses do this level
       1. Physical: salinity, temperature, light, Secchi
       2. Biological: density, cover, biomass
       3. Chemical (meter-based): dissolved oxygen, pH
       4. Geological: sediment/substrate type, bulk density, organic content
     - Level II – Intermediate – dependent on site facilities and faculty expertise
       1. Physical: elevation/depth, sea level, turbidity
       2. Biological: species diversity, morphometrics, reproduction
       3. Chemical: nutrient levels
       4. Geological: granulometry, porosity, etc.
     - Level III – Discipline-specific parameters – for targeted courses
       1. Physical: spectral irradiance, wave exposure

2. Chemical: nutrient fluxes, xenobiotics, CDOM
3. Biological: productivity, chemical composition, genetics
4. Geological: mineralogy, isotopic composition

4. Determine if field trips/cruises should be linked to proposed short courses or constitute a stand-alone course.
    - Can the field trips be set up support multiple courses?
    - Should field trips support the "flipped" classroom concept (online centralized lecture with a distributed multi-campus field component)?
    - Should a field course be set up to be the 5th core course (e.g., Field Techniques in Marine Science)

5. Week day versus weekend scheduling. What are the pros and cons?
    - Students need background lectures to gain an understanding of the context and goals of various field activities. Therefore, field/cruise trips at the end of short courses would be the most time/cost efficient.
    - Weekend field trips might limit interference with other courses, especially during academic year.

6. Provide lists/flyers of field trip and research cruise opportunities on a central website.
    - Send out notifications via mass emails (similar to COSEE).
    - The number of students that can be accommodated should be listed.
    - Seek support for a webmaster responsible for site development and maintenance.

4. MOOC – Massive Open Online Course

Background

MOOC offerings are is a relatively new concept that is being explored by the UNC system. The general format is videotaped lectures that are made accessible to the students through an on-line services. These facilitator services include "edX", which hosts courses from HarvardX and MITx and with "Coursera" which UNC recently joined. Students are given texts to read and test are given online and graded automatically. Searching on- line for offerings by the UNC-system yielded the following information:

NCSU: Mathematics Learning Trajectories Massive Online Open Course for Educators: Equipartioning (MLT MOOC-Ed) – College of Education

UNC-Chapel Hill: Carolina Joined MOOC Partnership with Coursera to offer noncredit courses online at no cost. The University will offer its first MOOCs this fall. The article which announced this initiative stated that five Carolina faculty members initially will offer four courses through Coursera:

i. Lorraine Alexander and Karin Yeatts, Gillings School of Global Public Health: "Epidemiology: The Basic Science of Public Health";
ii. Evan Feldman, department of music: "Fundamentals of Rehearsing Music Ensembles";
iii. Don Hornstein, School of Law: "Introduction to Environmental Law and Policy"; and
iv. Jeffrey Pomerantz, School of Information and Library Science: "Metadata: Organizing and Discovering Information."

A request for proposal to offer "UNC Emerging Economies MOOC" was issued in July 1, 2013. In this proposal, the two characteristics were specified as required: i. no prerequisites to participate meaningfully and ii. students should be able to participate both for-credit (for UNC system students) and not-for-credit (for non-UNC participants).

Duke University is offering an introductory ocean MOOC entitled "Marine Megafauna: An introduction to marine science and conservation," during Spring 2014. The details are here:

http://superpod.ml.duke.edu/johnston/2013/05/08/the-mega-mooc-taking-marine-megafauna-online-in-spring-2014/

Georgia Tech, in partnership with Udacity, plans to offer a massive open online course-based online computer science master's to 10,000 tech students. AT&T is underwriting the massive online degree experiment in hopes of finding more affordable ways to increase the national brain pool of computer scientists. Estimated price of the massive online computer science degree: $7,000.

Examples of Courses by US State Institutions on Coursera (hyperlinked):

i. University of Kentucky: Advanced Chemistry with Allison Soult & Kim Woodrum
ii. Jan 27th 2014-10 weeks long
iii. State University of New York: Introduction to Computational Arts: Processing with Margaret Anne Schedel & Timothy James Vallier
Jan 27th 2014-5 weeks long
iv. University of Colorado System: Fundamentals of Global Energy Business with Michael J. Orlando
March 2014-5 weeks long
v. University of Colorado System: Beginning Game Programming with C# with Tim "Dr. T" Chamillard
Sep 16th 2013-8 weeks long
vi. University System of Georgia & Kennesaw State University: K-12 Blended & Online Learning with Jordan P Cameron & Anissa Lokey-Vega
Jan 6th 2014-8 weeks long

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Summary

There is some effort within the UNC system to offer MOOCs, but it is not clear to what extent such an effort is targeted toward Ocean and Coastal sciences. Some of the questions that remain to be answered such that a program is successful are:

i. How to address the issues of academic integrity when a credit is to be given for a course or a group of courses?
ii. What students actually learn and what certificate or credit is to be offered in these courses?

Results from an on-going study at San Jose State University, sponsored by the National Science Foundation, indicated that regardless of the mode of course offering (MOOC vs Traditional) student motivation a primary factor for success, "that means students who took charge of their own education and submitted more problem sets, logged in more often and watched more videos than the course mean were more likely to succeed than their peers were." (the quote is from http://www.insidehighered.com/news/2013/09/12/after-weeks-delays-san-jose-state-u-releases-research-report-online-courses#ixzz2sMeJVoWY)

iii. What is the format of providing formative and summative feedback to the students?
iv. How to create the support the cyber infrastructure needed to make such an offering to a large group of students?
v. How many students remain and finish the courses to the end?
vi. How such an offering can be beneficial to the on-campus students?

It seems that offering on-line courses is the first step to offering MOOCS. Distance Education programs are offered at several of the UNC system campuses with the goal of increasing educational access to those undergraduate and graduate who cannot traditionally be full time students (although some full time students take advantages of the offering as well).

Recommendation

Our committee is focused on graduate-level education. Looking over the MOOCs offerings nationwide, these courses are mostly within the realm of first level, general courses that appeal to a wide audience. At this point, the value of MOOCs offering at the graduate level is unclear.

The committee, however, recommends exploring the possibility of offering multi-campus on-line graduate-level coastal-related collection of courses across the coastal disciplines. These classes will have the following attributes:

i. Will be open to UNC-system graduate students and offered in the form of flipped classroom setting. In this case, the lectures are pre-recorded and students gain exposure to new material outside of class. The class time is used for discussions, student presentations, solving practice time and the general assimilating of course materials.

ii. A portion of some of the classes will have a laboratory and field components that are taught at one of the four North Carolina Marine and Coastal Institutes.
iii. The laboratory and field components will serve to deliver core ideas and teach important skills such as field data collection, use of a specialized laboratory devices, and the principles of data reduction and related aspects of precision and accuracy

The committee recognized that the offering of these classes will require a commitment of resources including teaching assistants to help with conducting the class, a budget for laboratory and field work, accessibility to video-conferencing classrooms and the use of temporary housing for students during the field/lab excursions.

5. Inter-institutional Course Registration

Need: An inter-institutional course sharing arrangement, similar to that existing between UNC-CH, NCSU and Duke, may provide students access to ocean and coastal courses not available on their home campuses and create new opportunities for collaboration and efficiencies.

Benefits: In conjunction with increasing student access to system expertise, faculty will be able to market courses and programs and share expertise with a wider audience. Inter-institutional registration has the potential to create efficiencies (if X campus delivers Y course available through inter-institutional registration, then Z campus can apply its expertise to develop other needed courses).

How it might move forward:

The UNC Exchange, put in place in Fall 2013 for the World Language Consortium, provides a potential technical and administrative platform for seamless inter-institutional course registration across UNC institutions (http://online.northcarolina.edu/unconline/exchange.php). In February 2014, an interest survey was distributed to coastal and marine faculty at ECU, NCSU, UNC-CH and UNCW to explore the viability of (1) creating an inter-institutional "exchange" for distance-delivered courses in coastal and marine sciences and (2) developing 1-2 week short courses at coastal sites. Ninety-five faculty responded to the survey (34% ECU, 12% NCSU, 17% UNC-CH, and 38% UNCW). Highlights from the survey results include:

- 40 respondents (42%) identified at least one course they were currently teaching that could be part of an exchange. 45 courses were listed in total.
- Only 28% of the 45 courses listed as possible courses to be offered on the exchange are currently offered on-line; 72% (31 of 45 listed) would have to be developed for on-line delivery.

- Respondents most often cited release time, TA help, and technical support as the resources needed to develop and deliver a course through the exchange model.
- 27 respondents (31%) believed their existing master's curriculum had gaps that could be met through courses available at other UNC institutions; 46 respondents (53%) did not know if their existing master's curriculum had gaps or not that could be met through other campus's courses.
- 70 respondents (80%) indicated a course inventory would be extremely or very useful.
- Interest levels in developing short courses were most often somewhat or not at all. The most interest was in developing a 1-2 week field experience at a coastal site (42% of respondents definitely or very interested). No one site was of significantly more interest than another.
- Salary, housing and travel compensations were most frequently cited as the incentives needed to develop a 1-2 week short course.
- Respondents provided a mix of views as to whether inter-institutional course development and delivery through an exchange should be pursued. Several respondents indicated more clarity was needed as to the ultimate objective(s) and outcomes desired.

The large number of responses to the faculty survey was encouraging and confirms the need for further faculty engagement to clarify areas where the benefits will merit time, effort and other resources needed to pursue an exchange or short-course strategy for inter-institutional collaboration. A group of interested faculty could be assembled to further examine and interpret the survey responses and define the potential for an exchange pilot in coastal and marine sciences. As part of that effort, the group might:

  - Identify existing courses that are good candidates for an exchange now;
  - Identify existing courses that would be good candidates for an exchange in the future, if developed for distance-delivery;
  - Identify existing courses that would be good candidates for inter-institutional collaboration in course content and delivery;
  - Request seed-level funding that could be competitively awarded for course modifications and other activities contributing to a course exchange pilot;
  - Determine how to develop and maintain a course inventory across UNC coastal and marine programs.

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Appendix E: Marine Consortium Working Group Report

Executive Summary

This North Carolina Coastal and Marine Consortium report was developed through the diligent efforts of a joint University of North Carolina System-Duke University workgroup consisting of leaders from coastal and marine programs across the state. This report responds to a request from UNC-General Administration (UNC-GA) as a result of recommendations from a UNC System coastal and marine activities review facilitated by the American Association for the Advancement of Science (AAAS). The AAAS review was conducted at the behest of the UNC Board of Governors and President Ross to ensure that the UNC coastal and marine programs were operating efficiently and effectively, and without unnecessary redundancy.

The development and execution of any Consortium will be contingent on the strong justification of the need for such a group, as well as the positive engagement and support from all universities involved. The mission, goals and objectives address a suite of recommendations from the AAAS panel, and provide a realistic view from the bottom-up of what can be achieved through enhanced coordination and collaboration. Membership in the Consortium initially would be limited to the UNC System and Duke University, however as the Consortium evolves consideration should be given to expanding the membership to include non-university partners including governmental, industry and nonprofit entities. Recognizing that resources available for new programming are limited, some level of support will be required to ensure Consortium sustainability and functionality. Resource requirements will be better defined once the Consortium is established and has strategically selected priorities. The timeframe for establishing a Consortium is dependent on the perceived value of this activity by UNC-GA and the various constituent campuses and, subsequently, guidance from UNC-GA on how to proceed.

The new North Carolina Coastal and Marine Consortium outlined herein has the potential to enhance coordination, communication and engagement by complementary university programs across the state.

Introduction

The University of North Carolina and Duke University have considerable long-term and growing investments in coastal and marine programs across the state. Significant university investments are being made in science, education, and outreach that are impactful at local, state, regional, national and international levels. In Winter 2013, as a result of a request from the UNC Board of Governors and UNC President Ross, a formal review of the UNC System coastal and marine science programs was conducted by the American Association for the Advancement of Science (AAAS) to ensure that the UNC coastal and marine programs were operating efficiently and effectively without unnecessary redundancy. UNC programs reviewed included East Carolina University, Elizabeth City State University, North Carolina State University, University of North Carolina-Chapel Hill, University of North Carolina-Wilmington, and Western Carolina University.

Additionally, the North Carolina Sea Grant College Program and the UNC Coastal Studies Institute also were included as both are deemed "interinstitutional" programs working collaboratively across all UNC System universities with a coastal and marine focus in the state.

As delineated in the *AAAS Independent Review of the University of North Carolina System Marine and Coastal Activities,* there is no significant redundancy across programs in coastal and marine sciences within the UNC System. The panel recognized that the UNC coastal and marine enterprise represents a world-class research, education and extension program of significance to the state, nation and international community. The panel provided 14 recommendations to facilitate future growth and continued improvement of marine programs in the state. These recommendations were provided to assist the UNC System in working toward greater coordination that could engender a more cohesive and collective UNC coastal and marine program and improve program competitiveness in an increasingly competitive funding environment. AAAS recommendations were categorized into four overlapping areas: statewide planning and coordination; reducing barriers for research and academic collaborations; marine science activities planning and communication; and other.

This North Carolina Coastal and Marine Consortium (hereafter "the Consortium") workgroup was tasked with specifically addressing a set of overarching recommendations from the AAAS review and a follow-up two-day workshop held in Summer 2013 with leadership across the UNC System. Specifically, the Consortium workgroup was to develop a framework for the establishment of a Consortium whose leadership and coordination of UNC System activities would provide added value for the state. Any effort to support the development and coordination of coastal and marine programs across North Carolina needs to include not only the capacity within the UNC System, but also the considerable capabilities embedded within Duke University. Thus, Duke University coastal and marine program leaders were included with the UNC System leadership on the workgroup for additional perspectives and engagement in this important area for the state (See Appendix A for Consortium workgroup membership).

The workgroup defined how a Consortium could significantly contribute to, support, and add value to the coastal and marine programs across the state. The workgroup noted that there have been a series of discussions over the years to coordinate activities and that this information could be useful as any new Consortium is established. Specifically, the workgroup identified the Duke/University of North Carolina Oceanographic Consortium (DUNCOC) that was established in 1980 and ended in 2013 to jointly operate the research vessel *Cape Hatteras,* as well as a previous white paper developed by UNC-GA in 2010 that described a coastal and marine research council, to provide leadership and coordination across the state's coastal and marine programs. (These additional background documents can be found in Appendix B.) While DUNCOC effectively accomplished its mission for over 30 years, the coastal and marine research council never advanced past the planning stages. Thus, future coordinated university coastal and marine efforts will require a well-defined structure and purpose.

As part of the process of developing this Consortium report, workgroup members compiled feedback from across the represented universities to engage faculty and administrators to inform the development of the Consortium mission and goals. The workgroup noted the need for the Consortium to be articulated clearly across the state and supported at senior administrative levels, as well as by on-the-ground programs within the universities because any investment considerations of time, resources, etc., would have to be evaluated and assessed alongside competing priorities.

The information presented in this report provides an initial roadmap to assist UNC-GA in their deliberations with the UNC System and Duke University coastal and marine programs as to whether there is significant value in working together to develop and execute a Consortium. The Consortium mission, goals, objectives, membership, resources needed and a timeline for creation are provided as first steps and considerations during initial developmental discussions. A record of the conference call discussions can be found in Appendix C.

Consortium Mission

The North Carolina Coastal and Marine Consortium will promote cooperation and interaction among member institutions to leverage talent and expertise, to ensure superior learning resources, to explore efficiencies, and to maximize the positive impact on the citizens, coastal environments, and economic condition of the State, Nation, and international community.

Consortium Goals and Objectives:

Goal 1: Provide a vehicle for cross-institutional communications.

Objectives:

- facilitate communication and coordination to connect expertise and disciplines across universities and programs;
- help consortium members communicate the value of North Carolina's coastal environment and their role in providing vital understanding, education, and outreach to support the wise use and stewardship of important natural resources;
- promote interactions and exchanges of faculty and students among the partners;
- organize regular interinstitutional faculty and student science discussions (e.g., state-wide symposiums, "NC Marine and Coastal Conference", online & social media opportunities).

Goal 2: Promote continued excellence in coastal and marine research.

Objectives:

- leverage unique scientific expertise of consortium members to strengthen funding opportunities;
- support efforts to develop synergistic research projects involving multiple consortium

partners;
- develop mechanisms and sources for research "seed funding" for consortium members;
- identify research support from non-traditional funding sources.

Goal 3: Promote education, outreach and training opportunities.

Objectives:
- enhance the capabilities for experiential learning opportunities for K-12, undergraduate, and graduate students in research on the coast;
- facilitate institutional ability to capitalize on unique assets (e.g. observing systems, diverse facilities, research vessels) of member institutions to create integrated educational experiences, outreach opportunities, and partnerships for learners of all ages;
- explore collaborative opportunities (e.g. service on graduate committees);
- develop opportunities to grow educational investments, activities, and collaborations, ranging from traditional university-based educational programs through informal education and public outreach, on important coastal and marine issues (e.g. aquariums, UNC-TV,);
- aid and promote diversity initiatives for students and faculty.

Goal 4: Provide effective and efficient operations and facilities.

Objectives:
- periodically re-assess infrastructure use to maximize productivity and efficiency;
- continue and as practical expand methods and means to share large equipment items, for certain types of analytical capabilities that can serve multiple institutions where feasible;
- foster expanded statewide participation in coastal field studies and education, develop strategies for providing additional student housing through expanded dormitories
- facilitate opportunities to provide assistance with between-campus travel (e.g. regularly scheduled transportation among consortium members).

Goal 5: Engage with coastal populations, businesses, local government and the State.

Objectives:
- facilitate discussions to support infrastructure development opportunities;
- enhance and expand commercialization efforts from coastal and marine science discoveries and innovations;
- facilitate efforts to conduct economic valuation of coastal ecosystem services and natural and social capital, including direct and indirect economic benefits of marine science and technology activities;
- support faculty, student and staff engagement and outreach efforts;

- support, where appropriate and feasible, service-based activities with and for the people of the State, including state, county and local governments;
- facilitate a process for providing unbiased information for North Carolina institutions, including State agencies and the State Legislature, and their component organizations.

Consortium Membership, Roles and Responsibilities

The workgroup recognized that the Consortium mission, goals and objectives will likely evolve over time and these recommendations are provided as a starting point for discussions on membership and the roles of members. Initial membership was envisioned as including the UNC System and Duke University, however, at a future time other public and private members could be added. The workgroup recommends that:

1) Authority within the UNC System derives from UNC-GA, who authorizes the Consortium "charge" to the chancellors with authority to delegate authority and responsibility. Authority within Duke University would come directly from its president.

2) Initial roles and responsibilities will be to affirm, or redefine, the mission, goals and objectives presented in this document, to identify steps to take to achieve this mission, and to develop a set of bylaws for the Consortium.

Consortium Resource Requirements

Developing a specific set of resource requirements for the Consortium was not possible without specific goals, objectives, and administrative structure. The workgroup acknowledged that there were pros and cons to establishing a dues-based model to support the Consortium's efforts. While no specific fee structure was broached at this time, the workgroup briefly discussed the potential need to have different "membership levels" if the consortium were to include a variety of members (e.g. university versus non-governmental program). The option of considering private funds to support the Consortium's mission was also broached for consideration by the Consortium. The workgroup created a brief list of possible Consortium needs that could require resources including: staffing (full or partial FTE), convening meetings, seed grants, vessels, and housing at the coast. It is clear that some level of support is needed to ensure that the Consortium has the capacity to engage and respond appropriately to strategic opportunities to support coastal and marine resource programs across the state.

Consortium Timeline for Creation, Review and Initiation

The following provides a suggested timeframe for UNC-GA actions to move forward, as well as for the Consortium itself to consider.

1) UNC-GA receives the Coastal and Marine Science Consortium Workgroup report in April 2014 and works with the UNC institutions and with Duke University to engage senior administrators in considering the creation of this Consortium and solicits feedback specifically on the mission, membership, and resource components of the report (April 2014-July 2014).

Note: At least two facilitated discussions to support UNC-GA's engagement with these senior administrators across institutions are recommended.

Assuming that there is significant interest and engagement on behalf of these institutions the following steps and associated timeframes are suggested for the Consortium.

2) Member institutions identify Consortium membership based on the report and discussions with UNC-GA (July – Aug 2014).

3) Consortium members participate in a facilitated 1.5 day retreat in Fall 2014 to: a) discuss and commit to develop a strategic plan for the Consortium, including identifying a series of short, mid- and long-term priorities for the Consortium and specific strategies to achieve those objectives (short, mid- and long-term), b) consider what resources are necessary to address these priorities and how resources may be identified, and c) outline clear next steps, actions and responsible parties to develop a plan of action for 2015 (Sept-Oct 2014).

4) The Consortium, and associated sub-groups, move forward in discussions, engagement, planning and execution as identified in the Fall 2014 retreat. The Consortium will meet quarterly via conference calls to discuss progress, challenges and additional opportunities to consider for 2015 (Nov 2014-Aug 2015).

5) Consortium members participate in a facilitated 1.5 day retreat in Fall 2015 to review effort and contributions made in 2015, review effectiveness and consider any adjustments to improve Consortium design, and discuss, prioritize, and commit to a series of priorities for 2016 efforts (Sept-Oct 2015).

Conclusion

At the request of UNC-GA, this workgroup has developed an initial road-map for a new North Carolina Coastal and Marine Consortium comprised of the University of North Carolina System and Duke University, to support and coordinate coastal and marine programs within the state. It is clear that identifying and communicating the need for, and positive contributions from, such a consortium, as well as obtaining high-level administrative support from within the universities' administrations, will be critical for its success.

The Consortium's initial mission, goals and objectives are aligned with the recommendations outlined in the AAAS report and have been vetted within each university. While the initial Consortium membership is defined by leadership positions within the UNC System and Duke University, additional membership and strong partnerships with other public and private entities (e.g. government, industry, non-profits) should be considered once the Consortium is

established. A better understanding of the resources required to operate the Consortium will depend on the specific activities to be pursued. The need for some amount of support is clear to ensure the continuity and sustainability of a Consortium, with its goal is to coordinate and support a range of coastal and marine program needs across the state. UNC-GA, in close coordination with its member institutions and Duke University, will lead further activities related to building the Consortium. These will include identifying and evaluating the need for a Consortium, developing bylaws and a strategic plan, identifying resources and ultimately launching the organization.

Workgroup Membership

Members	Title/Affiliation
Susan White, NCSG (Chair)	Exec. Director, NC Sea Grant College Program
Chris Brown, UNC-GA (Co-Chair)	Vice President for Research & Graduate Education
Rick Luettich, UNCCH IMS	Director, Institute for Marine Sciences
Harvey Seim, UNCCH	Prof. & Chair and Director, Department of Marine Sciences
Dave Eggleston, NC State CMAST	Director, Center for Marine Sciences and Technology
Dave DeMaster, NC State	Prof. Marine Earth and Atmospheric Sciences
Dan Baden, UNCW CMS	Director, Center for Marine Sciences
Chris Finelli, UNCW	Dept. Chair, Department of Biology and Marine Biology
Cindy Van Dover, DUML	Dir. Duke Univ., Marine Lab & Chair, Div. of Marine Science
Lincoln Pratson, Duke	Chair, Earth and Ocean Sciences
Nancy White, CSI	Exec. Director, UNC Coastal Studies Institute
David Griffith, ECU	Interim Dir., Institute for Coastal Science and Policy
Rob Young, WCU	Program Director, Study of Developed Shorelines
Maurice Crawford, ECSU	Coordinator, Marine Environmental Science Program

UNIVERSITY OF NORTH CAROLINA
A SYSTEM OF HIGHER LEARNING

Appendix F: Operational Efficiency Report on UNC@Morehead City

Jonathan Womer, Associate Vice President for Finance and Economic Analysis, UNC General Administration

A. Summary

The most glaring inefficiency in the University of North Carolina at Chapel Hill's Institute of Marine Sciences (IMS) and North Carolina State University's Center for Marine Sciences and Technology (CMAST) is the lack of space utilization. About an additional 10,000 square feet could be occupied for $100,000 per year for a state government tenant or as much as $280,000 per year for a commercial tenant. In addition, merging the two facilities in brand and management would add additional efficiencies.

B. Background

The University of North Carolina at Chapel Hill's Institute of Marine Sciences (IMS) and North Carolina State University's Center for Marine Sciences and Technology (CMAST) are located approximately a half mile apart on the shores of Bogue Sound in Carteret County, NC. CMAST lies on the west side of property owned by the Carteret Community College (CCC). CCC occupies approximately 3/4 of the land between CMAST and IMS; the remainder is occupied by the North Carolina Division of Marine Fisheries (NCDMF). The National Oceanic and Atmospheric Administration (NOAA) and Duke University maintain marine laboratories on Pivers Island, approximately 5 miles east of IMS/CMAST.

CMAST is a four story 42,000 square foot building with offices on one side of the central corridor and labs on the opposite side. It was built in the late 1990s and is in good condition. The IMS facility is composed of three two story buildings that house research and office space, and a fourth smaller building that serves a dormitory function. Coker Hall, 15,000 square feet, was completely renovated in 2002. Coastal Processing and Environment Health is approximately 17,000 square feet and was built in the late 1990s. The Fisheries Lab, 7,500 square feet, which houses the salt water "wet" labs was built around the same time. The building of CMAST and the newer building renovations at IMS occurred at the same time as the Coker renovation.

1. How IMS and CMAST Operate

IMS and CMAST faculty and graduate students often collaborate on research. The directors of the two facilities have written many papers together. The IMS director has a PhD in civil engineering and has an adjunct appointment in the NC State engineering school in order to get engineering graduate students. However IMS and CMAST operate very differently, reflecting their institutions' individual missions.

IMS is managed as a separate "department" in UNC-CH with 11 full time faculty and associated graduate students and a facility operating budget of $1.4 M, reflecting its complete management of employees, operations and facility maintenance. UNC-CH allows IMS to keep 19% of administrative overhead of

research grants. It is a dedicated marine research lab with a history from the 1940s in fishery preservation. Fisheries preservation continues to make up a significant portion of the research. As a result, IMS might be more tightly integrated with NCDMF than CMAST. IMS researchers receive $1.8 M a year from NCDMF and faculty serve on the Coastal Management and Marine Fisheries commissions. The most pressing physical plant need of IMS is a back-up generator to protect research during storm related power outages.

CMAST is more of "NC State at the coast" than a purely dedicated marine research lab. CCC uses the fourth floor per agreements made during the beginnings of CMAST in the 1990s. The third floor is primarily occupied by the County Cooperative Extension Service which provides education and outreach functions like classes in breast feeding, cooking, sewing and raising chicks. It also provides a few offices for NC Sea Grant, The Science House and NC Marine Biotechnology Center of Innovation that provide services to both IMS and CMAST faculty as needed. The first and second floors are used in what would be considered as traditional research. CMAST has three full time faculty; whose salary and expenses are managed by their NC State departments. In particular, the veterinary school faculty have created an internationally recognized marine veterinary program. Interestingly, none of the faculty (part or full time) are from the school of engineering. CMAST feels it lacks a critical mass of faculty and it should have 6 more full time positions.[1] The CMAST facility operating budget is relatively small at less than $400 K, reflecting facility maintenance and faculty expenses handled centrally by NC State and NC State, rather than CMAST, collecting all administrative overhead on research grants.

2. Current Resource Sharing and Collaboration

An MOA outlining resource sharing between IMS and CMAST was written at the time of creation of CMAST and updated in 2001. Informal resource sharing happens frequently between the two facilities when one needs an extra boat, piece of equipment, or access to expertise. Formalized resource sharing in the Morehead City facilities currently include:

a) IMS provides facilities and operational support for two dedicated NCSU wet laboratories (total 765 sq ft)." - This relieves NCSU of a major expense of building, maintaining and operating a sea water pumping, filtration and distribution system at CMAST.
b) CMAST provides IMS and CCC with internet access through a system set up with MCNC.
c) NCDMF provide IMS with use of NCDMF pier, boat ramp, and dedicated boat slip.
d) CCC provides housekeeping, grounds-keeping, and facilities maintenance to CMAST.
e) CCC provides CMAST with access to a smaller pier and additional wet laboratory space.
f) IMS has an 8 person dorm that CMAST can use in the non-peak (non-summer) months. IMS uses the Duke University dorms on Pivers Island during the non-peak months.
g) IMS provides a SCUBA dive safety officer for recertification used by both facilities.

[1] NC State University Coastal and Marine Science Activities Self-Study (2012) page 35.

3. AAAS Findings

The American Association for the Advancement of Science (AAAS) report, Independent Review of the University of North Carolina System Marine and Coastal Activities (2013), provided a number of recommendations regarding the Morehead City coastal assets including:

a) **Branding and Merger**: "[W]hen someone in the public thinks about ocean sciences, he or she inevitably identifies leading institutions such as Woods Hole, Scripps, and perhaps a few others. Few professionals, even those in the marine sciences, would identify Morehead City as a national center of excellence, except perhaps for the researchers located there [but] Morehead City is truly an exceptional and important center of marine and coastal research at the national scale . . . with reasonable investment, marine science assets in the Morehead City-Beaufort area could easily be packaged as a national center of excellence . . . with some master planning and relatively little landscape architectural work and signage, a clear visual identity could be given to this significant campus as an integrated unit."[2]
b) **Research**: More coordination across facilities would increase external funding and investment.[3]
c) **Dormitory**: "significant program enhancement and efficiencies could be achieved if UNC Chapel Hill and NC State collaborate on operating a shared dormitory facility in Morehead City."[4]
d) **Equipment Sharing**: "A shared system to manage vessels and equipment could both improve efficiencies and expand access of these resources to a wider user base."[5]

C. Inefficiencies

Below are identified inefficiencies in the Morehead City operations. They were identified through requested raw data from the campuses, campus self-assessments, published reports, and interviews of faculty and staff through a Morehead City site visit.

1. Uncertainty Surrounding CMAST

Interviews with faculty and staff at both facilities suggest that the constant questioning of the mission and operation of CMAST is holding back the facility from reaching its full potential. Faculty are reluctant to become part of a facility that "is a sinking ship" and NC State has been reluctant to invest in a facility that is perceived to be a liability.

2. Lack of a Central Brand

The AAAS review found that the Morehead City parts were less than their sum. If the parts were integrated around a central brand the facilities would, most likely, receive more outside research

[2] Page 15.
[3] Page 28.
[4] Page 6.
[5] Page 6.

funding. This is particularly true given the recent resource changes in this area nationally.[6] Other regions have brought together pieces of marine science efforts from different organizations under a single brand. They include the very large and historic Woods Hole Oceanographic Institute[7] and the regional Hatfield Marine Science Center of Oregon State University that has provided a central brand over many non-university partners.[8]

3. Facility Utilization

Space utilization is difficult to quantify, as it varies with the time of year and number/types of grants. Generally speaking, CMAST is a quarter to a third underutilized and IMS is at capacity. IMS reports an off season occupancy of typically 70 people or so and an in-season (summer) occupancy of 105-110. CMAST, larger than IMS (especially when space specialization is considered), reports a total occupancy of about 60 and it reports a capacity 80 people for regular occupancy. Classroom utilization by CMAST, as reported to UNC GA, suggests about a third underutilization.

Specific findings suggest there is excess space capacity. CMAST has 4 video conferencing spaces, each about 550 sf. that are reportedly used 15-20 hours per week, an 1161 sf classroom on the second floor that is used 10 hours a week. On the 4th floor (Community College space), there are 2 large labs (1650 sf each) and a smaller computer lab (1044 sf) that are reportedly used 20 hours per week. The 2100 sf. library in IMS appears to be larger than needed, and there is no utilization data provided. CMAST exclusively uses an electronic library run from NC State. Most faculty/researchers have private offices regardless of how much they are on site. Graduate and post-doc occupants typically share office space with 2-4 people per office. Directors occupy the Directors office and maintain their own research office. There appear to be some lab spaces that are improperly sized for the current usage, i.e. kitchen labs, computer lab (685 sf for 2 people). CMAST has a machine shop (406sf), maintenance shop (132sf), and equipment fabrication shop (656sf) that don't appear to be as heavily utilized as IMS's shop.

The nature of the research at both CMAST and IMS requires wet suits, scuba gear, waders, nets, traps, and boats related equipment over and above more typical sample containers, lab equipment, etc. CMAST is in a very visible location on the Community College grounds with no place to store things near the building. They do have a remote storage location (1/2 mile away) with a fenced perimeter in which they can store boats and other large things outside, and a 4500 sf storage building that is weather tight. It is only about a third full. The IMS facility is not as open to view from either the road or the water, and they have some trees which allow them to keep many things 'out of sight'. During the 2002 Renovation of Coker, the wing formerly housing salt water labs was converted to storage bays totaling about 2800 sf. There is a 650 sf mezzanine in the Fisheries Lab building and 3 – 40' shipping containers that are also used for storage.

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[6] See http://www.sciencemag.org/content/339/6124/1138.full . *A Sea Change in U.S. Oceanography*, Science, March 8, 2013.
[7] http://www.whoi.edu/main/partners-sponsors
[8] http://hmsc.oregonstate.edu/agency-research

As noted in the background section of this report, the third floor of the CMAST facility is primarily occupied by the County Cooperative Extension Service. This occupancy adds no synergies to the marine science facility and seems to be used to prevent the space from being unoccupied. If it were moved it could occupy space of substantially reduced value.

4. Boat Management

CMAST has eight boats of an original value of approximately $123,000. IMS has 23 boats of an original value of approximately $626,000. Boats are almost always purchased with excess grant funding. IMS rents boats out to visiting researchers for fixed rates but they are not capacity managed in a central pool. IMS used to have a single large boat pool and it had similar difficulties as a motor pool without proper management in terms of maintenance and repair. Because of complaints, IMS moved to a "buy your own boat" model. As a result, IMS clearly has more boats than usage would warrant. CMAST has such few boats every transaction is handled informally.

5. Dorm Management

IMS has a small dorm for students and faculty that is a bit run down and not optimal for extended stays. The dorm averages 1819 bed-nights a year, which is 30% of full capacity. But it is at about 80% capacity during the summer months.[9] IMS charges $10 per night for students and $25 per faculty. In addition, Duke University has dorm capacity during the fall and spring semesters (not summer) that students and staff often use. Given the rates at Duke,[10] IMS might be able to charge more, but the Duke facilities are in better condition and have a dining hall that IMS does not.

6. Facility Operations

CMAST has most of their operations and maintenance activities performed by the Community College, with a few outside contracts for specialty needs. It has one maintenance staff member. IMS has a staff of six – two custodians, one supervisor, and three other maintenance staff. The maintenance staff is cross trained and performs other non-traditional functions. For example, the supervisor is also one of two licensed captains for the research vessel, and one of the mechanics is a licensed mate. The maintenance people at both facilities maintain boats and trailers, and fabricate salt water tanks and other apparatus in support of the research. These are beyond what would be expected of normal facilities maintenance and do not lend themselves to contracting out. NCDMF has a separate facility department and use prisoners for custodial. The facilities staff, at the three facilities, collaborates back and forth on the facility/maintenance end when they have issues.

It is possible that the housekeeping functions could be combined into the community college contract. Using the NCDMF contract would not be appropriate around students. IMS hired their last custodian from the community college but reports no excess capacity in custodial staff. Given the excess shop

[9] *Site Review of the Curriculum in Marine Science University of North Carolina at Chapel Hill*, 2014, page 9.
[10] http://nicholas.duke.edu/marinelab/visiting/individual-class-rate-schedule

capacity noted in the above facilities discussion and the maintenance of three separate facility organizations with generally the same mission, consolidation here could bring in some savings. However, there would have to be a single entity controlling all three entities like Hatfield or Woods Hole as discussed above.

D. Efficiency Options

1. Merge CMAST and IMS

A merger under a single director would directly address inefficiencies #1 and #2. It would also likely have a positive impact on #3 and #6. UNC-CH and NC State already run a joint Biomedical Engineering department.[11] This same governance model could be replicated with a joint marine science center. UNC Chapel Hill recently completed an independent Site Review of the Curriculum in Marine Science University of North Carolina at Chapel Hill and concluded that if any merger were to take place IMS should have the lead given its larger national profile.[12] This assessment seems factually based and reinforced by the IMS director's current ties to NC State engineering.

If CMAST and IMS were combined under one entity and space utilization was reviewed across all programs in all buildings, there are more space efficiencies to be gained. NC Shellfish Sanitation might fit in one of the IMS buildings. Classroom and videoconferencing space could be consolidated, increasing utilization and freeing up more usable/rentable space.

2. Fill CMAST with High Value Occupants

The most glaring inefficiency is the lack of utilization or high value occupancy of the CMAST facility. This could be remedied in a few different ways. Some of these proposals would require the County Cooperative Extension Service to be moved to less valuable space.

a. Division of Marine Fisheries

The Shellfish Sanitation and Water Quality Section of the Division of Marine Fisheries is not located in the DMS headquarters building.[13] Instead it must rent space 4 miles away for about $90,000 a year. Its five year lease expires at the end of November 2014. The leased space is for about 10,000 square feet and holds 18 employees and lab equipment. IMS faculty want the Shellfish Sanitation and Water Quality Section located close by for collaboration. This section could fit within CMAST or, if the facilities were merged, possibly the section could be located closer to the appropriate IMS faculty.

b. Marine Industries

[11] http://www.bme.unc.edu/
[12] Page 10.
[13] http://www.ncspo.com/fis/dbOWLease.aspx?OWLeaseID=8142

University of North Carolina at Wilmington routinely leases lab/office space to private companies in its recently completed Marine Biotechnology Building (MARBIONC) to achieve collaborative benefits of colocation with university and private partners. Annual rent at MARBONC is about $28 a square foot. CMAST or some CMAST-IMS merged entity could pursue a similar strategy. In particular, the seafood science work and the new marine magnetic imaging tool at CMAST is reported by faculty to have a number of industry uses.

c. More Faculty and Students

More faculty, students, research, and classes taught in Morehead City could fill the capacity at IMS and CMAST. While many proposals have been considered and rejected in the past, NC State is considering three proposals to bring more faculty and students to CMAST. The proposals that are being considered for funding are:

1. Natural Resource Economist: this position would be based in the College of Natural Resources and would interface with CMAST and NC Sea Grant faculty. Both IMS and CMAT faculty are very interested in this position. In particular, they are hopeful the position will be able to quantify the benefit of the two facilities to the public.
2. A cluster hire of three faculty: (i) Physiologist/Research Imaging, (ii) Molecular Microbiologist, (iii) Systems Modeler. These positions are part of a Marine Science Cluster hire proposal submitted by NC State Coastal & Marine Science Faculty, and this initiative will be considered by the Provost in the Fall.
3. Build a Dorm: CMAST has acquired 7 acres next to it in preparation to build a 36 person dorm at about $1.5-$2.5 M total. However, a funding mechanism has not been identified. It is made difficult by the seasonal nature of housing demand.

IMS is not part of the CMAST dorm proposal. Currently it feels its needs are met with its current dorm and access to the Duke facilities. However, IMS reports it could take three times as many students in the summer if they had space for them to live. The department of Marine Science at UNC-CH is contemplating adding a Marine Science undergraduate major which would increase demand on the Morehead City facility.[14]

3. Administrative Efficiencies

Administrative mergers between IMS, CMAST and even in some cases NCDMF could provide savings but they are unlikely to be substantial due to their size. In addition, due to the small size it is unlikely these savings could ever be realized if the facilities continue to operate under different management. There are not enough long term incentives to keep any administrative consolidation going. Possibilities include:

[14] *Site Review of the Curriculum in Marine Science University of North Carolina at Chapel Hill*, 2014, page 13.

- Custodial services merger onto community college contract, with savings possible of about $5,000.
- Machine shop merger saving a couple hundred square feet of space. Possibly some FTE savings if all three facilities were merged.
- IMS, CMAST (and NCDMF) shared boat pool. Likely save 1 to 2 boats immediately.
- Storage consolidation such that IMS could use CMAST storage facilities. At the very least IMS would not have to leave equipment outside or buy additional shipping containers for storage.
- Further space efficiencies if IMS and CMAST were merged.