AGENDA
ECU Board of Trustees
University Affairs Committee
ECHI Conference Rooms
November 19, 2009

I. Minutes

A. Approval of Minutes (September 24, 2009)  Action

II. Research and Graduate Studies

A. Institute for Coastal Science and Policy
B. Chancellor’s Workforce Initiatives
C. Stimulus Funding
D. Indirect Cost Rates
E. UNC Tomorrow Phase III
F. Life Sciences and Biotechnology Building

III. Athletics

A. Facilities Update
B. Financial Report
C. Athletics Update

IV. Academic Affairs

A. Conferral of Degrees  Action

V. Enrollment Management

A. Enrollment and Retention
Minutes of the Meeting of the
University Affairs Committee
East Carolina University Board of Trustees
September 24, 2009
1:30pm – 3:00pm
ECU Heart Institute, Conference Room

Attending: Bob Lucas (chair), Joel Butler, Robert Brinkley, Carol Mabe, Steve Ballard, Austin Bunch, John Durham, Nick Floyd, Terry Holland, Deirdre Mageean, Brad Congleton, Marilyn Sheerer, William Bodenhamer

Mr. Lucas opened the meeting by reading the conflict of interest statement.

Mr. Lucas welcomed the two new members of the University Affairs Committee: current BOT member Robert Brinkley and new SGA president Brad Congleton.

The committee approved the minutes of the previous meeting (April 16, 2009).

Athletics – Terry Holland and Nick Floyd

- Terry Holland said the softball complex likely won’t be ready for the start of the 2010 season and that the athletic department doesn’t mind pushing hard to get things done, but if it’s going to prevent ECU from having a first class facility than the timeframe may be moved back some.
- Terry said the football stadium expansion is still on track at this point. Bill Bagnell stated that the sewage and scoreboard project are working through some issues. Terry said the expansion project is still scheduled to be moving forward in December 2009.
- He talked about last year’s budget and they were pleased with how it went.
- This year’s budget is projecting zero budget increases as opposed to the last couple years of about 8 percent. He said ECU’s coaches and teams and staff are ready for that and anticipating the revenues conservatively to make sure ECU is ready for unexpected costs and expenditures. ECU expects having more revenues than the budget shows, but have some built in contingency plans.
- Terry provided an update to the out-of-state waivers for 2009-2010. Of the full scholarship athletes in the programs, 94 of them will receive the special provision out-of-state waiver.
- He gave an update on the Season Tickets for 2009 and said the biggest numbers of change have been for those in the cheaper ticket sections. The goal is to keep as open access as possible for those who support the programs to make sure they can continue to attend games and enjoy the experience.
- Terry talked about the first three games of the football season and expectations were a little bit higher after the big wins last year. We are disappointed that we didn’t win, but the season success is still well within reason.

Academic Affairs – David Powers, Marsha Ironsmith and Michael Bassman presented on the Honors College proposal.

- David Powers presented on the construction of the Honors College Planning Task Force which included 15 members from disciplines all across both campuses with Marsha Ironsmith serving as chair.
- The charge was to look at the existing honors program to see if the foundation for an Honors College was in place as well as make a plan and model to create and launch an Honors College.
Michael Bassman discussed the admission criteria and honors requirements for the current honors program. He explained the types of courses that award honors credits, the service-learning components as well as living learning communities for these honors students. Dr. Bassman stated Study Abroad is major component of the honors program.

David Powers said he contacted several alumni from the honors programs and the comments were extremely positive. He discussed the activities of the task force as well as the communication with the National Collegiate Honors Council for developing a “Fully Developed Honors College.” The recommendation of the task force was to establish an Honors College to replace the current honors program. Additionally, David Powers explained the benefits that East Carolina University will receive by creating and developing an Honors College. He demonstrated the differences from an Honors Program vs. an Honors College.

Marsha Ironsmith discussed the goals of the Honors College which included recruiting the most talented students, foster critical thinking, inquiry, research and discovery, student leadership and preparing for a global environment. Additional goals would be to identify the best and most effective faculty, increase multidisciplinary education, and establish an honors learning community. She discussed the expected resources that would be needed to start an Honors College including personnel, facilities, funding to support faculty buyouts, operating budget, scholarships and marketing.

Enrollment Management – Austin Bunch

Dr. Bunch explained that we are trying to build ECU as a first choice type university. ECU has focused on enrollment management changes and new roles to make sure ECU was prepared to handle the impending growth. He discussed the drivers of enrollment growth, challenges and shifts in practice. The enrollment numbers for this year to date are 27,673 which were down about 30 students from 2008. Dr. Bunch discussed the undergraduate, graduate, online and freshmen numbers. Fall 2009 freshmen numbers to date are 3,967, which is down about 571 from 2008 and out of state freshmen are 737, which is 18.6% of the total freshman class. Dr. Bunch said the final numbers will be released on October 15th.

Dr. Bunch stated the reduced number of freshmen was a part of what university administration asked of enrollment services. The goal was set to be about 4,000 freshmen and ECU came in just 33 students shy of that number.

Dr. Bunch discussed the definitions of access and success and how they relate to achieving East Carolina University’s goals. He further talked about the goals for retention, which for ECU this year was 79%, and in fall 2008 our numbers were 78.7%. A committee is being created to address ECU’s retention plans for the near and long term future. The goal set by GA for ECU is to be 81% which will be a two percent jump for ECU. Dr. Marilyn Sheerer added that Erskine Bowles said campuses who don’t meet their goals of retention will not be allowed to grow.

Dr. Bunch talked about the current measures for four year and six year graduation rates which will be challenged in the future with loftier goals for ECU in the coming years.

Dr. Bunch talked about the Master Planning process for ECU and the enrollment plans looking ahead to 2017 and 2025. The expected growth of high school graduating students in the next 4-5 years is expected to be relatively flat and this may allow ECU to get a good handle and control on our growth during that same time and then move ahead toward our goals for 2025. He said if ECU slows growth to 2017 to just 15-17% and then from 2017 to 2025, we replicate the same 15-17% growth, the campus will be somewhere in the neighborhood of 40,000 students.

Dr. Bunch compared the grade point averages of students housed on campus, those assigned to off campus, and those living off campus voluntarily. The GPA’s are much lower for those off campus.
Graduate School Enrollment Task Force – Dr. Deirdre Mageean

- Dr. Mageean talked about the creation of the Graduate Enrollment Task Force to develop an enrollment management plan for the graduate programs. Steve Thomas will chair the task force and Robert Brinkley is serving as the BOT member on the task force. She added that only about 165 of the 6,000+ graduate students are out-of-state. The trend in the workplace is that it is not enough anymore just to have an undergraduate degree, but there is a need to have a graduate degree. This task force will look at the plans to meet this demand as well as how it can be sustained and managed at ECU.

Hard Waiver – Austin Bunch

- The hard waiver will be officially put in place at ECU starting in the fall 2010. This requires ECU students to have insurance or be required to obtain a hard waiver for university provided insurance. The costs to students will go to the cost of attendance and will allow that to be packaged into the financial aid packages. By going to a hard waiver, the cost to ECU will go down per student to about $700 per year.

Campus Safety – Bill Koch

- Bill Koch discussed the Management Guide to Campus Safety. This is just a starting draft and there will be more added to this which will include the education components needed across campus. There is a plan to address these educational components in the next week or two and Peter Romary has been added to the safety team to pull some of these programs and training together and implement it across the board to all faculty and staff.
- Mr. Lucas challenged the administration to make sure that by the end of the academic year many of these academic challenges have been addressed. Chancellor Ballard said there is a need to provide some updates at the next two board meetings on progress and plans put in place.
- Mr. Congleton mentioned that SGA is fully supportive of safety being a priority on campus as well as off campus. He believes there is a role for the students in this process and they are willing to help in any way.
- Mr. Bodenhamer suggested bringing students in earlier for freshmen orientation to address campus safety.
- Mr. Peter Romary shared what other universities are using to get campus safety training to students as incoming freshmen through courses like Health 1000 and other programs.
- Bill Koch also shared some of the things already in place include outdoor speakers on campus for alerts which was tested on Move-In Weekend.

Research and Graduate Studies – Dr. Deidre Mageean

- Dr. Mageean said the cuts from this year in research have been significant. Two centers were closed which was very difficult, but we are still seeing some progress in other areas such as September research money which was increased six million dollars from last year to this.

Meeting Ended at 3:35pm.
INSTITUTE FOR COASTAL SCIENCE AND POLICY

The goal of the institute is to enhance understanding of the complex interactions between human behavior and the marine environment and its resources and to draw on this understanding to develop sound public policy.

Key Objectives of the Institute

• Identifying, initiating, promoting, coordinating, and directing research and instructional initiatives designed to advance understanding of natural and human systems, with particular emphasis on the interactions between them.

• Developing and submitting large-scale research proposals that integrate natural and human system dynamics.

• Developing methodological approaches and theoretical perspectives that advance integrated understanding of the coastal environmental and human systems, drawing on emerging technologies and conceptual tools such as systems and network theory, geographic information sciences, and computer-based modeling.

• Providing the detailed understanding of these coupled systems required to design and implement sound public policy and balanced economic development in the coastal margin.

• Enhancing graduate and undergraduate education by providing opportunities for students (postdoctoral, doctoral, master, and undergraduate) to participate on research projects designed to advance theory and practice in the sustainable use of coastal resources.

• Disseminating the findings and recommendations of institute investigators to a broad audience of scholars, citizens, decision makers, and educators.

Areas of Emphasis

Coastal-Estuarine Ecology: Focuses on near-shore and estuarine processes important for living marine resources and environmental quality

Coastal Geoscience: Emphasizes coastal processes, geomorphology, climatology, and hydrology as they affect the use and development of watersheds, the coastal plain, and barrier island systems

Social Science and Coastal Policy: Examine politics and public policy, natural resource economics, coastal hazards, tourism, and demographic and social behaviors as they relate to coastal resources management

Maritime Studies: In partnership with the Program in Maritime Studies program, identifies cultural and historical dimensions of coastal resources with an emphasis on maritime history, nautical archaeology, and the role of maritime cultural heritage in coastal use and development
Participants
In mid-2009, the Institute for Coastal Science and Policy included 13 scientists with joint appointments in academic departments, plus one new position to be filled by late 2009. These scientists conduct research in the coastal area of North Carolina, as well as in the mid-Atlantic, Gulf of Mexico, Alaska, Puerto Rico, Nova Scotia, Mexico, Honduras, Malaysia, and New Zealand. In addition, more than 60 faculty members from a wide range of disciplines contribute to its mission.

The institute is home to the PhD program in coastal resources management and the Office of Diving and Water Safety, and works closely with campus research centers with shared interests in the coast. A Water Resources Institute, also to be housed within ICSP, is in the planning stage. A Coastal Maritime Advisory Committee, comprising representatives from each of the participating centers and programs, helps promote collaboration and joint initiatives.

ICSP PhD Program in Coastal Resources Management
The CRM program emphasizes the links between coastal science and policy through an integrated, interdisciplinary program of research and education in the social and natural sciences. It prepares students for resource-focused careers in government service, private and nonprofit organizations, and university research and teaching. www.ecu.edu/crm

Diving and Water Safety
Technical specialists provide training, research support, equipment maintenance, and safety oversight for those involved in scientific diving, water-related research, and scuba instruction. They also oversee the safety of 16 university research vessels, providing maintenance, operators and operator training, and certification, supervision, and support of scientific and recreational diving activities. www.ecu.edu/diving/

Associated Centers and Programs

Center for Coastal Systems Informatics and Modeling
The center draws on advanced technologies to support research, instruction, and outreach to improve understanding of the interaction between physical, biological, and human resources on North Carolina’s coast, particularly as these relate to coastal disaster. Research topics focus on coastal environmental modeling, geovisualization, and human response to hazards. CSIM was initiated as an engagement center sponsored by the UNC system-wide Renaissance Computing Institute (RENCI). www.ecu.edu/renci

Center for Geographic Information Science
The Center for GIScience at East Carolina University is committed to: (1) educating and training the next generation of geospatial scientists by supporting state-of-the-art courses, quality mentoring, and internship opportunities; (2) promoting research that applies geospatial data and technologies to help solve environmental and social science problems; and (3) serving the university and eastern North Carolina as a regional resource for innovative geospatial technology and technical expertise. www.ecu.edu/cs-cas/giscenter

Center for Natural Hazards Research
The hazards center focuses on hurricanes, tornadoes, flooding, and erosion as they affect North Carolina and the eastern United States. Areas of research include the financial impacts of hurricanes and floods, the effectiveness of warning systems, how policy makers manage emergency response, and how citizens can protect themselves from hazards. www.ecu.edu/hazards

Center for Sustainable Tourism
The center promotes and conducts research on sustainable practices in the travel and tourism industry, disseminates findings to businesses, planners, destinations, and communities in North Carolina and beyond, introduces students to sustainability issues that challenge the travel and tourism industry, and offers educational programs for careers in sustainable tourism business management. www.ecu.edu/sustainabletourism/

North Carolina Center for Biodiversity
The central focus of NCCB activities will be to support and promote all aspects of biodiversity research and education in North Carolina, the two primary objectives of the center are to: (1) establish a group of scientists who share related interests in biodiversity research, education, and conservation; and (2) serve in a leadership capacity to the university and eastern North Carolina for biodiversity research, education, and outreach. These goals are intended to foster closer ties with the community and significantly strengthen the broader impacts of research and education conducted by members of the center and others on ECU’s campus. http://sites.google.com/site/ncbiodiversity

Program in Maritime Studies
Maritime studies offers a master’s degree in maritime history and nautical archaeology that combines course work, field projects, and internships to prepare students for a professional career in these areas. www.ecu.edu/maritime/

University of North Carolina Coastal Studies Institute
The University of North Carolina Office of the President established UNC-CSI in 2003 in partnership with East Carolina University, North Carolina State University, the University of North Carolina at Chapel Hill, Elizabeth City State University, and the citizens of Dare County to promote collaboration and shared resources for applied research, education, and outreach. Work focuses on the northeastern region of the state. In July 2007, the legislature approved $32.5 million to build the UNC-CSI campus, which will include research and education buildings and short-term housing for students and visiting scientists. http://csi.northcarolina.edu
In an era of sea-level rise and climate change, coupled with unprecedented human expansion into coastal environments, we have much to learn about the coasts and not much time in which to learn it. ICSP works to understand North Carolina coastal systems so that the problems and opportunities associated with them can be addressed successfully, applying that knowledge to meeting our needs for a sustainable future. In doing so, we train students in both the specific lessons of the coastal region, and in the techniques of natural and social science applied to coastal environments. Through both our research and educational program, we intend to provide direct service to the community whenever possible, testing knowledge gained through research against the real-world challenges met every day along the coasts.
The Institute for Coastal Science and Policy

Faculty
Jennifer F. Brewer
East Carolina University
Institute for Coastal Science and Policy/Department of Geography
East Carolina University, Greenville, North Carolina 27858  252-328-9404 brewerj@ecu.edu
http://www.ecu.edu/cs-cas/geog/brewer.cfm

Education
1989  B.A.  (with High Honors) Art and Society, College of Literature, Science and Arts, University of Michigan, Ann Arbor
2002  M.S.  Marine Policy, School of Marine Sciences, University of Maine, Orono
2007  Ph.D.  Human Geography, Graduate School of Geography, Clark University
Dissertation:  Governing the Fishing Commons: Institutions, Ecosystems, and Democracy in the Co-Management of Maine Lobster and Groundfish

Previous Professional Experience

Peer-Reviewed Publications


Book Chapters, Reports and Other Publications


External Grants, Awards, and Honors
Maine Sea Grant, Research Grant, Principal Investigator, 2009-2010.


D. Reide Corbett
Institute for Coastal Science and Policy/Department of Geological Sciences
East Carolina University, Greenville, NC 27858 252-328-1367 corbettd@ecu.edu
http://core.ecu.edu/geology/corbettd/home.html

Education
1994  B. S.  Chemistry, Florida State University
1996  M.S.  Chemical Oceanography, Florida State University
1999  Ph.D.  Chemical Oceanography/Geochemistry, Florida State University
Dissertation: Tracing groundwater flow into surface waters by application of natural and artificial tracers

Professional Experience
2007-pres.  Institute for Coastal Science and Policy, East Carolina U.  Associate Scientist
1999-2000  Department of Geology, Tulane U.  Postdoctoral Fellow

Research Interests
My overall scientific interest is to better understand the cycling of biologically active constituents (e.g., carbon, nitrogen, phosphorus) in coastal and open ocean environments. I am especially interested in evaluating and quantifying pathways of nutrient delivery to the coastal ocean that have been either under estimated or potentially ignored altogether, such as groundwater discharge and advective transport associated with sediment disturbances. Specific areas of my on-going research include those focused on:

• Sedimentary and geochemical processes in coastal environments
• Naturally-occurring radionuclides as tools for quantifying rates of sedimentary and biogeochemical processes
• Investigations of the discharge of groundwater into the coastal zone

Selected Recent Publications

Pertinent Research, Teaching and/or Related Activities
• PI or CO-PI on major research grants (totaling over $5 million in last 7 years) from the NSF, USGS, NC Sea Grant, NOAA, etc.
• Current teaching assignments include Elementary Oceanography and a graduate-level course in Biogeochemistry
• Duke/University of North Carolina Oceanographic Consortium Advisory Board, 2000-present
• ECU Diving and Water Safety Control Board, 2000-present; Chair 2002-present.
• ECU University Research Council, 2005-present
• ECU Coastal and Maritime Council, 2005-present
• UNC Coastal Science Institute Advisory Board, 2006-present

Supervision of 16 Theses and 3 Dissertations. Membership on 18 Graduate Student Committees
David Griffith
Institute for Coastal Science and Policy/Department of Anthropology
East Carolina University, Greenville, NC 27858  252-328-1748  griffithd@ecu.edu

Education
1973  B.A.  Anthropology and English, University of Iowa
1975-1977 Graduate Study in English and Creative Writing, Iowa Writers’ Workshop, University of Iowa, and University of Montana
1979  M.A.  Anthropology, University of Iowa
1983  Ph.D.  Anthropology, University of Florida
Dissertation:  The Promise of a Country: The Impact of Seasonal US Migration on the Jamaican Peasantry
1996 Institute on Research Methods in Cultural Anthropology, National Science Foundation

Professional Experience
2007-pres.  Institute for Coastal Science and Policy, East Carolina U.    Senior Scientist
1999-2007 Institute for Coastal and Marine Resources, East Carolina U.  Senior Scientist
2001-pres.  Department of Anthropology, East Carolina U.   Full Professor
1983-1999 Institute for Coastal and Marine Resources, East Carolina U.  Ass’t and Assoc. Scientist
1983-2001 Department of Anthropology, East Carolina U.  Ass’t and Assoc. Professor
2003-pres.  Human Organization  Co-Editor-in-Chief

Research Interests
Human dimensions of coastal and marine environments, population flows/ migration, human knowledge, Latin America, the Caribbean, the U.S. Southeast, creative writing.

Selected Publications
Jeffrey Carl Johnson  
Institute for Coastal Science and Policy/Department of Sociology  
East Carolina University, Greenville, NC 27858  252-328-1753  johnsonje@ecu.edu  
http://www.ecu.edu/cs-cas/soci/jeffrey-johnson.cfm

Education
1975  B.A.  Anthropology, University of California, Irvine  
1981  Ph.D.  Social Science, University of California, Irvine  
Dissertation:  Cultural Evolution and the Organization of Work: Scarcity and Resource Management in an Alaskan Fishery

Professional Experience
2007-pres.  Institute for Coastal Science and Policy, East Carolina U.  Senior Scientist  
1997-pres.  Department of Sociology, East Carolina U.  Professor  
1996-2007  Institute for Coastal and Marine Resources, East Carolina U.  Senior Scientist  
1996-pres.  National Science Foundation Summer Institute for Research Design in Cultural Anthropology  
                              Director  
2002-pres.  Department of Biology, East Carolina U.  Adjunct Professor  
1996-pres.  Department of Biostatistics, East Carolina U.  Adjunct Professor  
1996-pres.  Department of Anthropology, East Carolina U.  Adjunct Professor

Research Interests
I am interested in the influence of technological and environmental factors on the organization of work, leisure, and cognition, particularly in groups in extreme and isolated environments. I have focused a major portion of my teaching and research program around the use of social network theories and methods for understanding social structure and organization. Recent substantive interests have focused on the relationship between cognition and social structure. The bulk of my research has focused on these concerns among the maritime peoples of the Pacific basin, especially the insular Central Pacific, the Caribbean, and coastal North America. Interdisciplinary in both training and orientation, I have had teaching experience in economics, anthropology, sociology, statistics, and Pacific studies.

Selected Publications


David G. Kimmel  
Institute for Coastal Science and Policy/Department of Biology  
East Carolina University, Greenville, NC 27858  252-328-9986  kimmeld@ecu.edu  
http://www.ecu.edu/cs-cas/biology/kimmel_dave.cfm

**Education**

1996  B.S.  Pennsylvania State University  
2001  Ph.D.  University of Maryland, Baltimore County

**Professional Experience**

2008-pres.  Institute for Coastal Science and Policy, East Carolina U.  Assistant Scientist  
2008-pres.  Department of Biology, East Carolina U.  Assistant Professor  
2006-2008  UMCES, HPL  Research Assistant Professor

**Research Interests**

The primary focus of my research is zooplankton dynamics in estuarine and coastal systems. Zooplankton are critical components of food webs as they link the primary production of phytoplankton to fish. The interaction between zooplankton and fish varies in time and space, thus I am particularly interested in determining how zooplankton populations respond to environmental forcing. We use a combination of traditional and novel methods in order to determine zooplankton abundance and distribution. These include net sampling, optics and acoustics. Other interests of my lab include climate forcing of aquatic populations, analysis of long-term data and the use of size-based approaches to address ecological questions.

**Teaching**

Survey of Applied Statistics for Ecologists; Zooplankton Ecology; General Ecology; Coastal Ecological Processes

**Relevant Publications**

Joseph J. Luczkovich
Institute for Coastal Science and Policy/Department of Biology
East Carolina University, Greenville, NC  27858   252- 328-9402   luczkovichj@ecu.edu
http://personal.ecu.edu/luczkovichj

Education
1978  B.S.   Biology, Lehigh University
1982  M.S.   Ecology, Rutgers University
1987  PhD   Biological Science, Florida State University

Professional Experience
1997-pres.  Institute for Coastal Science and Policy, East Carolina U.  Associate Scientist
           Biology Department, East Carolina U.
1990-1997  Institute for Coastal and Marine Resources, East Carolina U.  Assistant Scientist
           Biology Department, East Carolina U.
1989-1990  Department of Zoology, North Carolina State U.  Postdoctoral Research Associate
1988-1989  Department of Fisheries, Humboldt State U.  Lecturer

Research and Teaching Interests
Biology of fishes, fisheries ecology, ecology of marine and estuarine ecosystems, food webs, passive and active
acoustic surveys, seagrass, coral reefs, mangroves, salt marshes, estuarine observing systems, Pamlico River and
Sound, Neuse River, Core Sound (in NC), Panama, Belize, Dominican Republic (in Caribbean).

Selected Publications
seagrass ecosystem: Direct and indirect effects of gulf flounder, spot and pinfish on benthic polychaetes. J.
Pamlico River water quality and fishes. Pages 235-246 in J.R. Maiolo, J.C. Whitehead, M. McGee, L. King, J.
Johnson, and H. Stone (eds), Facing Our Future: Hurricane Floyd and Recovery in the Coastal Plain. Coastal
Carolina Press, NC.
Sounds of sex and death in the sea: bottlenose dolphin whistles silence mating choruses of silver perch.
through effective trophic levels. Ecological Modelling 117: 99-124.
ontogeny of two percoid fishes, Lagodon rhomboides and Centropomus undecimalis. Environmental Biology
of Fishes 44: 79-95.
Alex K. Manda
Institute for Coastal Science and Policy/Department of Geological Sciences
East Carolina University, Greenville, NC  27858   252-328-9403  mandaa@ecu.edu
http://core.ecu.edu/geology/mandaa/home.html

Education
2001    B. S.    Geology, Cardiff University, UK
2004    M.S.    Geology, Florida International University
2009    Ph.D.   Geosciences, University of Massachusetts-Amherst
Dissertation: Development and verification of conceptual models to characterize the fractured bedrock aquifer of the Nashoba Terrane, Massachusetts.

Professional Experience
2009-pres. Institute for Coastal Science and Policy, East Carolina U. Assistant Scientist
2009-pres. Department of Geological Sciences, East Carolina U. Assistant Professor

Research Interests
My general interests include characterizing the physical properties that control groundwater flow in media that are dominated by discrete features such as fractures and conduits. I use field surveys and geophysical techniques to quantitatively characterize fractured and karstic media to better understand the controls on groundwater flow and storage in these types of aquifers. I am also interested in assessing how land-use and climate change affect surface and subsurface reservoirs of freshwater in coastal environments. I am specifically interested in:

- Assessing the role of macropore geometry and distribution on groundwater movement in karst aquifers
- Investigating the impacts of sea level rise on salt water intrusion in coastal environments
- Studying the effects of urban development on groundwater and surface water quality

Selected Recent Publications

Pertinent Research, Teaching and/or Related Activities
Current teaching assignments include Environmental Geology and supervising undergraduate and graduate students.
Ryan P. Mulligan  
Institute for Coastal Science and Policy/Department of Geological Sciences  
East Carolina University, Greenville, NC  27858   252-328-9406   mulliganr@ecu.edu  
http://core.ecu.edu/geology/mulliganr/home.html

Education
1997    B.A.Sc.  Geological Engineering, Queen's University  
1999    M.A.Sc. Coastal and Ocean Engineering, University of British Columbia  
2008    Ph.D.  Physical Oceanography, Dalhousie University  
Dissertation:  Wave-driven circulation in Lunenburg Bay

Professional Experience
2009-pres.  Institute for Coastal Science and Policy, East Carolina U.  Assistant Scientist  
2009-pres.  Department of Geological Sciences, East Carolina U.  Assistant Professor  
2008-2009  Bedford Institute of Oceanography  Postdoctoral Fellow  
2003-2008  Dept. of Oceanography, Dalhousie U.  Research Assistant  
1999-2003  Hay & Company Consultants (Vancouver, BC)  Coastal Engineer

Research Interests
My research interests are in the physical forces that cause changes to coastal regions and the ways in which coastal systems respond. I am particularly interested in severe storms, surface waves, ocean currents, transport of water and sediments and contaminants, and changes in the geomorphology of the coastline and seabed. I use field observations and numerical models to study coastal systems, and develop further understanding of the processes that affect oceans, estuaries and rivers. My current research sites are in Canada, including Lunenburg Bay and the Bay of Fundy (NS) on the Atlantic Ocean and the Mackenzie River Delta (NWT) on the Arctic Ocean. I am presently establishing a research program in coastal North Carolina.

Selected Journal Publications

Selected Conference Presentations

Research, Teaching and Related Activities
•  Currently teaching Introduction to Oceanography and developing a graduate-level course in Coastal Science.  
•  Field experience in coastal observatories including the Lunenburg Bay coastal Observatory (NS, 2003-2007), Martha’s Vineyard coastal Observatory (MS, 2007) and the Sediment Acoustics Experiment (FL, 2004).  
•  Registered Professional Engineer (in Canada) since 2003.
Enrique Reyes  
Institute for Coastal Science and Policy/Department of Biology  
East Carolina University, Greenville, NC 27858  252-328-5778  reyese@ecu.edu  
http://www.ecu.edu/cs-cas/biology/reyes_enrique.cfm

**Education**
1983  B.S.  Biology, Universidad Autonoma Metropolitana. Mexico  
1988  M.S.  Biological Oceanography, Universidad Nacional Autonoma de Mexico  
1992  Ph.D.  Marine Sciences, Louisiana State University

**Professional Experience**
2005- pres.  Department of Biology, East Carolina U.  Associate Professor  
2002–2005  Department of Geology and Geophysics, U. New Orleans  Assistant Professor  
2002 - 2005  College of Urban and Public Affairs, U. New Orleans  Assistant Professor  
1995 – 2002  Coastal Ecology Institute, Louisiana State U.  Assistant Professor Research  
1992 - 1995  Multiscale Experimental Ecosystem Research Center;  
Chesapeake Biological Laboratory, U. Maryland System.  Ecosystem Modeling Coordinator

**Research Interests**
My academic experience lies on large-scale approaches to ecosystem analysis. Using simulation modeling as a research tool, my interests have been to understand how coastal areas respond to diverse impacts, natural and man-made. I have been active in several modeling efforts that span from plant productivity, fish migration, medium-sized experiments, to landscape simulation focused on understanding processes in wetlands and tropical watersheds.

**Selected Publications**

**Synergistic Activities**

**Contributions to Review Panels**
Roger A. Rulifson  
Institute for Coastal Science and Policy/Department of Biology,  
East Carolina University, Greenville, NC 27858 (252) 328-9400 rulifsonr@ecu.edu  
http://www.personal.ecu.edu/rulifsonr/  

Education  
B.S. 1973 Biology and French, University of Dubuque  
M.S. 1975 Marine Science (major) and Zoology (minor), North Carolina State University,  
Ph.D. 1980 Marine Science and Engineering (major) and Zoology (minor), North Carolina State University  

Professional Experience  
1995-pres. College of Arts and Sciences, East Carolina U.  
Director, Field Station for Coastal Studies at Mattamuskeet  
1993-pres. Department of Biology, East Carolina U.  
Professor  
2007-pres. Institute for Coastal Science and Policy, East Carolina U.  
Senior Scientist  
1993-2007 Institute for Coastal and Marine Resources, East Carolina U.  
Senior Scientist  
1987-1993 Department of Biology, East Carolina U.  
Associate Professor  
1987-1993 Institute for Coastal and Marine Resources, East Carolina U.  
Associate Scientist  
1983-1987 Institute for Coastal and Marine Resources, East Carolina U.  
Assistant Scientist  
Postdoctoral Study  

Research Interests  
My career-long research thrust has focused on diadromous fish species, particularly their ecology and evolution. This research has covered all life phases, from eggs and larvae to adults. I have also been researching various aspects of the spiny dogfish or spurdog, Squalus acanthias, perhaps the world’s most abundant shark, which overwinters in coastal waters off North Carolina. My lab has been addressing the environmental impacts related to coastal development and the need for fresh water.  

Professional Expertise  
- Life history studies, anadromous species, migration, habitat assessment.  
- Species: striped bass, hickory shad, American shad, river herring, American eel, Atlantic sturgeon, spiny dogfish.  
- Geographical location: N.C. coastal watersheds, NC nearshore Atlantic Ocean, Bay of Fundy, Atlantic Canada coastal watersheds.  

Selected Publications (striped bass only)  

Professional Certifications  
Fisheries Scientist (American Fisheries Society, No. 1558, 1982)  

91 Peer Reviewed Publications, 67 Technical Reports, ~225 Professional Platform and Poster Presentations, 11 Current Graduate Students - 11
John D. Rummel  
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**Education**

1974  B.A.  Environmental Biology, University of Colorado, Boulder  
1985  Ph.D.  Biological Sciences, Stanford University  
Dissertation: *Investigations into Interspecific Competition and Evolutionary Theory*  (J. Roughgarden, Advisor)

**Professional Experience**

2009-pres.  Institute for Coastal Science and Policy, East Carolina U.  Director; Professor of Biology  
Science Mission Directorate  
Planetary Protection Officer, 1997-2006  
1999-2001  Colorado State University, Fort Collins, Colorado  Research Scientist / Associate Professor  
1998-1999  NASA–Ames Research Center, Moffett Field, California  Associate Program Scientist, Fundamental Biological Sciences Program  
1994-1998  Marine Biological Laboratory, Woods Hole, Mass.  Director of Research Administration and Education  
Research Scholar, Center for Advanced Studies in the Space Life Sciences  
Mission From Planet Earth Study Office (1993)  
Life Sciences Division (1987-1992)  
Planetary Protection Officer  
Discipline Scientist, Exobiology Program  
Chief (acting), Biological Systems Research Branch / Research Programs Branch  
1986-1987  National Research Council, NASA Headquarters  Research Management Associate  
1979-1984  Stanford University  Graduate Research Assistant  
1974-1979  United State Navy  Naval Flight Officer

**Research Interests**

My scientific interests have always been focused on the relationship between life and its environment, both as a theoretical puzzle and for practical applications. In addition, I have spent a number of years considering the potential for the solar system and the universe beyond to support both indigenous and Earth organisms, and how to prevent biological cross-contamination in space exploration. Using our understanding of coastal and planetary processes to shape policy and its application in coastal and maritime governance is a particularly interesting facet of the work to be done within the Institute for Coastal Science and Policy.

**Selected Publications**

Education
1995  B.A.  Geology, Colgate University
1997  M.S.  Marine Sciences State University of New York, Stony Brook
2001  Ph.D.  Geological Oceanography University of Washington

Professional Experience
2007–pres.  Institute for Coastal Science and Policy, East Carolina U.  Assistant Scientist
2004–pres  Department of Geological Sciences, East Carolina U.  Assistant Professor

Research Interests
Generally, I am interested in how materials from land are dispersed and accumulate in the ocean. I use sediment characteristics, environmental measurements (including oceanographic observations), and geophysical methods like seismic reflection to understand the modern and ancient processes influencing the seabed and sedimentary record of continental margins. This research is important to examining the fate of pollutants and runoff, assessing carbon storage, quantifying natural resources, evaluating biological habitats, identifying and extracting petroleum, defining hazards and protecting our nation’s coastlines. I am actively involved in research projects in New Zealand, Puerto Rico, the Gulf of Mexico, and North Carolina.

Synergistic Activities
- Working with federal and state partners to build an estuarine observing system in NC.
- Leading the development of a web portal for communicating coastal hazards information.
- Reviewer of journal articles, grant proposals and book chapters for leading publications.
- Continuing to develop outreach/education material and web sites for supported research.

Selected Publications


NORTH CAROLINA’S COASTS IN CRISIS:
A VISION FOR THE FUTURE

Department of Geological Sciences
Thomas Harriot College of Arts and Sciences, Institute for Coastal Science and Policy
East Carolina University

FRONT COVER PHOTOGRAPH The erosion in the Sound Pass Road photograph has flanked embankment houses that are now in the flood zone, and destroyed the adjacent houses and access road. Photograph by S. Riggs.
NORTH CAROLINA’S COASTS IN CRISIS: A VISION FOR THE FUTURE

A White Paper by

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The coastal zone of North Carolina that we know today is not permanent. It has evolved throughout its history. These changes, which can be both imperceptibly gradual or sudden and violent, continue today and will do so into the future. Humans are moving into this environment in ever increasing numbers accompanied by towns, industry, tourism, and the supporting infrastructure of services such as roads, bridges, water, power, and waste disposal. The changing coastal system is not fragile. It is the fixed human infrastructure that can easily be destroyed by natural processes. This is the coastal conflict that we must examine closely and then manage. The climate is changing; tropical storms and hurricanes will continue to strike our coast as will nor’easters, and sea level is rising at an increasingly rapid rate. We must accept these changes as inevitable but we seem reluctant to do so. This is why our coasts are in crisis.

The coastal system of North Carolina is incredibly varied, with rivers, swamps, estuaries, marshes, barrier islands, inlets, beaches and offshore shoals and rock. In the south, barrier islands are short, with many inlets, and are close to the mainland. In the north, the barrier islands are long and narrow, with few inlets, and they extend out into the Atlantic Ocean leaving an immense estuarine system of sounds behind them. This spatial variety of our coasts means that coastal management issues vary considerably from place to place.

Tide gauge and historical data demonstrate that relative sea level is currently rising in northeastern North Carolina at a rate of 16 to 18 inches per century. One hundred years ago, the rate was 7 inches per century and 200 years ago it was only 3 inches per century. The rate will likely continue to increase into the future as climate continues to warm. The warming climate might also spawn more frequent and intense hurricanes. When so much of down-east North Carolina is just a foot or two above current sea level, we must take note. The future will likely see accelerated rates of coastal erosion and associated loss of urban infrastructure, agricultural land, wetlands, and segments of barrier islands. In addition, there will likely be increased economic losses due to floods, droughts and storms with a potentially serious impact on the state’s coastal tourism and recreation economy – unless we accept and plan for environmental change, and adapt.

We know that rising sea level, resulting from melting of the last Ice Age’s glaciers and ice sheets, began to affect the area of our modern coastal zone about 12,000 years ago when rising ocean level flooded into the Roanoke River valley and gave birth to Albemarle Sound. The Neuse and Tar rivers to the south and their tributary, Pamlico Creek, began the transition to estuaries approximately 7,000 years ago. The barrier island system began to form about 3,500 years ago in a position very close to its current location. Since that time, development of barriers has been influenced by opening and closing of inlets and collapse and reformation of portions of the Outer Banks, occasionally exposing southern Pamlico Sound to oceanic influences. In the one hundred years or so before the first Europeans arrived in 1584, the barrier islands took a form similar to that of today.

During the 20th century, human development and engineering have become a dominant force in disrupting natural coastal processes and modifying coastal evolution. Roads and bridges have been built on mobile barrier islands. Barrier dune-ridges were constructed to protect the roads but, in doing so, have curtailed the natural processes of barrier island growth and migration. Jetties have been built to stabilize the location of inlets but, in doing so, have disrupted the natural process of along-shore sediment transport. Resulting coastal erosion has been addressed by expensive beach nourishment programs, but they have not been particularly successful; they must be repeated indefinitely, and suitable sand is hard to find. Sand dredged from navigation channels is often dumped too far offshore for natural beach renourishment to occur. Stabilization structures, such as jetties, groins, bulkheads, and sandbags demonstrably cause erosion problems. Inlets open naturally, and we close them almost immediately before they can do their work of building island width by adding sand to the barrier island system. Wetlands are filled, bulkheads are constructed, and ecosystems disrupted. Storm-water is increasingly hard to manage as we pave more of the land’s surface, compromising water quality in the rivers and sounds.
What are our alternatives? We must understand how the natural coastal system works and accept that reality. We must consider building temporary bridges across new inlets instead of closing them. We must consider letting oceanic overwash build barrier island elevation and width, and install temporary roads to allow access. We must consider the challenges of coastal change to be opportunities. We can then determine the best ways to sustain and grow our coastal economy, and new ways to make our living at the coast. We must embrace relocation as a means of adaptation to an ever-changing environment. We should embrace the historic culture and the wild, remoteness of the Outer Banks and parlay that attribute into economic advantage. Ocracoke Village and Ocracoke Island are desirable tourist destinations in large part because of their remoteness. Perhaps the other villages along the Outer Banks can be part of a “string of pearls” of vacation destinations. Perhaps personal cars can be replaced by other means of transport (rented golf carts, trolleys, bicycles) along some portions of the barrier islands. Perhaps fast high-tech ferry systems can transport vacationers to their destinations. Perhaps rural mainland towns can become ferry hubs with motels, restaurants, service stations, parking lots, and other industry in support of this new coastal economy. Perhaps these towns can themselves become the centers of coastal tourism with estuarine cruises, wildlife tours, historic and cultural programs, hunting and fishing tours, natural history aerial field trips, black-water paddle and camping trips, etc. Adaptation strategies can be similarly developed for the southern part of our coast where the barriers can be considered to be “islands of opportunity”.

This vision for a new and economically viable and advantageous coastal North Carolina is preliminary and unrefined. But no matter how this vision evolves, planning for future coastal development must take place within the framework of known natural processes of change. Our coastal economy can then experience a renaissance that has more potential pay-offs than the current approach to coastal management can provide in a changing climatic regime.

Change is the only constant within the North Carolina coastal system. It can occur as an almost imperceptibly gradual process in response to shifts in climate and sea level, or suddenly during high-energy events such as winter nor’easters and summer hurricanes. Barrier islands are built by storms and are dependent upon storm events to maintain their short-term health and long-term evolution.

Some of the greatest population growth rates in North Carolina, together with unprecedented urban expansion, are presently occurring within this coastal zone. New four-lane roads and bridges are being constructed, new water supplies are being developed, and pressures upon severely overloaded sewage disposal systems are increasing. This growth, intimately intertwined with a booming tourist industry, has substantial environmental impacts. Maritime forests are cleared, shorelines are hardened with bulkheads, shallow-waters are dredged, wetlands are channelized and filled, dune fields are bulldozed, and the surface is paved for parking lots. All of these activities modify the land surface, alter the drainage, and result in increased contaminants moving into the adjacent coastal waters.

The natural coastal system is not fragile. It is a high-energy, storm-dependent system characterized by environmental extremes. It is the fixed anthropogenic structures superimposed upon this dynamic system that are fragile. No guaranteed permanency exists for any ecosystem, landform, or built structure at the coast. Our attempts to transform our coasts into a stable, engineered system conflict with the dynamic nature of the natural environment. Our coasts are eroding, roads and bridges are threatened, water quality is compromised, and the tourist economy is at risk. This is why North Carolina’s coasts are in crisis.

This White Paper is produced for coastal managers, agencies, business owners, politicians, residents of and visitors to the coast – anyone who has an interest in maintaining the unique character of our coast that draws so many tourists to it every year. The global climate is warming, the intensity of tropical storms might increase, and the rate of sea-level rise is increasing. Can we deal wisely with these issues so that we can adapt to the coming changes rather than be overwhelmed by them?
Regional Setting

The North Carolina coastal system (Fig. 1) consists of about 325 miles of ocean shoreline, 23 inlets, over 5,000 miles of estuarine shoreline, and over 3,000 square miles of brackish-water estuaries. It has two distinct zones that are very different in both their geometry and processes (Fig. 1, Table 1). The Southern Coastal Zone is characterized by a relatively steep land slope compared to the gentler slope of the Northern Zone. Rising sea level has flooded the disparate slopes producing different kinds of barrier islands, inlets, and associated estuaries (Fig. 1). The steeper slope of the Southern Zone produces short, stubby barrier islands that hug the mainland shoreline, resulting in narrow back-barrier estuaries connected to the ocean by 18 inlets. The gentler slope of the Northern Zone produces long barrier islands and a broad expanse of drowned-river estuaries, the vast Albemarle-Pamlico estuarine system. The northern barrier islands are broken by five inlets and project seaward to form the famous Cape Hatteras and associated Outer Banks.

The coastal system can be further divided into four coastal geomorphic compartments (Fig. 1). These compartments, defined by capes and associated cape shoals, are known as cuspate embayments. Cape shoals are shore-perpendicular, shallow sand bodies that extend seaward for about 10 miles (Diamond Shoals off Cape Hatteras), 15 miles (Lookout Shoals off Cape Lookout), and 30 miles (Frying Pan Shoals off Cape Fear). These vast shoal systems have led many mariners to their demise and the North Carolina coast to the dubious honor of being called the “Graveyard of the Atlantic”.

The orientation of each compartment and continental shelf geometry determine wave and current dynamics, astronomical

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FIGURE 1. The coastal zone of North Carolina. Imagery from a NASA (MODIS) sensor provided by the Institute for Marine Remote Sensing of the College of Marine Science, University of South Florida.
and storm-tide characteristics, and the nature of the coast’s response to specific storm systems. The Hatteras compartment faces northeast to east and receives the head-on impact of frequent nor’easters. In contrast, the Raleigh Bay compartment is generally southeast-facing and only receives glancing blows from powerful nor’easters. The Onslow Bay compartment faces south to southeast and the Long Bay compartment faces south. These orientations result in offshore winds and waves during nor’easters, but onshore seas from the dominant southwesterly winds during the summer and a high proportion of direct hits from less frequent, but higher energy tropical storms and hurricanes.

**Estuaries and Barrier Islands**

The drainage basins of North Carolina form a vast and complex network of creeks, streams, and rivers that move surface water off the uplands of the Blue Ridge, Piedmont, and Coastal Plain provinces to the Atlantic Ocean. The estuaries formed when rising sea level flooded up the valleys of these drainage systems, while the higher inter-stream divides formed low upland regions (Riggs and Ames, 2003). Estuaries act as great mixing basins where the interplay between fresh and saline water, together with the regularity of astronomical tides and irregularity of wind tides, largely determines the coastal plant communities within the estuarine system. These, in turn, determine the type and distribution of shorelines (Riggs and Ames, 2003). As barrier-island inlets open, migrate, and close through time, chemical and physical conditions in the estuaries also change, resulting in major shifts in estuarine ecosystems.

Fronting the estuarine zone is a narrow strip of barrier islands that acts as a dam between the estuaries and ocean (Fig. 1). The sand islands, produced at sea level by the interaction of high-energy ocean storms with the paleo-topography of the gently sloping Coastal Plain, are broken by a series of small openings called “inlets” that allow the mixing of ocean water with riverine water (Fig. 1). Only a small portion of the barrier islands rises above the sea surface; the greater portion lies hidden below sea level. The sub-aerial portion of barrier islands is perched at the top of the shoreface, which slopes steeply to between 25 to 75 feet below sea level, where it flattens out onto the inner continental shelf. The shoreface ramp is the portion of a barrier island that functions as an important energy-absorbing surface for wave, tide, and current energy.

Barrier islands form and persist at the energetic interface between the land, sea, and air in response to four physical criteria: the presence of a gently sloping coastal plain-continental shelf, availability of adequate sediment, sea level, and the occurrence of high energy oceanic storms that build the islands and maintain them through time. Consequently, barrier islands are not only built by storm-dominated processes of inlet and overwash dynamics, but also act as critical energy-absorbing buffers at the land-sea-air interface. During times of rising sea level, storm dynamics constitute the process by which landward barrier island migration occurs.
HOW THE COASTAL SYSTEM WORKS

Formation of the Modern Coastal System

Our understanding of the evolution of the coastal zone is more complete for northeastern North Carolina (e.g., Riggs et al., 2000; Mallinson et al., 2005, 2008; Culver et al., 2007, 2008). However, the dynamic processes that drive our coastal system, and responses to those processes, are similar from the north to the south of North Carolina. Figure 2 shows the paleogeographic reconstruction of the southern Pamlico Sound region over the last 7,000 years (Culver et al., 2007). Rising sea level flooded up the drainages incised into the paleo-landscape thus leading to estuarine conditions around 7,000 years ago (Fig. 2A). A generally northeast to southwest-draining tributary of the Tar River drainage, Pamlico Creek, was separated from a similarly oriented tributary drainage to the east by

FIGURE 2. Four time slices show paleographic reconstructions for the Pamlico Sound region over the last 7,000 years. See text for explanation. Figure is modified from Culver et al. (2007). The outline of the modern shoreline is shown for geographic reference in A-C.
higher land named the Hatteras Flats Interstream Divide. An ocean shoreline, and possibly barrier islands, would have existed on the southeast side of Hatteras Flats at this time (Fig. 2A). By approximately 4,000 years before present (BP), flooding began to occur across the low, southwestern end of the Hatteras Flats Interstream Divide, in the region that is now Ocracoke Island. The flooding of portions of the Neuse and Tar rivers and Pamlico Creek allowed tidal exchange to occur and normal salinity oceanic waters to extend into the southern part of the Pamlico basin (Fig. 2B). Barrier islands formed along the crest of the Hatteras Flats Interstream Divide as it was increasingly drowned by rising sea level. By 2,500 years BP, the barrier islands probably resembled those of today (Fig. 2C).

The southern portion of the Pamlico Sound estuary underwent a rapid and fundamental environmental change during a warm climatic interval known as the Medieval Warm Period. One or more large storms, or a series of smaller storms, struck the southern Outer Banks around 1,100 years BP causing the collapse of a large segment of the barrier. Sand was eroded from the islands and redeposited as a broad, shallow submarine shoal (Fig. 2D). Microfossil data indicate that Gulf Stream waters were transported into the southern Pamlico basin resulting in normal oceanic salinity. Radiocarbon age estimates indicate that the barrier islands were not re-established for approximately 600 years. Indeed, the earliest map drawn by the first English visitors to North Carolina (1590 AD) shows a series of short barrier islands separated by numerous inlets. The majority of these inlets closed during the 17th and 18th centuries leaving a few long, thin barrier islands separating the once more estuarine Pamlico Sound from the Atlantic Ocean (Fig. 1).

We are presently in an interglacial episode characterized by rising sea level. If global warming continues and substantial portions of the Greenland and/or Antarctic ice sheets were to collapse, the ocean shoreline of North Carolina would move significantly inland of the present coast. This occurred during the last interglacial sea-level highstand, 125,000 to 80,000 years ago, when the ocean was 20 to 25 feet above today’s sea level and it occupied the Suffolk Shoreline some tens of miles west of the present shore (Fig. 3).
Nature of the Modern Coastal System

Sediment Supply for Coastal Barriers

Barrier islands are not created equal. Many barrier island segments are sediment poor while some have adequate supplies to maintain a healthy island system. The North Carolina coast is characterized by two basic types of barrier islands (Fig. 4). Complex barrier segments are sediment-rich and consequently are generally wide and high islands. They consist of multiple beach ridges and swales and extensive dune fields. Simple barrier segments are sediment-poor, low and narrow, are dominated by inlet and overwash dynamics, and tend to be relatively young.

In addition to the sand that is already on any given barrier island, there are four major potential sources of sand that play variable roles in the sediment budget of the North Carolina barrier island system.

1. Inlets (Fig. 5) between barrier segments contain several types of sand deposits within the various channel systems, the flood-tide delta on the estuarine side, and the ebb-tide delta on the oceanic side.
2. Deposits of sand and gravelly sand occur in paleo-riverine channels and paleo-deltaic sediments deposited by the larger trunk rivers on the continental shelf during previous glacial intervals characterized by sea-level lowstands (Mallinson et al., 2005).
3. Tremendous volumes of sand are potentially available in cape-shoal structures (Fig. 1): Diamond Shoals off Cape Hatteras (Boss and Hoffman, 2000), Lookout Shoals off Cape Lookout, and Frying Pan Shoals off Cape Fear (Riggs and Cleary, 1997).
Complex Barrier Islands – Welding Pieces Together

Nags Head Woods, Jockeys Ridge, and Shackleford Banks are characterized by extensive back-barrier dune fields, whereas Buxton Woods, Kitty Hawk Woods, and Bogue Banks are characterized by a series of beach-ridge and swale structures (Fig. 6).

Kitty Hawk Woods are fronted by a dune field that was still active in 1932. The source of the dune sand was overwash occurring east of N.C. Highway 158. Construction of Highway 12 in 1932 and a barrier dune ridge in the late 1930s, in concert with subsequent development, has led to stabilization of the dune field, termination of modern overwash processes, and elimination of the sand source from the beach that fed the dune field (Fig. 7). Coastal development at Kitty Hawk is threatened, as indicated by the reduced distance from the shoreline to NC Highway 12 in the 1932 and 1999 aerial photographs (Fig. 7).

Simple Barrier Islands – Inlet and Overwash Dynamics

Storm surges are critical processes on low and narrow simple barrier islands (Fig. 4). They may open shallow inlets that build back-barrier flood-tide deltas or they may overtop the barrier depositing overwash fans on top of the barrier and as back-barrier shoals. These processes build both island width and island elevation and are critical for barrier island health and migration as sea level rises.

Recent research from Oregon Inlet to Cape Hatteras (Smith et al., 2006) suggests that between 50 and 70% of this area have had one or more inlets during the past several hundred years. Up to 70% of the sand-poor islands in the Onslow Bay compartment have had one or more inlets during the past several hundred years (Riggs et al., 1995). Inlets are high energy, self-adjusting safety valves in the barrier island sand dam that open during storms to let the increased water volume (from increased river flow due to heavy rainfall or from increased storm surge) to flow either in or out. When storm and river floods abate, inlets close back.
FIGURE 7. This figure compares a 1999 aerial photograph of the complex barrier island in the Kitty Hawk area of North Carolina (Panel A) with a 1932 aerial photograph of the same region (Panel B). The photographs show: 1) the younger overwash-dominated part of the island being welded onto the ocean side of the older ridge and swale part of the barrier, 2) the complete urbanization of the younger overwash portion of the island by 1999, and 3) rapid ocean shoreline recession as indicated by the reduced distance of Highway 12 from the ocean over time. In 1999, a section of Highway 12 is covered by overwash sand. Figure is modified from Riggs and Ames (2003).

to an equilibrium point that is dictated by the normal hydrodynamics of the estuarine-oceanic system.

Inlets are essential for barrier island evolution by building extensive shallow sand shoals known as flood-tide deltas (FTDs) within the estuary behind the barrier islands and ebb-tide deltas (ETDs) on the ocean side of an inlet (Fig. 5). The FTD sand shoals form the foundation that the barrier island migrates onto in response to sea-level rise. Once an inlet closes, the FTD develops into marsh and adds width to the island (Fig. 8A-C). FTDs and ETDs store sand and are critical components of the coastal sediment budget. During storm events they bypass sand up and down the ocean shoreline, as well as in and out through the inlet.

FIGURE 8. Aerial photographs of Core Banks show how storms build island elevation and width. Panel A is a 1945 aerial photograph of a low, unvegetated island segment consisting of multiple breaches. After an inlet opened in 1962 and built flood-tide delta shoals (Panel B), the inlet closed and developed into marsh that, by 1998, became part of a wider and vegetated island segment (Panel C). Panel D shows storm-deposited overwash fans extending across the island and into the sound in 1962. Sediment deposited on the island built elevation and shoals, which developed into marsh (Panel E), and widened the island. The 1998 estuarine shoreline is superimposed on the historic photographs to demonstrate estuarine shoreline change. The superimposed ocean shoreline is that of 2006.
Simple barrier islands are dominated by storm overwash events (Fig. 9). Storm waters flowing across the island deposit large sand fans that build island elevation. Occasionally the overwash fans extend into the back-barrier estuary thus building island width and contributing to island migration (Fig. 8D, E).

**History and Role of Storms**

Sea level does not just gently rise and oceanic waters flood quietly across the land. Because storms are frequent and significant high energy events, they become the drivers that erode the shorelines, move the barrier islands, and cause ecosystems to migrate upward and landward (Fig. 8).

One hundred and five tropical storms and hurricanes impacted North Carolina during the 20th century (Robinson, 2005). Sixty four hurricanes made landfall between 1900 and 1999. The two decades in the 1940s and 1950s represent an active period followed by a relatively inactive period during the 1960s and 1970s. This was followed by two decades (1980s and 1990s) of frequent hurricane landfall in North Carolina.

The consequences of any given storm or series of storms vary and are generally unpredictable. Their impact upon the coastal system depends on type, size, strength, duration and forward speed of the storm, storm track, rainfall amount, storm surge height, tidal cycle, coastal elevation and orientation, and continental shelf geometry. The potential economic impact not only depends on storm characteristics but also on land use and type and density of development. As urbanization increases, so does the potential economic loss.

Even though nor’easters are not as strong as tropical storms, they can have farreaching impacts since they are regional in extent and do not move as rapidly as hurricanes. They can build a sea state over several days and pound the coast through multiple tidal cycles (Stick, 1987). Up to 35 of these extra-tropical storms can occur every year during the fall to early spring.

**FIGURE 9.** Hutaff-Lee Island is located between Figure 8 and Topsail Islands and is characteristic of what those two islands used to look like. Panel A is a 1998 oblique aerial photograph of the sediment-poor barrier island at low tide. Notice the dark line of back-barrier marsh peat along the high-tide line and the large storm overwash fan that has transported beach sand onto the back-barrier marsh, thus building island elevation. Panel B is a close-up of the marsh peat on the beach at low tide. Photographs are by S. Riggs.
Sea-level change results in a relatively slow and gradual reshaping of the North Carolina coastal system. More rapid change is achieved by hurricanes and nor’easters. Rising sea level floods up the stream valleys and adjacent land slopes, and storm waves erode and move the shorelines further landward.

Long-term tide gauge records (Hicks et al., 1983; Gornitz and Lebedeff, 1987; Douglas et al., 2001) indicate that sea level is rising at about 1.01 feet/100 years in the Charleston area and about 1.06 feet/100 years in the Norfolk area. Short-term data for the period from 1980 to 2000 at Duck, N.C. (Zervas, 2004) indicate that sea level for the Albemarle/Pamlico region is rising slightly faster at about 1.5 feet/100 years.

Extensive studies of salt-marsh peat on Roanoke Island have produced detailed sea-level curves for the past few thousand years (Kemp et al., 2007; Horton et al., 2007). Salt marshes grow vertically by depositing peat to keep up with rising sea level. The rate of sea-level rise recorded in cores of peat can be determined by using multiple research approaches (radiocarbon, lead and cesium isotopes, and various types of microfossils). The resulting data suggest that the rate of relative sea-level rise has increased from 3 inches/100 years between 0 AD and 1800 AD to 7 inches/100 years during the 19th century and to 16 inches/100 years during the 20th century (Table 2).

The increasingly rapid rate of sea-level rise results in flooding of low coastal land and almost ubiquitous recession of North Carolina’s ocean shorelines. The NC Division of Coastal Management (NCDCM, 2004) ocean shoreline erosion data, based upon aerial photograph analysis from 1946 to 1998, calculates the average annual erosion rate of 1.6 feet/year (J. Warren, pers. comm., 2008) with local rates that range upwards to 15 feet/year. Riggs and Ames (2007) analyzed historic surveys and aerial photographs of Core Banks from 1849 to 2003 and demonstrated a net landward recession of the ocean shoreline for the past one and a half centuries. Figure 10 demonstrates island narrowing between Avon and Buxton where the ocean shoreline has receded up to 2,500 feet over 151 years (an average annual erosion rate up to 17 feet/year). Up to 76% of the island width in 1852 has been lost and NC Highway 12 has been moved westward four times since 1955. The highway is now immediately adjacent to the Pamlico Sound shoreline. Figure 11 demonstrates island recession in the urbanized area of South Nags Head. The ocean shoreline has receded up to 1,000 feet in 149 years at an average annual erosion rate up to 7 feet/year. Sandbagged houses have been flanked by the ocean, the access road has been eroded, and the second and third rows of houses are threatened. Storms often damage the sandbagged houses and expose septic tanks and drain fields (Fig. 12).

<table>
<thead>
<tr>
<th>Table 2. The varying rate of relative sea-level rise in northeastern North Carolina for the last 11,000 years (extracted from data in Horton et al., 2007, in press and Kemp et al., 2007).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Period</td>
</tr>
<tr>
<td>11,000 – 8,000 yrs ago</td>
</tr>
<tr>
<td>8,000 – 2,100 yrs ago</td>
</tr>
<tr>
<td>2,100 – 200 yrs ago (100 BC – 1800 AD)</td>
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<tr>
<td>200 – 100 yrs ago (1800 AD – 1900 AD)</td>
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<tr>
<td>100 – 0 yrs ago (1900 AD – 2000 AD)</td>
</tr>
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Figure 10. 2003 aerial photograph of the Avon-Buxton portion of the Cape Hatteras National Seashore displays the location of the 1852 shoreline (yellow line) relative to the shoreline location in 2003. NC Highway 12 (black line) was constructed in 1955 and has since ‘gone-to-sea’. The highway was rebuilt in 1974 (red line), in 1999 (white line), and again in 2003 (green line).
Figure 11. Panel A is a 1998 aerial photograph of a portion of South Nags Head on Bodie Island and displays the location of the 1849 shoreline (red line) relative to the shoreline location in 1998 (black line). The location of the shoreline is shown in a recessional sequence for 1940, 1955, and 1962 (white lines). Panel B is an oblique aerial photograph (2008) that shows a housing development built in the 1980s, encased in sand-bags for several decades, and the receding shoreline adjacent to the houses. The red star is the same location on both panels. Panel B photograph is by S. Riggs.

Figure 12. Photographs of sand-bagged houses in South Nags Head on Bodie Island (Panel A) and Bogue Inlet on Bogue Banks (Panel B) demonstrate the loss of the public beach. Photographs of sand-bagged houses in South Nags Head on Bodie Island (Panels C and D) with exposed and broken septic tanks and drain-fields. After storms these houses are condemned until the septic systems can be temporarily repaired and reburied in sand. Photographs are by S. Riggs.
WHAT IS AT RISK?

The variety and scale of the natural resources and human infrastructure/activities that are at risk are quite staggering.

**Natural Resources:** Approximately 325 miles of barrier islands with more than 20 inlets; the second largest estuarine and wetland system in the US; over 5,000 miles of estuarine shoreline; eight major drainage basins and the associated wetland system.

**People and Industry:** Population of 865,000 residents in 20 coastal counties (population growth rates on the barrier islands of 75-150% since 1980); tourism, agriculture, forestry, and commercial fisheries.

**Infrastructure:** Private, public and commercial buildings in 20 coastal counties; roads and bridges; power systems and sewage treatment plants; water treatment and distribution systems.

**U.S. and NC Government Land Holdings and Operations:** U.S. Military Bases (3 major bases and many support facilities); U.S. Coast Guard Facilities (numerous); U.S. National Park Service (two National Seashores and two Historical Sites); U.S. Fish and Wildlife Service (13 National Wildlife Refuges); U.S. Forest Service (one National Forest); NC Department of Transportation (two major ports, 16 ferry facilities, many miles of coastal highways and many coastal bridges); NC Division of State Parks (10 State Parks and Historic Sites); NC Division of Wildlife Resources (~300 public boat launch sites and ~2 million acres of game lands).

The Intergovernmental Panel on Climate Change Report (IPCC, 2007) predicts increased rates of global sea-level rise over the next century in direct response to global climate warming. Increased rates of sea-level rise and possibly increased intensity tropical storms will likely impact the North Carolina coastal zone adversely in the following ways.

1. Accelerated rates of coastal erosion and resulting loss of agriculture and forestry lands, estuarine wetlands, and other coastal habitats.
2. Economic losses due to increased salt-water encroachment, higher flood levels, and increased storm damage.
3. Increased loss of urban infrastructure.
5. Negative impacts on North Carolina’s coastal tourist and recreational fishing economy.

Approximately 25 miles of North Carolina’s Outer Banks are immediately threatened by erosion. Along these island segments it is increasingly difficult and costly for NC DOT to maintain a coastal highway. More than 400 structures on the ocean-front and at inlet shorelines have been preserved only by walls of sand-bags (Figs. 11, 12). In the early 1990s about 12 miles of public ocean beach were being nourished on a regular basis; coastal communities are now trying to develop beach nourishment programs for over 122 miles (Fig. 13).

Is a rate of 16 inches/100 years (Horton et al., 2007; Kemp et al., 2007) for rising sea-level significant for the North Carolina coastal system? Major portions of Currituck, Carteret, Dare, Hyde, Tyrrell, and Pamlico counties are only 1 to 2 feet above present sea level.
During the 20th century, human development and engineering have become a dominant force in modifying barrier island evolution. Among these modifications are the construction of bridges, roads, and barrier dune ridges, beach management (e.g., hardening, sand bags, and nourishment), and inlet management (e.g., closing, hardening, and sand mining/dredging). All of these anthropogenic processes interrupt the natural barrier island dynamics.

**Infrastructure Construction**

**Roads and Bridges**

During the 20th century, highways and bridges were built to facilitate development of the Outer Banks, NC. Highway 12 was paved in 1952 and connected to the 2.44 mile long Oregon Inlet bridge constructed in 1962-63. These structures were built across Cape Hatteras National Seashore and Pea Island National Wildlife Refuge to connect eight isolated villages with the Kitty Hawk to Nags Head urban area to the north.

Oregon Inlet was opened by a hurricane in 1846 north of the current Bodie Island lighthouse. It had migrated 2.5 miles southward by 1989. Construction of a bridge with a fixed navigational span over a migrating inlet required immediate dredging to keep the main channel under the fixed span. The amount of dredging required to hold the channel increased through time. By 1980 the problem became severe enough to require a substantial increase in the volume and frequency of dredging. The dredged sand was dumped offshore in deep water and lost to the inlet-barrier island system. This resulted in increased rates of inlet migration and beach erosion on Pea Island. As the inlet migrated southward, the bridge was becoming severed from Pea Island.

When the inlet approached the old U.S. Coast Guard Station, a variance was received from the NCCRC to stop inlet migration by constructing a rock jetty and to build an extensive rock revetment around the northern end of Pea Island to secure it to the bridge (Fig. 14). The jetty and revetment were built in 1989-1991 and did stop the southward migration of the inlet. In the meantime, however, the northern side of the inlet continued to migrate southward, thus narrowing the inlet width and substantially deepening the navigational channel under the fixed bridge span. This, in turn, jeopardized the central bridge piles and rock fill was required to rebury the piles.

With construction of the jetty, it was determined that the down-drift Pea Island beach should be nourished with sand obtained from inlet dredging. Approximately 7.7 million yards$^3$ of inlet sand were pumped onto the beach and placed in shallow, near-shore waters of Pea Island during 23 operations between 1989 and 2005. In addition, about

**FIGURE 14. Photographs of the Oregon Inlet bridge with a rock revetment built in 1989 around the south end of the bridge to secure it to Pea Island (Panel A) and a jetty built in 1989-91 to stabilize the south shore of the migrating inlet (Panel B). The red star shows the location of the former U.S. Coast Guard Station. Photographs are by S. Riggs.**
overwash and inlet formation, the proposals for construction of a new Oregon Inlet bridge and Pea Island road are complex and expensive. One alternative is to build a new bridge parallel to the present bridge, maintain the Pea Island road on its present right of way, and rebuild new segments of road as needed. However, the Pea Island road, even with continued beach nourishment and construction of barrier dune ridges, is expected to ultimately require either elevation or relocation to a back-barrier causeway at some time within the life span of the new bridge. Minimum cost estimates for the parallel Oregon Inlet bridge and Pea Island road (to 2060) range from $602 million to $1.58 billion.

A second alternative is to build a back-barrier bridge-causeway across the Oregon Inlet FTD and into the deeper water of Pamlico Sound. This 17-mile long structure would return to the barrier island in the village of Rodanthe (Fig. 1). Minimum cost estimates for the back-barrier corridor (to 2060) range from $1.3 billion to $1.8 billion.

**Constructed Barrier Dune Ridges**

Natural coastal processes in the northern part of the state were forever altered in the late 1930’s by construction of barrier dune ridges from the Virginia line south to Ocracoke Inlet. Continued reconstruction and maintenance of the

700,000 yards$^3$ of sand were mined from the fillet south of the jetty by NC DOT and trucked down the coast to construct dune ridges. However, Pea Island’s ocean shoreline continues to erode at average rates up to 13 feet/year, one of the fastest erosion rates in North Carolina. The consequence is that there are three “hot spot” segments of Pea Island where NC Highway 12 has previously “gone-to-sea” (Fig. 15). Even after being relocated to the west, the road on these three segments is continuously threatened. Every storm requires teams of bulldozers to mine the overwash sand and rebuild one or more constructed dune ridges.

Pea Island has been dominated by inlets and overwash throughout the last 500 years of its history. A new inlet could open in several places along the island depending upon the location and magnitude of a storm. In the context of this history and an ever-narrowing Pea Island, threatened by...
barrier dune ridges for the past six decades have changed the
dynamics of all barrier islands, but particularly simple inlet-
and overwash-dominated barriers (Fig. 16). The constructed
barrier dune ridges have acted as walls that have prevented
most overwash associated with average storm events. This
has resulted in little sediment delivery to the barrier island’s
sound side. Lack of overwash sand has led directly to
increased rates of sound-side shoreline erosion (Riggs and

The constructed barrier dune ridges, in concert with a
natural sand deficiency and net ocean shoreline recession
related to sea-level rise, cause the ocean beach profile to
steepen, resulting in even higher rates of shoreline recession.
The constructed dune ridges, built to protect the islands
have, ironically, contributed to their erosion.

**Beach and Inlet Management**

**Shoreline Hardening**

Most North Carolinians have supported the concept of
maintaining natural beaches and historically have preferred
beach nourishment and relocation as the main measures for
combating ocean-front and inlet shoreline erosion. North
Carolina law dictates that trading concrete, steel, rock,
and debris for the natural sand beach is not an acceptable
erosion control measure. Further, hardened structures on
beaches and inlets inevitably cause increased erosion and
ultimate loss of the beach (Fig. 17).

However, as sea level rises and shorelines recede, there is
ever increasing pressure for implementing more permanent
shoreline stabilization structures along the North Carolina
ocean beaches and inlets. Along the 325 miles of ocean
and inlet shoreline in North Carolina, there are eleven

![Figure 17](image-url)
hardened structures (Fig. 13), eight of which pre-date the 1985 no-hardening rule. The three structures constructed since 1985 required variances from the North Carolina state agencies. The rock jetty and rock revetment at Oregon Inlet were constructed to protect the bridge (Fig. 14). The third structure was a rock revetment constructed to protect the earthen-work Fort Fisher (Fig. 17).

The ban on hardened structures is increasingly challenged. Senate Bill S599, proposed in 2007 was an effort to open the door to inlet-stabilization with construction of terminal groins (jetties) along many of North Carolina’s developed inlets. The island communities desiring to stabilize adjacent inlets are those with threatened houses located within the Inlet Hazard Zone of the NC Division of Coastal Management’s Areas of Environmental Concern. The Inlet Hazard Zones are well defined areas that have historically, and often recently, been occupied by active inlets.

Sand Bag Hardening
Bulkheads composed of sand bags form a hardened shoreline similar to any rock, concrete, or steel bulkhead. As a result, the beach in front of the bags is lost and erosion is increased on the adjacent beaches (Fig. 18). The North Carolina regulations allow sand bags to be used as a temporary, stop-gap measure providing the owner time to either participate in a community beach nourishment program, move the structure to a new location, or dismantle it.

However, the sand bag regulation has not been enforced and as a result there are many segments of the North Carolina ocean shoreline where houses and their septic tanks are in the surf zone (Fig. 18). Storms often expose and break septic tanks, which are rapidly repaired and reburied. They may continue to leak and contaminate the adjacent beaches and near-shore coastal waters. North Carolina recently (May, 2008) began to enforce the sand bag regulation with the requirement that all exposed sand bags that have been in place beyond the permitted time must be removed.

Beach Nourishment
To locate and define potential sand sources for beach nourishment projects requires extensive exploration programs. Since the best sand is already on the beach and
there are only a few other potential sources, beach nourishment represents a temporary solution.

The ocean floor does not contain vast deposits of suitable sand. The sediment on the shoreface becomes finer grained offshore. The large sand bodies of Diamond Shoals, Lookout Shoals, and Frying Pan Shoals (Fig. 1) are too far from beaches that need nourishment and too difficult to mine to currently be viable as a source for beach sand. Unfortunately, the sand dredged from navigation channels is too often lost to the coastal system by being dumped in spoil piles or too far offshore for natural beach renourishment to occur.

Sand sources on the mainland are locally available. However, these sand deposits are generally more valuable for other uses or are far enough away that transportation costs make mining the sand for beach nourishment economically unviable. The most commonly utilized source of beach nourishment sand in North Carolina is the ebb-tide delta and channel sand in adjacent inlets. Even though this sand is usually high quality and beach-compatible, mining it destabilizes the inlets and results in negative impacts upon long-shore sediment transport and long-term sediment budget for both the barrier islands and their adjacent inlets.

Prior to the storms of the late 1990s, about 12 miles of public beaches in North Carolina ocean coast communities were regularly nourished. Wrightsville Beach started nourishing their beach in 1939, Carolina Beach started in 1955 (Fig. 19), and Kure Beach started in 1997, all with significant federal funding programs. Today, ocean beach communities desire over 122 miles of nourishment projects. Since the early 2000s, the federal government appears to be unwilling to fund any new beach nourishment projects, other than navigation projects, and public referendums have generally failed to produce the necessary support for local funding, except for Bogue Banks and a few other island communities.

A summary of available data (from the Program for the Study of Developed Shorelines) for two coastal towns follows:

**Carolina Beach, NC**
- 28 operations 1955-2004 (49 years)
- Total nourishment sand = about 18.55 million yds³
- Average = 1 operation of 662,321 yds³ every 1.75 years

**Wrightsville Beach, NC**
- 19 nourishment operations 1955-2002 (47 years)
- Total nourishment sand = over 10.84 million yds³
- Average = 1 operation of about 570,421 yds³ every 2.5 years

The histories of Carolina Beach and Wrightsville Beach nourishment projects demonstrate the generally short-term life expectancy and large volumes of nourishment sand required to “hold the line”. What the data do not record is the dramatic increase in the cost of projects through time.
**Inlet Openings and Closings**

Hurricane Isabel came ashore in the vicinity of Ocracoke Inlet on September 18, 2003. This small storm produced Isabel Inlet in a low and narrow portion of the barrier adjacent to Hatteras Village (Fig. 20). Two other weak spots (on the northeast end of Ocracoke Island and at the 1962 Buxton Inlet site) came close to forming inlets. Isabel Inlet was subsequently closed within five weeks utilizing sand from the dredged navigation channel for the Hatteras-Ocracoke ferry. This extremely narrow island segment, however, needed a flood-tide delta and its sand deposits to develop island width. This island segment is as vulnerable to inlet formation now as it was prior to Hurricane Isabel. In fact, there are several locations along the North Carolina coast where new inlets could open during a future storm. Using digital elevation data along the Outer

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**FIGURE 20.** Panel A, a 1998 aerial photograph, shows the vulnerable barrier island segment near Hatteras Village. The 1860 coastline is superimposed (purple lines) to show the extent of island narrowing over 138 years. Panel B is a September 2003 aerial photograph of the newly formed Isabel Inlet through that segment. An inlet at such a location, if allowed to develop, would build sound-side shoals which would widen the island segment, once the inlet closes. Panel C shows marsh peat exposed on the beach after the storm. The marsh peat, which is a few hundred years old, formed on the sound side of the barrier when the ocean shoreline was substantially seaward of its present location. The presence of peat at the location indicated by red stars reduced the likelihood of inlet formation at that site. Panel D shows NC Highway 12 “going-to-sea” following Hurricane Isabel. The location of the north eastern margin of the inlet is indicated by the green stars. Panel C and D photographs are by S. Riggs.

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**FIGURE 21.** 1932 (Panel A) and 1999 (Panel B) aerial photographs of the Nags Head area show the growth of Old Nags Head village from the shores of Roanoke Sound to the ocean front. Notice the substantial decrease in the distance from the shoreline to NC Highway 12 from 1932 to 1999. The 19th century ocean-front houses have been moved seaward several times in response to shoreline recession. Notice that most of the land and dune fields have been urbanized since 1932. Figure is modified from Riggs and Ames (2003).
Banks, areas of future inlet-opening potential have been mapped. This and other data sets can be explored at http://www.coastal.geology.ecu.edu/NCCOHAZ/.

**Relocation**

In North Carolina, one of the earliest ocean-front developments, which began after the Civil War in the area of Old Nags Head, was characterized by very deep lots to allow for the systematic relocation of the houses as the shoreline retreated (Fig. 21A). Most of these early houses were moved landward several times during the 20th century. They are now adjacent to NC Highway 12 and cannot be moved further (Fig. 21B). In 1999, the Cape Hatteras Lighthouse was finally relocated 1600 feet inland after many futile efforts from 1969 to 1999 to combat coastal erosion. Relocation (Fig. 22) can be considered for all buildings that occur in the high-hazard ocean-front and inlet zones.

Within the southeastern portion of the North Carolina coast, the barrier island segments from Onslow Beach southward to Carolina Beach (Fig. 1) are sediment poor, dominated by numerous small and migrating inlets, and are in a general state of shoreline recession. The heavily developed, sediment-poor islands include Topsail, Figure 8, Shell Island, Wrightsville Beach, Carolina Beach, and Kure Beach to Fort Fisher. Communities along the ocean and inlet hazard zones have only been able to partially protect their property from sea-level rise and storm activity; they are dependent upon regular beach nourishment projects or hardened structures. However, as sea level continues to rise and sand supplies are diminished, the economic cost of beach nourishment will increase substantially and dictate the need to begin relocation.
A Vision for the Future

Until the middle of the 20th century, the North Carolina barrier islands had several villages with subsistence populations that supported small tourist and fishing industries. However, in the second half of the 20th century, the coastal barriers evolved into an economic engine that has become a critical cornerstone of North Carolina’s economy. Billions of tourism dollars are generated annually. North Carolina has 21 coastal counties with 865,000 residents (10.3% of the state population) and is growing. Several ocean-front counties had 76 to 150% population growth from 1970 to 2000 (http://maps.csc.noaa.gov/hurricanes/pop.jsp). The islands that used to be dominated by small beach cottages are now lined with high-rise hotels, condominiums, and large vacation homes. However, there are limits to growth and type of development on migrating barrier islands. To preserve the barrier island-based, tourist/recreation economy and the natural resources upon which it is based, it is imperative that we start to develop viable, long-term management plans that include adaptation to a dynamic, mobile, and rapidly changing natural system. The possibilities are limited only by our imaginations.

Northeastern North Carolina: “A String of Pearls”

Oregon Inlet Bridge and NC Highway 12 were constructed in the 1950s and 1960s to enhance the economic development of the Outer Banks. These structures were built across Cape Hatteras National Seashore and Pea Island National Wildlife Refuge to connect eight isolated villages to the Kitty Hawk to Nags Head urban area to the north. Over the following five decades, the ocean shoreline receded, overwash and inlet processes essentially terminated, sea-level rose, and many miles of the barrier islands narrowed substantially.

Thus, it is time to rethink our approach to utilizing the island segments that are threatened by rising sea level, storms, and anthropogenic modifications. If we withdrew from some of the coastal highways and terminated the construction of barrier dune ridges, the islands would begin their natural rebirth as inlet and overwash dynamics would once more rebuild them. The eventual result would likely be a barrier island system with eight Ocracoke-style destination villages (Fig. 23) strung like a string of pearls upon a vast network of inlet and shoal environments that would afford us many new opportunities for economic development.

We cannot stop major storms from striking North Carolina. We cannot stop sea-level from rising. We cannot stop the barrier islands’ natural tendency to migrate landwards in response to rising sea level. We are now at a threshold. Large segments of the barrier islands have almost washed away. NC Highway 12 can no longer be relocated on narrow island segments. But we can still maintain a vital coastal economy and preserve the natural resource base. As a starting point for discussion, consider this possible course of action. If we were to withdraw from the Oregon Inlet bridge (except for the ends to be utilized as fishing piers).
and from NC Highway 12, except within Bodie Island and the villages of Rodanthe, Waves, Salvo, Avon, Buxton, Frisco, Hatteras, and Ocracoke, we could not only save billions of dollars, but also expect the following responses.

1. Several small inlets and associated inlet flats and ebb- and flood-tide deltas would be formed, thus building back-barrier shoal and marsh systems critical to island integrity.

2. Large areas of island overwash would begin to build island elevation and width.

3. The increased water exchange between Pamlico Sound and the Atlantic Ocean would result in substantial improvement in water quality and productivity of marine and estuarine ecosystems.

4. Significant increase in overwash, inlet, and shoal habitats would vastly expand the natural habitats for several endangered bird and animal species.

5. The increase in overwash and inlet-shoal habitats would also produce an increase in fishing sites, as well as opportunities for other forms of recreation including hiking, camping, kayaking, birding, and off-road recreational vehicle use.

6. New opportunities would present themselves for many new small businesses such as water taxis, mule train and ATV tours, fishing and hunting guides.

7. Each of seven villages will have the potential to become an Ocracoke-style destination village (Fig. 23).

8. A world-class eco-tourism economy could be built around the natural and human history and culture of North Carolina’s unique Outer Banks.

9. The villages could be inter-connected by a system of modern ferry and water-taxi systems (jet-powered catamarans and hydrofoils) capable of moving large volumes of visitors rapidly to and between destination villages with minimal disturbance to ecosystems.

10. Supply trucks, tourist buses, garbage trucks, SUV’s, and personal vehicles of the village residents could be transported using the NC DOT ferry system or hovercraft similar to those used by the U.S. Marine Corps.

**Figure 24.** Examples of alternate, non-invasive transportation systems utilized on small island communities throughout the world. Photographs are by S. Riggs.
11. Ferry terminals could be located at the small rural mainland villages such as Wanchese, Stumpy Point, Engelhard, Swan Quarter, and Cedar Island (Fig. 23).

12. These towns could maintain short- and long-term car parks, allowing tourists in the destination villages to utilize less invasive types of transport systems (e.g., bikes, golf carts, pedi-cabs, trolleys, mule-trains, etc.) (Fig. 24).

13. Mainland towns would be in a position to develop many local businesses (e.g., motels, restaurants, B and Bs, service stations, etc.) and become centers for new natural resource-oriented business opportunities (e.g., guiding and supplying eco-tours of the Outer Banks and mainland Inner Banks (e.g., black-water paddle and camping trips, estuarine cruising trips, coastal over-flight field trips, historical tours, hunting-fishing-birding tours, etc.).

Southeastern North Carolina: “Islands of Opportunity”

Imagine what could be done with our highly developed beach communities of southeastern North Carolina as sea-level rise and storm dynamics continue into the future. By determining levels of vulnerability through detailed geomorphic mapping, communities can begin to develop adaptation programs that involve sustainable economic development. Below are some concepts that could be included in planning for barrier island adaptation management. Some of these ideas might be characterized as unfeasible but we include them here in the hopes of encouraging discussion of these issues. The alternative is to ignore the reality of sea-level rise and the associated and inevitable coastal erosion and barrier island migration.

1. A regional evaluation of the southeastern barrier island system and the mainland shore could be undertaken to assess long-term usability of each island. Some islands may be suitable for “holding the line” and others less so.

2. Recognizing that not all islands have the same characteristics, some could sustain full development, some could sustain lesser development, the amount dependant on the economic viability of beach nourishment. Some islands and segments of the mainland may be best suited to various kinds of day-use, and others could become nature preserves and wildlife refuges.

3. Bridges become old and unsafe and are extremely expensive to replace. Not replacing some bridges is an option that should be thoroughly researched and discussed. If it is determined that a bridge should not be replaced, a system involving car parks on the mainland and a water-taxi and/or ferry service to the island in question could be developed. Bald Head Island, which utilizes only golf carts and bikes, except for service vehicles, already operates this kind of system.

4. Owners of the high-hazard land along the oceanfront, inlet hazard areas, and locations where inlets are most likely to occur could consider a wide range of alternative uses (for example, bait and tackle shops, concession stands, bath houses, parking, etc.).

5. All houses and commercial structures could be raised and piled high enough off the ground to allow storm-surge overwash and sediment accretion. Less damage will result and the natural process of island building can take place.

6. Portions of shore-parallel roads could be left unpaved and, if necessary, portable metal ramping could be utilized on overwash fans after major storms. Shore-perpendicular roads could be staggered (to minimize flood conduits) and some could be maintained as sand roads.

7. Low supra-tidal zones and marshes on the sound sides of barrier islands could be protected to allow for natural island evolution. A similar strategy could be used for low-lying environments on the mainland coasts. These wetland systems, which are critical for fisheries and water quality, could continue to be utilized for eco-tourism.
A CONCLUDING THOUGHT

The documented increasing rate of sea-level rise and the possibility of increased intensity of tropical storms are threats to our coastal economy that we must not ignore. Adaptation to the ever-changing coastal environment is the key. Our vision for the future of coastal North Carolina, based on an understanding of the origin and evolution of the barrier island-estuarine system, is preliminary and unrefined. Future actions such as those outlined above could lead to a renaissance that has more potential pay-offs than our current approach to coastal management can provide in a changing climatic regime.

ACKNOWLEDGEMENTS

Much of the work summarized in this report is the product of the North Carolina Coastal Geology Cooperative, a multi-year research program led by East Carolina University, the United States Geological Survey and the North Carolina Geological Survey, with contributions from scientists at the University of Delaware, University of Pennsylvania, and Virginia Institute of Marine Sciences. Funding for the USGS cooperative agreement awards 02ERAG0044, 02ERAG0050, 01ERAG0015, 07ERAG0020 and NSF cooperative agreement award OCE-9807266 is gratefully acknowledged. Additional support came from a University of North Carolina Research Competitiveness award, as well as the U.S. National Park Service, U.S. Fish and Wildlife Service, Environmental Defense, N.C. Division of Coastal Management, N.C. Division State Parks and Recreation. The work of students and staff of the Department of Geological Sciences at East Carolina University and the ECU Institute for Coastal Science and Policy is gratefully acknowledged as is the review by G. “Rudy” Rudolph. Sources of aerial photographs: USACE-FRF, Duck; USACE-Wilmington; CHNS, Manteo; NC State database; NC DOT; US Geological Survey.
REFERENCES CITED


**FURTHER READING**


A digital version of this document, along with reports on related research funded by a grant from the University of North Carolina system, can be accessed at the North Carolina Coastal Hazards Decision Portal: http://www.coastal.geology.ecu.edu/NCCOHAz/.
## American Recovery and Reinvestment Act (ARRA) AWARDS

### DIRECT FED - AWARDS RECEIVED

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Total Direct $2,741,858

### SUB FROM ANOTHER ENTITY - AWARDS RECEIVED

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Total Sub $720,852

**CUMULATIVE ARRA FUNDING TO DATE**

$3,462,710
Indirect Cost Rates

2009-2010 is the base year for developing new indirect cost rates with the federal government. The indirect cost proposal must be submitted to the U.S. Department of Health and Human Services (DHHS) by December 2010. Once they receive the proposal, it will take approximately three to six months for the audit and negotiation process to be completed. We anticipate new rates to be effective as of 07/01/2011. ECU’s office of grants and contracts is in the process of soliciting for a consulting firm to complete the rate development and negotiation process. The University of North Carolina General Administration has established convenience contracts with Maximus, Inc., and Huron, Inc., to provide these indirect cost services. It is anticipated that a decision will be made by January as to which vendor will provide services for ECU’s rate proposal.
UNC Tomorrow – Phase III
The Next Steps

Implementation of the strategic plan as outlined in Phase I and II

**Tasks**

- **Revisit:** Phase I and II in the current budget situation
- **Set:** Goals, Objectives, Outcomes
- **Set:** Timetable
- **Identify:** Infrastructure requirements (link to Master Plan)
- **Establish** Metrics of success
- **Establish** Iterative process of assessment, ensuring interactions with SACS process and continuing improvement

Execution Teams
Biosciences Building
Planning Committee
October 2009

1. Jeff Shinpaugh – Physics
2. Jeff McKinnon – Biology
3. Paul Kauffmann – Engineering
4. Bill Bagnell – Campus Operations
5. Mike Wheeler – Nutrition
6. Cindy Putnam-Evans – Arts & Sciences
7. Hunt McKinnon – Faculty Senate / Interior Design
8. Tbd – Chemistry
9. Bob Lust – BSOM
10. Ken Chalk – Board of Trustees
11. Deirdre M. Mageean – Research & Graduate Studies
12. Paul Gemperline – Research & Graduate Studies
MEMORANDUM

TO:         Board of Trustees Athletics Committee
FROM:      Nick Floyd
DATE:     November 20, 2009
RE:     Athletics Financial Reports

The attached financial report contains information for the first quarter of the current fiscal year through September 30, 2009.

Due to greater than expected football ticket sales, the fiscal year is off to an excellent start. Football revenue will come in well ahead of the budget estimate, and we remain optimistic about the other revenue streams as well, particularly considering the overall economic environment at this time.

Our coaches and staff also continue to do a good job in controlling expenses and managing their individual unit and sport budgets.

The outlook for the balance of the year is positive, yet we still remain cautious due to the economic conditions that still confront the country.

Thank you for your support of the athletics program, and please let us know if you would like to discuss this report in greater detail.

NF/bs
### EAST CAROLINA UNIVERSITY ATHLETIC FUND
#### FINANCIAL REPORT FY 2009 - 10

#### Revenue

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<th></th>
<th>Budgeted</th>
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**Net Operating Income / (Loss)**

|                                | 0 | 3,457,542 | 692,840 | 692,840 |

**Fund Balance Increase/(Decrease)**

|                                | $0 | 3,457,542 | 692,840 | 692,840 |

**Beginning Fund Balance**

|                                | 1,801,985 | 1,801,985 |

**Ending Fund Balance**

|                                | $1,801,985 | 2,494,825 |
FOOTBALL

• The Pirates, under the direction of fifth-year head coach Skip Holtz, have posted a 5-3 overall record with a 4-1 Conference USA mark as of Nov. 3. East Carolina opened the campaign with a 1-2 record, including losses at West Virginia and nationally-ranked North Carolina, but has won four of its past five contests.
• The winning record for ECU is quite impressive, considering the Pirates’ schedule is ranked as the eighth-most difficult in FBS football by ESPN.com’s Mark Schlabach. The Pirates’ slate stands behind Virginia Tech, Georgia, Oregon, Oklahoma, Fresno State, the entire Sun Belt Conference and Florida State but ahead of Illinois and Rice.
• Despite the setbacks to the Mountaineers and Tar Heels, since 2003, ECU stands seventh nationally among all non-Bowl Championship Series programs with six victories against automatic-qualifying BCS members – Navy (14), Utah (14), TCU (12), Fresno State (9), BYU (8), Hawai’i (7).
• With a victory over Memphis Oct. 27, the Pirates improved to 5-3 through eight games for the second-straight season, marking the first time Holtz has led his ECU teams to winning records through eight games in back-to-back years. The triumph also produced East Carolina’s third-straight 4-1 C-USA record.
• Entering the Memphis contest, the Pirates sported the nation’s top-ranked punt return unit with a 20.00 average. Following the contest, ECU dropped to fourth in the country with a 17.7 clip, still its highest national ranking in any statistical category this season.
• In addition to the highly-successful punt return unit, the Pirates currently rank among the top 50 programs nationally in the following statistics: fumbles recovered (13th/10), passes intercepted (17th/11), turnovers gained (10th/21), turnover margin (17th/0.88), third-down conversion percentage (25th/45.0), fourth-down conversion percentage (18th/66.7), tackles for loss (47th/108.0), scoring defense (47th/22.6), kickoff returns (44th/23.0), fumbles lost (21st/5), turnovers lost (45th/14), net punting (29th/37.4) and fourth-down conversion percentage defense (32nd/40.0).
• ECU ranks among the top three C-USA teams in the following statistics: punt returns (1st/17.7), turnover margin (1st/0.88), rush defense (2nd/108.0), total defense (3rd/357.8), kickoff returns (3rd/23.0), and net punting (3rd/37.4).
• East Carolina has already booked double-digit rushing defensive totals to four opponents in ’09 — allowing 70 yards to UCF, a Holtz era-best 28 yards to SMU, 78 yards to Rice and 84 yards to Memphis. In addition to the SMU effort, the rushing totals allowed to UCF and Rice also rank in the top 10 performances of Holtz’ tenure.
• Holtz’ Pirates continue to attract record-setting crowds at Dowdy-Ficklen Stadium, enhancing their standing as C-USA’s attendance leader. In all, a total of 6,108,607 fans have seen the Pirates in action since 1963, and so far in the Skip Holtz Era, ECU has averaged 39,082 (977,047/25 games). This season, East Carolina leads the league in attendance, averaging 43,171 fans per home game, 3,496 more in average attendance than second-place UCF. The Pirates also stand third nationally among non-Bowl Championship Series programs in average home attendance, trailing only BYU and Utah. In all, ECU has drawn seven of Dowdy-Ficklen Stadium’s top 10 crowds since Holtz’ arrival (and 11 of 15).
• ECU’s 9-5 mark last year, its 8-5 record in 2007 and its 7-6 ledger in 2006 represent three-straight winning seasons – a first for the Pirate program since the 1998, 1999 and 2000 campaigns. The last time East Carolina enjoyed a run of four-straight winning years was from 1976 to 1979 (was part of eight consecutive winning seasons that began in 1972).
• With a victory Thursday against Virginia Tech, East Carolina would conclude its 2009 non-conference schedule with a 2-2 record, matching last season’s mark. That would give the Pirates their first consecutive non-losing non-conference marks since a run of three straight from 1998-2000.
• East Carolina has played four games on national television this season, culminating with Thursday night’s home contest against Virginia Tech. The Pirates have also had their game at West Virginia streamed on ESPN360.com and have the opportunity to add yet another ESPN broadcast to the schedule with the Conference USA Championship Dec. 5.

BASEBALL

• Billy Godwin enters his fifth season at the helm of the Pirate baseball program and has posted a 161-90 overall record, which is tied for fourth all-time at ECU. In addition, he has guided the Pirates to three consecutive NCAA Regional appearances.
• The Pirates, who have made 10 NCAA Regional appearances in the last 11 seasons, claimed the 2009 Conference USA regular season and 2009 Greenville Regional titles before advancing to their third NCAA Super Regional on the way to a 46-20 overall record.
• Returning to the diamond in 2010 are a pair of All-Americans in senior Kyle Roller and junior Seth Maness, along with 2009 Freshman All-American Kevin Brandt, Greenville Regional Most Outstanding Player Trent Whitehead, All C-USA performer Brad Mincey and Greenville Regional hero Devin Harris, who drove in the tying and game-winning runs against South Carolina.
• ECU lost 11 players from last year’s squad, including three to the Major League Baseball Amateur Draft (Stephen Batts, Chris Heston and Ryan Wood), but will welcome in nine newcomers in 2010.
• ECU’s 2009 recruiting class received a top 50 national ranking by Baseball America and Collegiate Baseball.
• Thirty-six home games at Clark-LeClair Stadium, including the Seventh Annual Keith LeClair Classic, highlight the 2010 schedule.
• The 2010 slate features 17 games against teams that earned a bid to the 2009 NCAA Regionals; 32 against teams with 30-plus wins; five that topped the 40-plus win plateau; two that made trips to the College World Series and five that finished ranked in the Top 25 polls, including three in the Top 10.

BASKETBALL (MEN)
• The Pirates open the 2009-10 season inside Williams Arena at Minges Coliseum at 6 p.m. on November 13 against Virginia-Wise. They will then play their next seven games away from the friendly confines before returning home on December 5.
• ECU has been projected to finish anywhere from as high as sixth to as low as 12th in Conference USA this season by the various media outlets.
• Junior Brock Young was named preseason All-Conference USA Second-Team by USA Today and Third-Team by Lindy’s. Sophomore Darrius Morrow was a preseason second-team choice by Yahoo!
• The Pirates return eight lettermen, including four players that started 10 or more games. The roster consists of one senior, four juniors, three sophomores and six freshmen.
• The Pirates have 14 home games this season, including non-conference visits from Clemson (Dec. 16) and George Washington (Dec. 22).
• John Ashaolu has been named Director of Basketball Operations following the promotion of John Moseley from director of basketball operations to assistant coach.
• The team hosted a coach’s clinic for members of the media on October 24.
• Former ECU standout Theodore “Blue” Edwards was named to the CAA Silver Anniversary Team.

BASKETBALL (WOMEN)
• A potential matchup with 2009 WNIT champion South Florida, eight games against last season's postseason qualifiers, 14 home contests and the Eighth-Annual Lady Pirate Invitational help to constitute the East Carolina women's basketball team's 2009-10 schedule. The 2010 Conference USA Women's Basketball Championship is slated for March 8-12 at the Reynolds Center in Tulsa, Okla.
• ECU adds four guards and two forwards to its lineup this season, as Shala Hodges (Guard, Raleigh, N.C.) Celeste Stewart (Guard, Charlotte, N.C.), Ariana Jackson (Forward, West Palm Beach, Fla.) and Elaine Morgan (Guard, Raleigh, N.C.) are set to suit up for the Lady Pirates. East Carolina also welcomes transfers Kelly Smith (West Virginia) and Caitlin Thys (High Point) into the fold.
• The Lady Pirates are scheduled to appear on national television twice in 2009-10, first when hosting Marshall on Jan. 4 in the league opener for both squads and then traveling to Memphis Feb. 27 for a C-USA contest at the FedEx Forum.
• Head coach Sharon Baldwin-Tener earned her 100th win at ECU on Feb. 15, 2009 as the Lady Pirates knocked off 2009 C-USA Tournament champion UCF, 86-83 in overtime. She needs just eight more victories to become the winningest coach in program history.
• ECU racked up a 12-2 record at Minges Coliseum in 2008-09, matching the second-most single-season wins in school history and the most since 2000-01.
• East Carolina led C-USA in attendance at 1,602 fans per game in 2008-09, its second-highest attendance average in program history.
• Three players earned All-Conference USA honors as senior LaCoya Terry was named to the first team, senior Jasmine Young was selected to the second team and all-defensive squad, and rookie Jean Best earned a spot on the all-freshman team. It marked the fourth-consecutive nod to the second team for Young and her third-consecutive all-defensive accolade.
• Terry and Best earned two C-USA Player-of-the-Week accolades each during the season. Terry was the league’s honoree on Dec. 8 and Feb. 16 while Best garnered selection as the Rookie-of-the-Week on Jan. 26 and Feb. 16.
• Young finished the season ranked fourth in the league in assists while also recording the eighth-highest single-season ECU career total with 162. She now owns four of the top 10 single-season mark in school history. Young also broke an ECU career record, moving into first-place in three-point field goals made with a trey at UCF (Jan. 29). She also finished her career ranked second in steals and assists, as well as third on the C-USA career assist chart.
• Seniors Young, Terry and Gabriela Husarova all played in their 100th career games at East Carolina.
CROSS COUNTRY
• The men’s and women’s cross country teams are enjoying one of the most successful seasons in program history and have the NCAA Southeast Regional meet remaining. • The men’s team has won two meets this season, the Campbell Invitational and the ECU Pirate Invitational, marking the first time the program has claimed a pair of first-place finishes since 2003. The men also added a second-place finish at the Seahawk Invitational. • The women won the ECU Pirate Invitational title and took second at the Campbell Invitational and Seahawk Invitational. The team championship for the women was the program’s first since the 2006 McAlister’s Deli Invitational. • At the Conference USA Championship, the men placed sixth and the women seventh, one spot lower than the squads’ performances at the 2008 league meet, but a place ahead of their 2007 finishes. • Freshman Dillon Hawley has been the top runner on the men’s team, pacing the group in every meet but one this season. He has yet to finish lower than 18th overall in any meet, with his highest finish being a second-place showing at the ECU Pirate Invitational. His time of 24:44 in the 8K at the Great American Cross Country Festival was the seventh fastest in program history and the first to break into the top-20 list since the 2004 season. • For the women, senior Samantha Lichtner has paced the team three times while sophomore Tara Wilson has led the Pirates in their other two individual meets. Lichtner’s time of 18:15 in the 5K at the Great American Cross Country Festival was a personal best and the 20th-fastest mark in program history. Wilson turned in a team-best time of 22:44 in the 6K at the Penn State National. The time was also her personal best and the 17th fastest in ECU history.

GOLF (MEN)
• Sophomores Harold Varner and David Watkins have each earned Conference USA Golfer-of-the-Week honors this fall. • The Pirates captured the team title at the 2009 Savannah Mizuno Intercollegiate. • David Watkins won individual medalist honors at the 2009 Savannah Mizuno Intercollegiate, becoming the first ECU player to win an event outside of Greenville since Jason Harris won the Georgetown Hoya Invitational in 2002. • ECU has competed in the three tournaments this fall (Maryland Intercollegiate, VCU Shootout and Savannah Mizuno Intercollegiate). The Pirates will close out their fall slate at the Hummingbird Invitational in Sapphire, N.C., November 2-3.

GOLF (WOMEN)
• The Pirates finished the fall portion of their schedule with a 39-39 overall record. • In five fall events, ECU has claimed a pair of Top 5 placements with a second-place finish at the Lady Pirate Intercollegiate and a fourth-place finish at the Palmetto Intercollegiate. • The Pirates have been ranked as high as No. 55 in the Golfweek/Sagarin Ratings. • ECU hosted the 2009 Lady Pirate Intercollegiate at the par-71, 5,939-yard Greenville Country Club. Of the 15-team field, nine teams were ranked in GolfWeek’s Top 100. The Pirates took second place with an 881 score, while three Pirates finished in the top 10 (Bools/2nd; Puche/3rd; Otteson/t-7th). • Abby Bools received the 2009 Conference USA Sportsmanship Award, qualified for the 109th U.S. Women’s Amateur Championships during the summer of 2009, was named 2008-09 NGCA Division I Scholar All-America for the consecutive season. The two-time first-team All-Conference USA selection was also named C-USA Golfer-of-the-Week (for the sixth time of her career) on Oct. 21, 2009 and took home all-tournament honors after her second-place finish at the 2009 Lady Pirate Intercollegiate where she carded a career-low 213. • Amber Littman recorded her 15th career top 20 finish with her share of 11th place at the 2009 Lady Paladin Invitational. She ranked second in the 94-person field in par 4 scoring (4.20), shooting four-over par. In addition, she also ranked among the tournament leaders with 22 pars in 36 holes of play and is a two-time first-team All-Conference USA selection. • In her first collegiate tournament, freshman Meghan Moore, took home a share of ninth place at the Paladin Invitational posting a 36-hole score of 153 (78-75). The Bahama, N.C., native ranked among the tournament leaders in par 4 scoring (4.40), par 5 scoring (4.88), birdies (4) and pars (23). • Ana Maria Puche carded a career-low 214 at the 2009 Lady Pirate Intercollegiate, claiming third place and all-tournament honors. She led the 84-person field in par-4 scoring (4.03), while sharing the lead in par-5 scoring (4.44). • Sophomore Amy Otteson recorded her career-best finish (share of 7th place) at the Lady Pirate Intercollegiate after carding a career-low 220.
SOCCER
• The East Carolina soccer team completed its season with a 9-7-3 overall record and a 4-6-1 mark in Conference USA. This year’s league tournament only took the top six teams and the Pirates were three points short of qualifying.
• Eleventh-year head coach Rob Donnenwirth has a career record of 107-78-30, making him the winningest coach in program history. He earned his 100th career victory with ECU’s 4-0 triumph over Gardner-Webb Aug. 30.
• The Pirates had a winning record this season, marking the fourth consecutive year the team has finished above .500, the longest streak in program history since posting five-straight non-losing seasons from 1998-2002.
• Sophomore Amanda Malkiewicz was named a CoSIDA/ESPN The Magazine Third-Team Academic All-District selection. She was one of only eight sophomores within the district to be selected to the first, second or third teams.

SOFTBALL
• For the third consecutive season, the East Carolina softball team’s schedule will allow them to face numerous nationally-ranked opponents. Eight NCAA regional teams from 2009, including the Women’s College World Series champion and runner-up, are included in the 2010 schedule.
• The 2009 team posted a 40-15 record, including a 19-5 mark in Conference USA. The Pirates had three more league wins than Tulsa, 16-4, but the Golden Hurricane had a higher winning percentage (.800 to ECU’s .792) and claimed the regular season conference title.
• The 19 C-USA wins were the most the program has had since joining the league in 2002. The Pirates also set the program record for most Conference USA three-game series sweeps with four.
• Redshirt sophomore pitcher Toni Paisley was named the Conference USA Pitcher-of-the-Year after earning seven C-USA Pitcher-of-the-Week awards, tying the league single-season record. Head Coach Tracey Kee was selected as the Coach-of-the-Year for the second time in her career. Senior infielder Jessica Johnson also earned C-USA honors, making the first team for the second time in her career.
• Johnson’s post-season honors also included First-Team All-Region, All-North Carolina Collegiate Sports Information Association (NCCSIA) University Division All-State, Conference USA All-Academic and ESPN The Magazine Academic All-District Second-Team selections. The Laguna Niguel, Calif., native was named East Carolina’s Most Outstanding Female Scholar-Athlete for the 2008-09 school year.
• The ‘09 Pirates not only enjoyed a successful season on the field, but also in the classroom. ECU’s academic achievements were recognized by the National Fastpitch Coaches Association (NFCA) when the organization announced the program had compiled the 40th-best GPA of all NCAA Division I softball teams during the 2008-09 school year. The Pirates finished the season with a cumulative mark of 3.286. Additionally, the team was honored with its second consecutive Conference USA Sport Academic Award.

SWIMMING AND DIVING
• The men’s team has compiled a 3-1 dual meet record, while the women’s team has posted a 4-2 record. The Pirates have one dual meet remaining this semester (at College of Charleston, Nov. 7).
• Sophomore Meghan Coyne has been named Conference USA Diver-of-the-Week three times. She has also qualified for the NCAA Regional Zone Championships on both the one-meter and three-meter springboard. Coyne also set the Minges Pool record on the one-meter board.
• Senior Rachel Blue and junior Jenna Stewart have each been named Conference USA Swimmer-of-the-Week.
• Former Olympic gold medalist Mark Lenzi joined the coaching staff as the Pirates’ diving coach.
• Former ECU swimmers Meredith Bridgers and Amy Hendricks were named to the CAA Silver Anniversary Team.

TENNIS (MEN)
• The East Carolina men’s tennis program enjoyed a successful fall 2009 season in which it collected 16 singles victories and six doubles wins.
• Freshman Massimo Mannino won the singles title at the Old Dominion Collegiate, picking up four triumphs along the way as part of his seven-win fall.
• The Pirate and Lady Pirate squads compiled a combined 34-12 record this past spring.
• The men’s team, under the direction of fifth-year head coach Shawn Heinchen, established a new program record for single-season wins with a 19-5 mark. The 19 dual match victories bested the previous standard of 16 first set in 1957 and later matched in 2000.
• With its 16-1 start, Heinchen’s club also challenged the ECU’s single-season winning percentage standard of .875 set in 1959 (14-2) before faltering down the stretch and dropping four of its last seven matches, including the opener of the Conference USA Championship Tournament (Orlando, Fla.) to Southern Miss.
• After suffering an early setback to Appalachian State on Feb. 15, the Pirates rolled of 12 consecutive victories until falling to USM in a regular season battle on April 4.
• The Pirates earned the program’s first-ever national ranking as ECU made its debut in the Intercollegiate Tennis Association (ITA) poll at No. 61 on March 3. East Carolina later reappeared in the polls at No. 70 in early April.
• The men’s team produced a 95-42 (.693) singles record and a 45-17 (.726) result in doubles play.
• Senior Aleksey Kochetov (17-3) and junior Stephen Whitwell (19-4) compiled a combined 36-7 record to lead the Pirates in singles action while the tandem of Whitwell and junior Bryan Oakley led all doubles players with a 15-3 ledger.

**TENNIS (WOMEN)**
• Tom Morris’ women’s squad tallied a 15-7 record in 2009. The Lady Pirates enjoyed a strong start, opening the 2009 campaign by winning nine of their first 11 matches before hitting the road for eight of their last 11 events.
• ECU opened post-season play with a 4-3 triumph over UAB in the first round of the Conference USA Championship Tournament (Houston, Texas) before ending its campaign with a 4-0 setback to nationally-ranked Marshall in quarterfinal action.
• Statistically, the women’s team owned records of 88-38 (.698) in singles and 42-23 (.646) in doubles.
• Junior Brooke Walter and freshman Natalie Collins paced East Carolina in singles action with 19-2 and 15-5 marks, respectively. Collins and sophomore Tamara Sachs enjoyed the most success in doubles play with an 11-4 record.

**TRACK**
• The Pirates signed 22 student-athletes that will attend and compete for the University this season. The contingent includes three prep national champions as well as four state title holders.
• ECU experienced a record-setting outdoor season under the direction of Curt Kraft as a program-high 11 athletes qualified for participation in the NCAA East Regional, held at North Carolina A&T. Additionally, three Pirates won conference titles at the Conference USA Outdoor Championships – Kevin Thompson (200m), Kris Bell (110m hurdles) and Maegan Lewis (hammer).
• The ECU men matched their highest all-time finish at the C-USA Outdoor Championships, taking fourth-place.
• East Carolina finished its indoor season at the C-USA Indoor Championships in Houston. The men took fifth-place while the women’s notched 12th. Additionally, the Pirates took medalist honors in four events as Kris Bell defended his 60-meter hurdles title, Adrian Sanderson and Thompson took second in the 60-meter dash and 200-meter dash, respectively and the 4x400 relay team finished second just behind UTEP.
• Freshman Sebastien Biau also set a new school record in the pole vault at the C-USA Indoor Championships.
• The Pirates found their way into the national rankings three weeks into the season, checking in at No. 117 in the United States Track and Field and Cross Country Coaches Association Top 130 Poll.
• In non-championship competition, Bell captured two individual titles in the 55 and 60-meter hurdles, taking first at Christopher Newport (Dec. 6) and North Carolina (Jan. 14). Additionally, Percy Hinnant (long jump) and Meghan Horne (high jump) captured their first individual titles of the season at North Carolina.

**Volleyball**
• The East Carolina volleyball program owns a 2009 season record of 9-16 and is 2-11 in Conference USA play. The Pirates defeated UCF and UTEP by 3-1 and 3-2 scores as part of a current 3-2 home ledger. The team ends the campaign with three-straight contests at Minges Coliseum.
• ECU holds the first televised home match in program history when it welcomes Memphis to Minges Coliseum on Nov. 6. The contest is slated for national broadcast by CBS College Sports and will be shown on tape delay basis Nov. 10 at 7 p.m.
• A few members of the team have put themselves into the top 10 on some of the East Carolina career ledgers. Fenker and classmate Stephanie Turner are currently eighth and ninth on the digs list, with 975 and 971, respectively. Fenker also resides in sixth on the assists chart, as she owns 1,907 while Turner is 10th in kills with 918.
• Fenker, Turner and Melissa Zentner have all reached the 100-match plateau for their careers. Fenker and Turner passed the milestone against Arkansas while Zentner reached the mark with her play in the contest vs. Savannah State.
• In the match with Savannah State, the Pirates allowed just two points to the Tigers in the first set. It is the fewest given up by East Carolina since rally scoring went into effect in 2001. Only UAB has matched this feat nationally this season, holding Alcorn State to a pair of scores in the first set of a 3-0 decision on Sept. 4 at the Magnolia Invitational in Oxford, Miss.
• With a 3-2 triumph over UNCW on Sept. 29, the Pirates solidified a streak in which they have produced a winning non-conference record for five-straight seasons. Over that time, the team has garnered a 46-25 ledger outside of C-USA.
• On April 9, Patricia “Pati” Rolf was appointed head volleyball coach. Rolf brings 21 years of head coaching experience to the Pirate volleyball program, the last seven as head coach at Big East Conference member Marquette University. Her 412 career victories made her one of only 45 active coaches at the NCAA Division I level with at least 400 wins as of the start of the 2009 season.
Proposed Motion to be Offered by University Affairs Committee
Board of Trustees Meeting
April 17, 2009

Conferral of Degrees

I move that the candidates for degrees, as approved by the Faculty Senate and the Chancellor, be authorized for conferral on Friday, December 18, 2009, at the annual Fall commencement.
Retention and Graduation Task Force:

Austin Bunch, Chair, Enrollment Services
Robert Brinkley, ECU Board of Trustees
Steve Jones, ECU Board of Trustees
Roderick Bradley, Ledonia Wright Cultural Center, Institutional Equity and Diversity
Anthony Britt, Admissions, Enrollment Services
Michael Brown, Academic Standards Committee, Faculty
Mary Beth Corbin, Academic Services, Enrollment Services
Cal Christian, Athletics Committee, Faculty
David Dennard, African-American Studies, Faculty
Samantha Fountain, Student
Jayne Geissler, Advising Center, Enrollment Services
Virginia Hardy, Vice Provost for Student Affairs-elect
Karen Kuz, College of Business, Advising Collaborative
Nancy Mize, Student Life, Student Affairs
Julie Poorman, Financial Aid, Enrollment Services
Beverly Reep, Pitt County Schools, Community
Lynn Roeder, Dean of Students, Student Affairs
Logan Schertzinger, Student
Clayton Sessoms, Continuing Studies, Academic Affairs
Wendy Sharer, Admissions and Retention Polices Committee, Faculty
Marianna Walker, Chair of the Faculty, Faculty
Alan White, Harriot College of Arts and Sciences, Deans representative:
Dr. Michelle Aheron, Community College representative (Wake CC) – to be finalized
XXX, former student

Ex-officio
Marilyn Sheerer, Provost
David Weismiller, IPAR

Support staff:
Rhonda Jordan, Enrollment Services
Claudia McCann, Enrollment Services
Retention Resource Team:
In addition to the Task Force, it would be good to have a Retention Resource Team, who would be the personnel who might work most directly with academic programs, residential life programming and other campus entities in helping develop particular strategies for building retention.

Elizabeth Coghill, Pirate Tutoring Center
Karen Smith, Orientation
Liaisons to be appointed from each colleges (1-2 reps per undergraduate college for a total of 9-18 representatives)
Off-campus student liaison
Online education liaison
Athletics services liaison
Parent/Student services liaison
Freshmen residency study group rep
Undergraduate (general) studies study group rep
Others as needed
Retention & Graduation Task Force

Workshop Agenda

Wednesday, November 18, 2009
1-5pm, Bate 1200

Welcome and Introductions  Dr. Austin Bunch
Purpose of the workshop    Dr. Judi Bailey

Parameters:

- National retention and graduations rates
- UNC institutions retention and graduation rates
- ECU historical retention and graduation rates

Best practices:

- National best practices and benchmarks
- UNC system best practices and benchmarks
- ECU best practices and benchmarks

Exercise: Goal-setting in small groups

- Priorities for ECU retention and graduation
- What’s missing?
- Identifying campus consideration – website, customer service, etc.

What’s next:

1. Identifying what resources are needed to assist the task force (consideration of a Retention Resource Team?)
2. Identifying the resources needed to accomplish the priorities
3. What else?