CURRENT RESEARCH, MONITORING, AND EDUCATION PROJECTS

2014–2015

Baruch Marine Field Laboratory
(BMFL)

North Inlet-Winyah Bay
National Estuarine Research Reserve
(NI-WB NERR)

University of South Carolina

Belle W. Baruch Institute
for Marine & Coastal Sciences

North Inlet-Winyah Bay
National Estuarine Research Reserve

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Introduction

The Baruch Marine Field Laboratory (BMFL) has been the center of research activities for scientists and students from the University of South Carolina (USC) and dozens of other institutions since 1969. We conservatively estimate that between senior scientist projects and masters and dissertation studies conducted by graduate students, more than 1,000 grant and institutionally-funded projects have taken place at BMFL. This work has contributed substantially to the 1,738 peer-reviewed scientific articles, books, and technical reports that have been published since the Baruch Institute was founded. Independent and multi-disciplinary studies have been conducted by biologists, chemists, geologists, physical oceanographers and other specialists who share interests in the structure, function, and condition of coastal environments. Results of research projects are used by educators, coastal resource managers, health and environmental regulators, legislators, and many other individuals and organizations interested in maintaining and improving the condition of estuaries in the face of increasing human activities and changing climate in the coastal zone.

The following annotated list summarizes 75 projects currently being conducted at the BMFL by staff, graduate students, and faculty associated with the University of South Carolina and other institutions. The University of South Carolina is the home institution for 57 of the investigators conducting research at the BMFL. In addition, 73 investigators representing 32 other institutions and agencies are carrying out projects at the BMFL. Dozens of graduate and undergraduate students assist scientists throughout the year to obtain hands-on training in field methods and to conduct research.

A wide variety of basic and applied research is represented. The projects are listed randomly and each project summary includes the title, investigators, affiliations, and project abstract. This list includes only those projects that make regular use of the site. Most of the studies that involve field measurements and collections are being conducted within the North Inlet–Winyah Bay National Estuarine Research Reserve (NI–WB NERR).

Funds for these research projects are provided by a variety of sources, including the National Science Foundation (NSF), Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA) National Estuarine Research Reserve System (NERRS) and SC Sea Grant Consortium, US Department of Energy (US DOE), US Dept. of Defense (DoD), Office of Naval Research (ONR), National Aeronautics and Space Administration (NASA), and the SC Department of Health and Environmental Control (SC DHEC). The Friends of the Institute, an independent organization that supports Baruch Institute activities, also provides assistance and the Belle W. Baruch Foundation provides the long-term stewardship of Hobcaw Barony, maintaining it in a natural state for research and education.

For more information, please contact the individual investigator(s), Dr. Dennis Allen, or Dr. Matt Kimball. Paul Kenny facilitates researcher use of the BMFL and is available for training and assistance. All BMFL staff can be contacted at 843-546-3623. Information can also be obtained from the Institute's website (www.baruch.sc.edu).

Contents

Imaging instrument array for integrated field studies of coastal system structure and processes

Dr. Dennis M. Allen[1], Dr. James Morris[2], Dr. Scott White[3], Dr. Matthew E. Kimball[1], James Edwards[4], and Kyle Houser[1]

1 - Baruch Marine Field Laboratory, University of South Carolina
2 - Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina
3 - Department of Earth and Ocean Sciences, University of South Carolina
4 - Marine Science Program, University of South Carolina

We have acquired several imaging instruments which provide opportunities to measure physical, environmental, and biological features of coastal landscapes. These instruments will provide new and unique insights into structure and processes at spatial and temporal scales not previously possible. Hyperspectral, thermographic, and video cameras and a portable spectrometer enable the mapping and quantification of primary productivity, temperature, suspended materials, water movement, animal distributions, and landscape features at scales of centimeters to kilometers and over a wide range of time periods. These instruments can be deployed at ground level (from a tripod or a boom that adjusts height from 1-6 m) or from a helium filled kite-balloon (Helikite®) that can view study areas from up to 150 m. Also available is a terrestrial laser scanner (TLS, also known as ground-based LiDAR) which provides three-dimensional topographic images and analyses of tidal marshes, creek basins, mudflats, oyster reefs, beaches, and other features. Landscape mapping and repeated measurements will be used to investigate factors affecting changes in topography, geomorphology, tidal inundation, plant distributions, productivity, and physiological states. Coupled with extant long-term time series measurements and process-oriented field experiments, the imaging instruments will be used to address impacts and mechanisms of change due to storms, warming temperatures, persistent droughts, sea-level rise, and other climate-related factors. The instrument array is intended to encourage new research activity and collaborations between BMFL-resident, USC campus-based, and visiting scientists from other institutions. Please see www.baruch.sc.edu/ecosystem-and-landscape-analysis for more information and contact us with your interests in using the instruments. Funding for the array came from the National Science Foundation's Field Station and Marine Laboratory Program.

Fluorescent dissolved organic matter dynamics in the North Inlet estuary

Investigators: Dr. Erik Smith, Tracy Buck, and Susan Denham

Baruch Marine Field Laboratory, University of South Carolina
North Inlet–Winyah Bay National Estuarine Research Reserve

There is growing interest in the use of the inherent optical properties of dissolved organic matter (DOM) as proxies for dissolved organic carbon (DOC) concentrations and biogeochemical cycling in coastal ecosystems. This study employs a fluorescent dissolved organic matter (FDOM) optical probe, recently available as part of Xylem/YSI's EXO water quality sonde, to quantify high-frequency DOC dynamics in the North Inlet estuary. Beginning in August 2012 an EXO equipped with an FDOM probe together with temperature, salinity, pH, dissolved oxygen and turbidity probes has been deployed at the Oyster Landing long-term monitoring station of the North Inlet–Winyah Bay National Estuarine Research Reserve. Initial research results have shown that over the majority of FDOM ranges observed to date, FDOM measures can serve as a reliable proxy for DOC concentration once temperature sensitivities and turbidity interferences are accounted for. Ongoing sampling is being conducted to understand the effects of different dissolved organic matter sources on FDOM–DOC relationships as well as the potential issues associated with sample quenching at high FDOM concentrations. This study will allow the temporal dynamics of DOC, the largest pool of organic carbon in marine waters, to be resolved at frequencies not previously possible.

Mapping zones of hyporheic flow in tidal creeks

Investigators: Tyler Evans, Dr. Alicia Wilson, Dr. Willard Moore, and Dr. Susan Lang

Department of Earth and Ocean Sciences, University of South Carolina

Estuaries are important zones of mixing and biogeochemical reaction in surface waters; equally important reactions occur in "subterranean estuaries" in groundwater. These groundwater mixing zones develop over multiple scales, driven by such flow processes as cm-scale flow through ripples, tidal fluctuations, and seasonal variations in mean sea level. This pilot project is designed to combine geochemical sampling and heat-tracer methods to map important zones of mixing as tidal creeks cut the first two confined aquifers at North Inlet. Geochemical samples are obtained via small-diameter temporary wells; thermal data are obtained via buried temperature loggers. Initial efforts have focused on Bly Creek, but we expect to include Crabhaul Creek.

Sea turtle nest monitoring on Hobcaw Barony

Investigators: Betsy Brabson[1], Robin Baughn[1], Wendy Allen[2], and other volunteers

1 - DeBordieu Colony (Debidue Beach Coordinators), SC
2 - North Inlet–Winyah Bay National Estuarine Research Reserve, Baruch Marine Field Laboratory, University of South Carolina

Nesting activity of the threatened loggerhead sea turtle, *Caretta caretta*, on the Hobcaw Barony portion of Debidue Beach has been monitored by trained volunteers, May-October, since 1992. This 2.2 miles of undeveloped beach, owned by the Belle W. Baruch Foundation, provides important nesting habitat for sea turtles and shorebirds. Volunteers walk the beach each morning during the turtle nesting and hatching period, record information on false crawls and nests, and protect nests from predators with screening. Nests laid in areas subject to tidal flooding are carefully relocated to higher areas. Volunteers also inventory nests 72 hours after the major hatch has occurred to determine hatching success of each nest. Inventories, usually conducted in the evening, typically draw large crowds of interested visitors and provide excellent opportunities to educate others about sea turtles. The volunteers are members of the South Carolina United Turtle Enthusiasts (SCUTE), which covers the northern beaches of the state, from Hobcaw Beach to North Myrtle Beach. Debidue Beach (Hobcaw Beach to Pawleys Inlet) typically accounts for 30-50% of all nests in the north coastal region. Reports summarizing nesting activity and success for Debidue Beach and the entire SCUTE region are prepared and submitted to the SC Department of Natural Resources that oversees the volunteer sea turtle program for the state. Data are also entered and available on the www.seaturtle.org website, and include information on a DNA study to track the nesting behavior of individual turtles.

Assessing the immune response of *Fundulus heteroclitus* due to environmental challenges

Investigators: Dr. Marlee Marsh and students

Division of Business, Mathematics and Sciences, Columbia College, SC

Fish innate immune responses can be evaluated as indicators of immune function and status following exposure to pathogens, biological response modifiers, immunotoxicants, and nutritional regimes. *Fundulus heteroclitus*, an estuarine fish commonly used as a model in immunotoxicological studies, will be collected from North Inlet. We have developed several monoclonal antibodies used to recognize immune responses in several species of fish, including *Fundulus heteroclitus*. Immunohistochemistry will be performed on gill, GI tract, head kidney, spleen and livers. Gonad morphology will be examined. We will also probe fish protein levels using SDS-PAGE and Western Blotting. Antibodies will include probes against lysozyme (neutrophils and macrophages), eosinophilic granular cells (possible mammalian eosinophil homolog), and cyclooxygenase-2 (produced in various cells during inflammation). In addition, two other antibodies that recognize the Aryl Hydrocarbon Receptor and CYP1A (both are proteins that are upregulated in response to toxic compounds in the environment) will be used. We hope to discover direct role(s), if there are any, of innate immune cells in fish immune responses to environmental pressures such as parasites and toxic compounds in the water.

A forty-five year comparison of the vascular flora at three abandoned rice fields, Georgetown, SC

Investigators: Dr. Richard Stalter[1] and Dr. John Baden[2]

1 - St. John's University, NY
2 - US Army Corps of Engineers, NC, Retired

The objective of this study is to inventory the vascular flora at three brackish marshes: Airport, Alderly, and Thousand Acre Rice Field on Hobcaw Barony. We are also investigating the distribution of vascular plant species at Thousand Acre Rice Field along an elevation gradient. To accomplish this, we are surveying plant species and recording the elevation of each taxon above the most flood-tolerant species, *Spartina alterniflora*. After collecting and identifying the vascular plant species present at each marsh, species composition at the three marshes will be compared with previously gathered species composition data: J. Baden thesis (1971), a second study of the flora of the marshes following Hurricane Hugo (September 1989) in 1990-1991, and a third study in 2002-2006. Vascular plant species collections at each of the marshes began April 2013 and will continue through June 2015. A small sample of each taxon will be collected, pressed, and mounted on a herbarium sheet as voucher material to be housed at the A. C. Moore Herbarium, University of South Carolina. Only one sample/taxon will be collected as reference material. Soil samples from each of the marshes will be collected; mineral analysis will be performed by the Nutrient Analysis Laboratory, Cornell University. The significance of this study is that it documents and compares vascular plant species composition at three brackish marshes over a 45-year period (1969-2015). There are few long-term studies of this kind and fewer where the same investigators follow up their work over 45 years of study.

Fish and crustacean use of marshes and intertidal creeks: Population and community level changes and relationships with weather and climate-driven changes in conditions within the nursery

Investigators: Dr. Dennis M. Allen, Dr. Matthew E. Kimball, and Paul Kenny

Baruch Marine Field Laboratory, University of South Carolina

Collections of nekton (fishes, shrimps, and crabs) have been made in the Oyster Landing marsh-creek basin since 1984. The objective has been to track the composition, abundance, and biomass and length distributions of nekton and determine patterns, trends, and factors influencing changes over seasons, years, and decades. From 1984-2003, this effort was based on biweekly seine hauls from an isolated pool (low tide) in the intertidal creek. In 1996, we started a new time series from the flooded marsh surface (high tide) adjacent to the creek. From 1996-2003, both the low tide seine and high tide enclosure collections were made on the same day and tide. From 1984-2003, overall abundance in the low tide catch increased, evenness decreased, water temperatures increased, and salinity decreased. For spot, the most abundant fish every year, increasing abundance, earlier arrival in the spring, and decreasing size at arrival and a decreasing growth rate were observed through 2003. From 2003 to 2011, total nekton abundance decreased while salinity increased. Since 2012, the effort has been reduced and focused on documenting the timing and size of ingressing juvenile transient species and their growth rates. These long-term time series are unique within the Southeast region and are becoming increasingly important as we interpret impacts of global climate change on nekton populations and the shallow water habitats that are essential to their development. The results are used to inform the management of salt marsh-estuaries, watersheds, and fisheries in the region.

Development and validation of a novel molecular tool to rapidly detect and quantify harmful algal bloom (HAB) species linked with fish kills and public health concerns

Investigators: Dr. Dianne I. Greenfield[1] and Dr. William J. Jones[1,2]

1 - Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina
2 – Marine Science Program and Department of Environmental Health Sciences, University of South Carolina

This project develops and evaluates sandwich hybridization assay (SHA) applications that detect and quantify SC harmful algal bloom (HAB) species as a novel molecular tool for understanding HAB population dynamics and effective water quality management. The foci are the ichthyotoxic raphidophytes *Fibrocapsa japonica* and *Chattonella subsalsa*, as well as the domoic-acid producing diatom *Pseudo-nitzschia pseudodelicatissima*, since they pose regional environmental and public health threats. Through this project, we will develop rapid species-specific identification and quantification of HAB species using ribosomal RNA-targeted molecular probes. Field samples from across the SC coast, including Winyah Bay and North Inlet, will be used to validate this technology with environmental samples. Results will augment the characterization and prediction of HABs in coastal South Carolina.

Personality-structured predator-prey interactions in intertidal oyster reefs

Investigators: Benjamin Belgrad[1], Eilea Knotts[2], and Dr. Blaine D. Griffen[1,2]

1 - Marine Science Program, University of South Carolina
2 - Department of Biological Sciences, University of South Carolina

Personality is a ubiquitous feature of natural populations, varying across individuals. We have previous shown that the mud crab *Panopeus herbstii* and the fiddler crab *Uca pugilator* each show variation in personality type along a shy-bold continuum. We have further demonstrated that individual personality plays an important role in foraging decisions that cause cascading effects to influence food webs. While the downward direction of these cascading effects are well known, little is known about the upward direction. In other words, What role does individual personality play in controlling the predation risk experienced by individuals? We are conducting a study to understand how mud crab susceptibility to predation by a range of nektonic predators varies with mud crab personality. Additionally, we are exploring the role that personality plays in spatial dynamics of fiddler crabs in the marsh and mud flat habitats.

Chemical characteristics of estuarine waters: Long-term monitoring at four sites in North Inlet estuary

Investigators: Dr. Erik Smith and Susan Denham

Baruch Marine Field Laboratory, University of South Carolina
North Inlet–Winyah Bay National Estuarine Research Reserve

As part of the National Estuarine Research Reserve System (NERRS) System-Wide Monitoring Program, water chemistry sampling was initiated in June 1993 to monitor concentrations of suspended solids, total nitrogen, ammonium, nitrate, nitrite, total phosphorus, orthophosphate, and chlorophyll *a* at four locations within the North Inlet–Winyah Bay National Estuarine Research Reserve. Water samples are collected every 20 days with ISCO automated water sampling devices at intervals of 2 hours and 4 minutes over two complete tidal cycles. Sampling and chemical analyses adhere to strict national protocols developed as part of the NERRS System-Wide Monitoring Program. The consistent, long-term collection of water chemistry variables allows for the characterization of short-term variability and detection of long-term change in key water quality parameters. These data also provide critical information for various studies of biological and physical processes in the North Inlet estuary. Data, along with detailed metadata, are sent to the NERRS Centralized Data Management Office (CDMO) for quality assurance and quality control, and then made available via the CDMO website: http://cdmo.baruch.sc.edu. Water chemistry data collected in North Inlet prior to the initiation of the NERRS System-Wide Monitoring Program sampling (some dating back to 1978) are available via the Baruch website's Data and Publications link: http://www.baruch.sc.edu/water-quality-chemistry-databases.

Hard clam (*Mercenaria mercenaria*) population dynamics in North Inlet tidal creeks

Investigator: Dr. Juliana M. Harding

Department of Marine Science, Coastal Carolina University, SC

Hard clam (*Mercenaria mercenaria*) populations play an ecological and structural role within tidal creek habitats. The population biology and dynamics of hard clams will be quantitatively examined in North Inlet tidal creeks. Hard clam age structure, growth rates, and sex ratios will be evaluated and combined with measurements of environmental variables to describe clam population dynamics in tidal creeks and their effects on habitat structure within the creeks over multi-year time scales.

Synthesis of high and low marsh habitat mapping, vulnerability, and responses to sea-level rise in the South Atlantic

Investigators: Dr. Tom Allen[1], Dr. James Morris[2], Dr. J.P. Walsh[3], Dr. Clark Alexander[5], and James Edwards[6]

1 - Department of Geography, East Carolina University, NC
2 - Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina
3 - Institute for Coastal Science and Policy, East Carolina University, NC
4 - Coastal Studies Institute, University of North Carolina
5 - Skidaway Institute of Oceanography, University of Georgia
6 - Marine Science Program, University of South Carolina

Uncertainty of wetland responses to sea-level rise is hampering coastal resource conservation and climate change adaptation. Mapping marsh dynamics has emerged as a high priority for assessing vulnerability to sea-level rise, highlighting the need to synthesize existing marsh habitat maps, develop improved methodologies for their continual monitoring, and gauge the vulnerability of wetlands in critical estuaries. The Baruch Institute is a study site being used to meet these objectives. Specific technology to be used include multispectral remote sensing, LiDAR, NWI coverage, and newly available ALOS PALSAR imagery. Field techniques consist of ground truthing the input datasets. This focused effort will provide for three critical needs: 1) mapping high and low marshes with ultra-high resolution multispectral imagery, including ecotone delineation; 2) estimating the vulnerability of marsh habitat loss from LiDAR hypsometric analysis and spatial situation within the tidal prism; and 3) testing expanded application of new remote sensing algorithms for broad-scale, high-resolution maps using object-based image analysis techniques. We expect to produce a comprehensive assessment of current coastal wetland communities within the Baruch property and to use this spatial information to predict vulnerable wetland areas and their future distribution. We expect to couple the results with Morris' Marsh Equilibrium Model to predict the future extent of these wetlands. Vulnerability maps will highlight potential future wetland loss and sites for adaptive management or restoration. Differential change and vulnerability across the landscape will also direct resource managers to prospective sites and appropriate practices for restoration or adaptation.

The conservation status of the canebrake rattlesnake at Hobcaw Barony, with identification of key areas for conservation of its herpetofauna

Investigator: Dr. Allan L. Markezich

Department of Natural Sciences, Black Hawk College, IL

This ongoing long-term project assesses the abundance and microgeographic and ecological correlations of canebrake rattlesnake (*Crotalus horridus atricaudatus*) occurrence in the approximate 8000 acres of terrestrial communities of Hobcaw Barony. Observations involve timed road and walking surveys and usage of drift fences and cover boards along with various marking techniques of specimens to assess abundance. Data taken on snake occurrences involve coordinates of specific geographic localities, topography, general and specific ecological characteristics of communities, and variables involving specific microhabitat and seasonal associations. Data taken by others and information on historical land usage at Hobcaw Barony are also utilized. Results currently indicate that a relatively small metapopulation of the canebrake rattlesnake exists on the property, with highest densities in specific and relatively small areas. Hardwood forests and palmetto swamplands bordering upland areas are key ecological components of this species' environment at Hobcaw Barony. The study to date indicates that the current conservation status of the canebrake rattlesnake on the property is poor, and that populations may have declined in the past five years. Management efforts should be made to conserve critical habitats on the property and to minimize disturbance of them. People using vehicles should also be vigilant of snakes on the roads to reduce road mortality of individuals, which has increased in the past several years. Similar information on occurrence and abundance of other reptilian and amphibian species is also used to understand geographic and habitat correlates of herpetofaunal diversity (i.e., species richness) on the property. Hardwood forests and freshwater wetlands, and associated ecotones between these and pine forests, are critical areas for herpetofaunal diversity, with the greatest species richness found in the northern portion of the property. Managed pine forests have had the lowest richness.

Global methylation of DNA among *Spartina alterniflora* clones differing in age in the North Inlet estuary

Investigators: Trenton Agrelius[1], Dr. James Morris[1], and Dr. Jeff Dudycha[2]

1 - Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina
2 - Department of Biological Sciences, University of South Carolina

Brown marsh or sudden marsh dieback is an ecosystem condition resulting in the loss of thousands of hectares of *Spartina alterniflora*, most notably along the coastline of Louisiana. In 2000, approximately 8,000 hectares of *S. alterniflora* died back following a 100-year drought, which prompted then Louisiana Governor Foster to declare a state of emergency. Other cases have been documented in the North Inlet estuary, as well as various other marshes along the southeastern United States. Currently, there is much dispute regarding the cause of sudden marsh dieback but environmental stress is one of the acknowledged constants across sites. We hypothesize an alternative mechanism in which methylation of the genome increases with plant age, reducing stress tolerance. DNA methylation occurs on the cytosine nucleotide and is an epigenetic modification that is crucial for stable gene regulation along with silencing of harmful transposable and repetitive elements (TE and RE respectively) in the plant genome. This modification is initiated and maintained through different pathways and methyltransferase families, but only one family of methyltransferases can propagate and maintain DNA methylation through a process denoted as de novo style methylation. We seek to address the level of global methylation and differences among *Spartina alterniflora* clones of variable age in the North Inlet estuary.

Quantitative descriptions of oyster (*Crassostrea virginica*) population biology in North Inlet

Investigator: Dr. Juliana M. Harding

Department of Marine Science, Coastal Carolina University, SC

Oyster (*Crassostrea virginica*) population biology sets the foundation for maintenance and persistence of the biogenic habitat as well as the associated trophic communities and ecological services. These dynamics respond to a variety of factors functioning at time scales ranging from days to decades. This research describes basic oyster population parameters including recruitment intensity and periodicity as well as density, demographics, and condition index at sentinel sites in the Town, Clambank, Crab Haul, and Bly Creek basins. Environmental data will be collected concurrently and integrated with the biological data. The integrated data sets will be examined in the context of available historic data and documented environmental changes across decadal time scales.

Organic phosphorus cycling in a coastal estuary

Investigators: Doug Bell[1], Dr. Claudia Benitez-Nelson[1,2], and Dr. Tammi Richardson[1,3]

1 - Marine Science Program, University of South Carolina
2 – Department of Earth and Ocean Sciences, University of South Carolina
3 – Department of Biological Sciences, University of South Carolina

The goal of this research study is to investigate the molecular composition of organic phosphorus (P) within a coastal estuary (Oyster Landing, North Inlet) and the potential influences on organic P composition with respect to tidal fluctuations and annual seasonality. Understanding the molecular structure of the organic P pool and any variability associated with the composition will give insight into the biological availability of the total P pool, as microbial utilization (heterotrophic bacteria and phytoplankton) of organic P sources has been unveiled as a potential driver in growth, metabolism, and community composition. This study will use two approaches to determining organic P composition: 1) by biomolecule (independent analysis for lipid-P and polyphosphate) and 2) by molecular bonding through nuclear magnetic resonance (NMR). A novel component of this research is the isolation procedure of dissolved organic matter (which includes dissolved organic phosphorus) prior to NMR analysis. An instrument has been constructed (by D. Bell) that combines electrodialysis and reverse osmosis components to desalt and concentrate seawater-DOM necessary for analytical preparation.

Biologically relevant sensor networks for climate change studies in intertidal ecosystems

Investigators: Dr. Wenyuan Xu[1], Dr. Brian Helmuth[2], and students

1 - Computer Science and Engineering, University of South Carolina
2 - Marine Science Center, Northeastern University, MA

The intertidal zone – the region between the low and high tide lines along the coasts of the world's ocean – serves as a key test bed to exploring the effects of global climate change on species distributions and abundances. Lots of biomimetic sensor nodes are deployed in these areas to monitor the temperature changes. However, current sensor nodes store the measurement locally, which requires marine scientists travel every a few months to collect data on spot. In this project, we develop a new type of *wireless* biomimetic sensors that can be self-organized as a sensor network and automatically transmit relevant data to a backend data center. With this system and network design, the biomimetic sensor network will make the collected data available online continuously without human intervention, which lets researchers focus on "how to analyze data" instead of "how to measure data". Towards this goal, we divide the project into two tasks: (1) the individual sensor design and (2) the networking design. Extensively deployed and tested onset, we hope that the emerging wireless biomimetic sensors and networks will be the next generation tools for marine scientists to study global climate change.

Examination of swimming abilities of common salt marsh fishes

Investigators: Dr. Matthew E. Kimball[1], Dr. Kevin M. Boswell[2], and Dr. Lawrence P. Rozas[3]

1 - Baruch Marine Field Laboratory, University of South Carolina
2 - Marine Science Program, Department of Biological Sciences, Florida International University
3 - NOAA / NMFS / SEFSC, Estuarine Habitats and Coastal Fisheries Center, LA

Salt marshes are physically and environmentally dynamic aquatic environments, with near constant fluctuations in water depth, flow direction, and flow velocities. Numerous fish species use salt marsh habitats during single or multiple life history stages, and nektonic life stages must rely on swimming abilities to confront and adapt to these ever-changing natural conditions. Further, because many coastal and marsh habitats are under some form of management that regulates water flow, fishes may experience unnatural aquatic conditions such as increased flow velocities at critical marsh access points (e.g., a water control structure in a levee system). Considering this, the swimming abilities of fishes, particularly juveniles, are likely an important factor guiding and limiting their distribution in salt marshes. While the swimming abilities of riverine fish species have been extensively evaluated, the swimming abilities of common salt marsh fishes are largely unknown. We propose to determine the critical swimming speed for juveniles (< 100 mm total length) of common salt marsh nekton species (e.g., mullet, spot, croaker, silver perch, etc.) using a laboratory swim tunnel. The swimming performance of fishes is generally related to fish size (length), and critical swimming speed increases with fish length, therefore by swimming a range of juvenile sizes for each species we expect to accurately determine the relationship between swimming speed and size for the target species.

Painted Bunting monitoring project

Investigators: Wendy Allen[1], Dr. Jennifer Plunket[1], Dr. James Rotenberg[2], and citizen science volunteers: Bill Brabson, Marsha Green, Marlene Konsek, and Pete Little

1 - North Inlet–Winyah Bay National Estuarine Research Reserve, University of South Carolina
2 - Department of Environmental Studies, University of North Carolina-Wilmington

Painted Buntings are the most colorful of the migratory songbirds that visit the coast of South Carolina. The adult males sport a royal blue head, neon green back and red breast and rump. Painted Buntings return to the area mid-April, nest in shrubs near marshes, and migrate south in the fall to central and southern Florida, Cuba and the Yucatan peninsula of Mexico. Surveys conducted since 1966 have demonstrated a decline in Painted Buntings which lead to the establishment of a monitoring project that includes banding at select sites in the southeast and observations made by citizen scientists. This project, Painted Bunting Observation Team or PBOT, is headed up by scientists at the UNC-Wilmington (www.paintedbuntings.org) The North Inlet–Winyah Bay National Estuarine Research Reserve (NERR) served as a PBOT banding site, 2007-2012, and has maintained a feeder near the Baruch Marine Field Laboratory (BMFL) since 2007. The NERR established a Painted Bunting monitoring project in summer 2014 to document buntings coming to the feeder. Reserve staff and citizen scientists make timed observations of Painted Buntings and record color band combinations, if present. Last season, 38 different Painted Buntings were observed based on their unique band combinations, at least 7 of which were banded at the BMFL. Citizen scientists will work with Reserve staff again this year to study Painted Buntings. The project will contribute to a better understanding of Painted Bunting longevity, how long they stay during the nesting season, whether they come back to the same site from year to year, and other aspects of their natural history.

Maintenance and operation of IOOS/SECOORA priority WERA HF radar sites

Investigator: Dr. George Voulgaris

Department of Earth and Ocean Sciences, University of South Carolina

The objective of this study is to remotely monitor the ocean surface currents and waves in Long Bay using two high frequency (HF) radar stations. Scientists from the University of South Carolina, operate and maintain two US IOOS/SECOORA identified priority WERA system radar sites (Georgetown, SC and Fort Caswell, NC). One station is located on Hobcaw Barony (33°21'19.60"N, 79° 9'12.56"W) and the other station is located at Caswell Beach, NC (33°53’25.18”N, 78° 1'40.64"W). Each station remotely measures the surface ocean currents up to 120 miles offshore and when combined create maps of temporal and spatial distribution of waves and currents over the entire Long Bay area. Data from these sites are sent to SECOORA and National High Frequency Radar Network for integration, display, and dissemination.

Fine-scale tidal and diel nekton movement and behavior within interconnected estuarine habitats

Investigators: Dr. Matthew E. Kimball[1], Dr. Kevin M. Boswell[2], and Dr. Dennis M. Allen[1]

1 - Baruch Marine Field Laboratory, University of South Carolina
2 - Marine Science Program, Department of Biological Sciences, Florida International University

Fish use of the multiple interconnected habitats within estuaries is largely species-specific and varies according to biological and physical factors. Movement of fishes at large and small spatial and temporal scales influences critical life-history functions (e.g., foraging, reproduction), shifts energy and nutrients among habitats, and supports multiple trophic levels within estuarine and coastal ecosystems. Therefore, the ability of resident and transient nekton to move in to, within, and out of various marsh habitats determines the relative value of those habitats. While it is generally acknowledged that habitat connectivity is an influential ecological factor for many estuarine organisms, few studies have focused on the connectivity between adjacent estuarine habitats, particularly at smaller spatial and temporal scales such as within tidal cycles. This is primarily due to the difficulties of sampling in dynamic marsh habitats and the limitations of traditional sampling gears (e.g., nets, traps). Recent advances in high-resolution acoustic imaging now allow for examination of traditional metrics such as presence/absence, abundance, and size of organisms, and also allow for examination of in situ behavioral metrics (e.g., movement, direction, speed) and intra/interspecific interactions (e.g., predation, competition) that have been elusive or very difficult to study in estuarine and coastal waters. We plan to build upon our earlier (2012) acoustic imaging sampling efforts in the North Inlet estuary and examine fine-scale nekton movement and behavior in and among subtidal and intertidal estuarine habitats within individual tidal cycles, throughout multiple tidal cycles, and during both day and night.

Public and K-12 community education activities – National Estuarine Research Reserve

Investigators: Beth Thomas and Melissa Heintz

North Inlet–Winyah Bay National Estuarine Research Reserve

Educational activities for the general public and K-12 teachers and students highlighting coastal ecology and integrating findings from research are offered throughout the year. Seasonal schedules of public outreach activities are produced throughout the year, and programs are promoted through informational fliers, Reserve newsletters, newspapers, and the Reserve's website (www.northinlet.sc.edu) and Facebook page in addition to local online community event calendars. Program offerings include estuarine and beach ecology activities for all ages, biking and kayaking programs featuring coastal ecology, open houses and research lectures, and research-based citizen science programs. Professional Teacher Development opportunities and field trips for K-12 public, private, and homeschool students are also available, as well as job shadowing and research experiences for middle and high school students. Off-site outreach includes presentations to environmental and civic groups, local festivals, special outreach programs at regional libraries and museums, afterschool programs for local elementary and middle schools, science and environmental fairs, and career days. Partnerships with other local environmental education providers, including the Belle W. Baruch Foundation, ACE Basin NERR, SC Department of Natural Resources, SC Sea Grant Consortium, Friends of Coastal South Carolina, the Waccamaw National Wildlife Refuge, and the Coastal Waccamaw Stormwater Education Consortium, provide additional opportunities for public education, teacher training, and professional development as well as staff and resources for enhanced programming and outreach.

Selective advantage of pathogenic *Vibrio parahaemolyticus* in the Eastern oyster (*Crassostrea virginica*)

Investigators: Dr. Charles R. Lovell and Savannah Klein

Department of Biological Sciences, University of South Carolina

Bacteria in the genus *Vibrio* are estuarine organisms that include potentially pathogenic strains. Strains become human pathogens when ingested in undercooked seafood or introduced into wounds. Oysters act as a vector for *Vibrio* diseases because they can concentrate the bacteria during filter feeding. This project will investigate the density of both benign and pathogenic vibrios in oysters in the North Inlet estuary. Oysters will be sampled during warmer times of the year to coincide with periods of maximum *Vibrio* growth. During sampling, 10-15 oysters will be collected from Oyster Landing and then brought back to Columbia for processing in the Lovell lab. Oysters will be washed, shucked, and homogenized individually. The homogenized mixture will then be plated on a *Vibrio* selective growth medium. By using improved PCR primers and protocols that detect virulence factor genes, the number of pathogenic strains of vibrios reared from oysters will be determined. Previous studies have detected low frequencies of pathogenic vibrios in oysters; however, our summer 2014 sampling showed that virulence factor genes occurred in as much as 65% of *Vibrio* isolates reared from Oyster Landing oysters. We will continue sampling oysters at Oyster Landing throughout 2015. We will also deploy oyster biomimics at Oyster Landing. iButton temperature loggers will be embedded in silicone in natural oyster shells to determine temperature fluxes within oysters during low tide exposure. Aerial exposure of oysters has direct effects on internal temperature, and could cause an increase in *Vibrio* population sizes within oyster tissues

Assimilation rates of dissolved organic carbon by photomixotrophic estuarine phytoplankton

Investigators: Dr. James L. Pinckney

Department of Biological Sciences and the Marine Science Program, University of South Carolina

Phytoplankton provide an energy source for higher trophic levels. However, some phytoplankton species function as both primary producers and heterotrophic secondary consumers. Phytoplankton that are photosynthetically competent but also take up AND assimilate organic compounds are classified as photomixotrophs. Unfortunately, we currently have few estimates of the proportion of the phytoplankton community that function as photomixotrophs, their rate of secondary production, or their temporal variation in abundance. Current paradigms about trophodynamics in marine systems do not consider this potentially important "alternative" pathway for energy flow for phytoplankton. The implication is that we may be missing a significant, fundamental process that affects carbon cycling and trophodynamics in estuarine systems. The proposed research will use a novel approach to provide quantitative measures of the *in situ* rates and magnitudes of "facultative heterotrophy" in natural, estuarine phytoplankton communities over seasonal time scales in a representative estuarine ecosystem. The purpose of the research is to apply a unique ^{14}C radiolabeling technique to quantify the *in situ* assimilation rates of dissolved

organic carbon (DOC) by estuarine photomixotrophs and estimate the amount of DOC converted to phytoplankton biomass by photomixotrophy over seasonal time scales. This information will provide new insights into carbon dynamics in estuaries, the contribution of DOC to estuarine food webs, and the importance of photomixotrophy in determining the structural and functional characteristics of estuarine phytoplankton communities.

Geographic variations in larval fish ingress to estuaries; long-term patterns of arrival times, abundance, and size distribution from South Carolina to Massachusetts and relations to climate change

Investigators: Drs. Dennis M. Allen[1,2], Ken Able[3], Tim Targett[4], Jeff Buckel[5], Todd Killison[6], Chris Taylor[6], Jon Govoni[6], and Jon Hare[7]

1 - Baruch Marine Field Laboratory, University of South Carolina
2 - North Inlet–Winyah Bay National Estuarine Research Reserve
3 - Rutgers University Marine Field Station and Jacques Cousteau National Estuarine Research Reserve, NJ
4 - University of Delaware
5 – North Carolina State University
6 - NOAA Center for Coastal Fisheries and Habitat Research, NC
7 - NOAA National Marine Fisheries Service, RI

Adult fishes which spawn in the ocean during late fall and winter produce larvae that arrive at inlets and then transform into bottom feeding juveniles that inhabit salt marsh and other shallow estuarine habitats until fall. Most studies on the early life stages have been site specific and of short duration. A collaborative effort among investigators from various locations in the Northeast, Middle Atlantic, and Southeast regions is comparing and interpreting patterns of abundance, timing, and size structure during ingress over multiple years. Our time series of larval fishes from the mesozooplankton collections at North Inlet appears to be the longest continuous dataset, with the 35th year of biweekly collections beginning in January 2015. Time series collections in Beaufort, NC (since 1985), Great Bay, NJ (since 1989), and DE (since 2006) will contribute to the analyses. Recently, the SC, NJ, and NC partners, which are the founding components of CCOR (Coastal Collaboration on Ocean Recruitment), contributed long-term ichthyoplankton datasets to the SEAMAP website. NOAA-based ocean sampling programs provide data about spawning locations, timing, and cross-shelf distribution of early stage larvae. Changing climate is expected to alter patterns of reproduction, movement, and growth for many coastal fishes, and preliminary analyses suggest that the phenology and growth of some species are responding to increasing water temperatures.

Hydrology and pollutant removal performance in stormwater ponds typical of the lower coastal plain of South Carolina

Investigators: Dr. Erik Smith[1,2], Dr. Richard Peterson[3], Angie Defore[1,2], Colleen Cohn[1,2], Tracy Buck[1,2], Susan Denham[1,2], Samantha Corley[3], and Austin Waldorf[3]

1 - Baruch Marine Field Laboratory, University of South Carolina
2 - North Inlet–Winyah Bay National Estuarine Research Reserve
3 - School of Coastal and Marine Systems Science, Coastal Carolina University, SC

South Carolina resource managers and stormwater engineers require locally relevant quantitative information on the residential stormwater ponds typical of the coastal plain. Stormwater ponds, especially detention ponds, are the most common best management practice (BMP) for controlling runoff in coastal South Carolina. Despite their prevalence, there are currently no published studies quantifying the extent to which residential stormwater ponds typical of South Carolina's coastal plain can be expected to offer an effective means of moderating hydrologic flows and pollutant loads from developed landscapes. To address this need, the specific objectives of this study are to: 1) Quantify the complete water budget (surface runoff, groundwater input, precipitation, evapotranspiration, storage, and total export) for selected stormwater pond at both the precipitation event scale and over the annual scale; 2) Quantify concentrations of total nitrogen, total phosphorus, suspended solids, and fecal indicator bacteria (E. coli) in pond outfall waters, relative to input waters, to determine detention pond effectiveness in their ability to remove or retain these pollutants prior to discharge to receiving waters. Research will directly account for the relative roles of both surface piped and over-land sheetflow inputs as well as groundwater flowpaths as sources of material delivery to ponds. The study will be conducted in ponds that vary in the degree of impervious surfaces within their catchment area and in the means by which runoff is routed to the ponds. Research results will be incorporated into technical recommendations for regulatory agencies, local stormwater managers, pond management professionals, homeowner associations, and the broader scientific community.

Sediment accretion in North Inlet estuary salt marshes

Investigators: Dr. James Morris[1,2] and Karen Sundberg[1]

1 - Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina
2 - Department of Biological Sciences and the Marine Science Program, University of South Carolina

The objective of this study is to understand how the elevation of the marsh surface is regulated. A major hypothesis being tested is that eutrophication initiates a sequence of changes in the sediments, beginning with a decrease in volume due to enhanced decomposition of organic matter. In fact, sediment accretion in experimentally fertilized marsh plots has increased. This is probably due to an increase in sedimentation caused by a higher density of plant stems in fertilized plots. Marsh plots were fertilized from 1996 or 2001 until 2004. A surface elevation table (SET) is used to measure marsh elevations in low and high marsh *Spartina alterniflora* plots approximately monthly. Currently we are looking at the effect of decreasing eutrophication on marsh surface elevation, and we hypothesize that there will be a decrease in volume of belowground biomass due to enhanced decomposition now that belowground production is no longer stimulated. Results of a model linking plant production and sedimentation with sea level indicate that the marsh maintains its elevation with respect to mean sea level for a range of rates of sea-level rise, up to a threshold. The elevation of the marsh platform with respect to mean sea level is inversely proportional to the rate of sea-level rise.

Green porcelain crab biology, larval production, and phenology

Investigators: Dr. Juliana M. Harding[1], Dr. Dennis M. Allen[2], and students

1 - Department of Marine Science, Coastal Carolina University, SC
2 - Baruch Marine Field Laboratory, University of South Carolina

The biology and phenology of the green porcelain crab (*Petrolisthes armatus*) will be described with a combination of field collections and laboratory culture efforts. Adult and juvenile crab demographics, density, and reproductive status will be surveyed monthly from May through November. Weekly zooplankton tows will be used to monitor the presence and stages of crab larvae. Larval morphology will be described from field caught and cultured specimens. This information will add to the understanding of this invasive (extended geographic range) species' occurrence in the North Inlet estuary. *Petrolisthes armatus* larvae first occurred in biweekly zooplankton collections in the mid-1990s and little is known about the timing, periodicity, and duration of larval production. Similar information can be extracted from archived biweekly collections during their period of occurrence to determine if there have been shifts in these patterns over the years.

Population monitoring of wintering sparrows in salt marsh

Investigator: Dr. Chris Hill

Department of Biology, Coastal Carolina University, SC

Seaside, Saltmarsh, and Nelson's sparrows are all confined to coastal marsh habitats in winter, and all three winter in South Carolina marshes. The occurrence, site fidelity, and survival of sparrows of these three species will be investigated by mist-netting and banding at high tide roost sites in high marsh hammocks.

Oysters and climate change: A geohistorical perspective

Investigators: Stephen R. Durham[1] and Dr. Gregory P. Dietl[1,2]

1 - Department of Earth and Atmospheric Sciences, Cornell University, NY
2 - Paleontological Research Institution, NY

Anthropogenic impact on oyster reefs long predates the earliest harvest records and scientific monitoring, so most restoration efforts may be defining goals based on already-degraded reefs. This problem is complicated further by climate change, which may obviate current restoration targets based on records of historical population distributions. The fossil record is an underappreciated resource for isolating and examining the responses of oyster populations to climate change. For over two million years, the earth has been oscillating between cold glacial periods and warm interglacial periods, each lasting thousands to tens of thousands of years, and the eastern oyster, *Crassostrea virginica*, has lived through several of them. Because important life history variables such as growth rate and lifespan are reflected in oyster shells, which have good potential for preservation as fossils, it is possible to compare these life history traits between climate intervals. This study aims to compare fossil *C. virginica* shells from

Pleistocene sedimentary outcrops in northeastern South Carolina with dead shells from within extant reefs living along the shore to investigate potentially climate-related differences in life history such as shorter lifespans, smaller body sizes, and faster growth rates in the fossil assemblages compared to Recent *C. virginica* reefs. Twelve intertidal oyster reefs were sampled across northeastern South Carolina, including two within the North Inlet estuary, in support of this project.

Interspecific competition among some salt marsh perennials in South Carolina

Investigators: Dr. Richard Stalter[1] and Dr. John Baden[2]

1 - St. John's University, NY
2 - US Army Corps of Engineers, NC, Retired

Salt marsh vegetation in the United States is characterized by distinct zonation of vascular plants. Zonation is less pronounced in brackish versus high salinity marshes. Previous transplant experiments indicated several species could not tolerate conditions in areas where they are not normally found. These experiments, however, failed to differentiate the effects of abiotic and biotic (namely interspecific competition) factors. Controlled, reciprocal transplant manipulations have been performed. Growth and survival were monitored to measure the relative importance of interspecific competition and abiotic factors as determinants of zonation patterns between the salt marsh cord grass, *Spartina alterniflora*, and the black needle rush, *Juncus roemerianus*. *Spartina alterniflora* was able to invade the *J. roemerianus* zone when the latter was removed from land that it originally occupied in the marsh. *Juncus* marginally invaded the *S. alterniflora* zone when the latter was removed. *Juncus* did not transplant well; almost 100 % of the transplanted *J. roemerianus* died even when dug up and replanted in place.

Silver nanoparticle accumulation and lipid peroxidation in an estuarine bivalve

Investigators: Shelby V. Butz[1,2], Dr. R.C. Merrifield[1], Dr. James L. Pinckney[2], and Dr. Jamie R. Lead[1]

1 - SmartState Center for Environmental Nanoscience, Arnold School of Public Health, University of South Carolina
2 - Marine Science Program, University of South Carolina

The primary goal of this research was to determine the uptake and fate of two different silver nanoparticles (AgNPs), charge stable citrate-AgNPs and sterically stable pvp-AgNPs, when exposed to the estuarine bivalve *Crassostrea virginica*. We hypothesized that uptake and toxicity are dependent on the type of surface material that coats the AgNP. There are multiple procedures for nanoparticle (NP) synthesis that involve various core and surface materials, which result in various characteristics such as size, shape, and surface coating. In this study silver nanoparticles (AgNPs) were synthesized by a chemical reduction of silver salts and characterized in stock solution and saltwater algal growth media (L1-Si) using a multi-methodological approach. Dynamic light scattering (DLS) and ultraviolet visible spectrometry (uv-vis) NP characterization resulted in an average size of 11.2 nm for citrate coated AgNPs (cit-AgNPs) and 17.6 nm for polyvinylpyrrolidone (pvp) coated AgNPs (pvp-AgNPs). Transmission electron microscopy (TEM) determined NP size of 14.0 ± 1.7 nm and 14.8 ± 5.7 nm (mean ± 1 sd), for cit-AgNPs and pvp-AgNPs respectively. Cit-AgNPs aggregated in the saltwater media indicated by DLS and dissolution analysis, while pvp-AgNPs remained mono-dispersed in the media indicated by a polydispersity index (pdi) value of 0.2-0.4. *Crassostrea virginica* exposures showed concentration and tissue dependent responses for silver (Ag^+) accumulation, with a direct relationship between exposure concentration and Ag^+ accumulation. Lipid peroxidation assays indicated a significant difference from the control in the 15 and 50 ppb exposures for cit-AgNP and $AgNO_3$ treatments and no toxic effect was observed in the 1 and 10 ppb exposures of any treatments.

Goby and blenny movements, fidelity, and habitat use

Investigators: Dr. Juliana M. Harding[1], Dr. Dennis M. Allen[2], and students

1 - Department of Marine Science, Coastal Carolina University, SC
2 - Baruch Marine Field Laboratory, University of South Carolina

Habitat use patterns of demersal oyster reef fishes, including naked gobies (*Gobiosoma bosc*) crested blenny (*Hypleurochilus geminatus*), feather blenny (*Hypsoblennius hentz*), freckled blenny (*Hyposblennius ionthas*), and striped blenny (*Chasmodes bosquianus*), in Crab Haul Creek, North Inlet are being examined. Artificial nesting substrates and passive integrated transponder (PIT) tags have been and will continue to be used to describe movement and fidelity patterns of these resident fishes. Regular surveys and recaptures of tagged fishes will provide information on site fidelity and home range as well as demographics of resident fish populations.

Quantifying biogeographic variation in consumer-plant interaction strengths in salt marsh ecosystems

Investigators: Rebecca Atkins and Dr. Craig Osenberg
Odum School of Ecology, University of Georgia

The salt marsh periwinkle, *Littoraria irrorata,* can both facilitate and suppress the smooth cordgrass, *Spartina alterniflora,* a dominant and important species in southeastern US salt marshes. Such variation in the sign and strength of this consumer-plant relationship is likely driven by environmental factors that alter plant productivity and consumer biomass. Our study will document large-scale biogeographic variation in *Spartina* (e.g., density, productivity), *Littoraria* (e.g., size-structure, density, biomass), and the strength of their interaction, as well as environmental factors that may modify their interaction (e.g., nutrient availability, sediment composition, elevation, temperature). From July 2015 through October 2016, and at sites from Florida to Maryland, we will survey 25, 0.0625 m^2 plots quarterly, and establish a field experiment to quantify the strength of the *Littoraria-Spartina* interaction. Experiments will consist of two *Littoraria* density treatments (0 and ambient) and a cage control, each with 5 replicates/site. Experiments will be established in July 2015 and continue through October 2016; they will be sampled monthly, assessing the same variables as in the marsh surveys. Results will be used to: 1) quantify spatio-temporal variation in *Littoraria* and *Spartina* population parameters; 2) quantify interaction strength at ambient *Littoraria* densities; and 3) evaluate the role of consumer density, biomass, size-structure (and metabolic demand), as well as environmental parameters, on the *Littoraria-Spartina* interaction strength. The results also will be extrapolated to better understand how marsh systems may respond to changing temperatures (e.g., due to climate change) or foodweb structures (due to changes in fishing practices and responses of predators on *Littoraria*).

Long-term changes in zooplankton in the North Inlet estuary and relationships with climate change and variability

Investigators: Dr. Dennis M. Allen and Paul Kenny
Baruch Marine Field Laboratory, University of South Carolina

Collections have been made at the same location, stage of tide, and time of day every two weeks since 1981. Oblique tows with 153 micron mesh nets collect copepod and small invertebrate larvae, and 365 micron epibenthic sled tows capture larval fishes, shrimps, and crabs and other large zooplankton species. Seasonal and interannual changes in abundance, diversity, and species composition of the assemblages in Town Creek are documented and correlated to fluctuations in the physical characteristics of the estuary. Information is collected for more than 50 taxonomic groups and species. Recent analyses of the large zooplankton component have shown that although the composition and overall densities have not changed significantly, there have been large and consistent responses to climatic events including ENSO (El Niño) and drought. Analysis of the 153 fraction has indicated a steady decrease in total small zooplankton, especially copepods, over the past 34 years. Reductions in river inflow, nutrient discharges, and related densities of phytoplankton best explain the major reductions in copepods and larvae of resident invertebrates in the plankton. Changes in the timing of larval shrimp and fish production have been observed for some species. The value of these datasets continues to increase as we formulate and test new hypotheses about impacts of climate change.

Prediction of *Spartina alterniflora* standing biomass and canopy structure from a high resolution terrestrial laser scanner

Investigators: James Edwards[1] and Dr. James Morris[2]
1 - Marine Science Program, University of South Carolina
2 - Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina

We propose to develop a non-destructive method for determining *Spartina alterniflora* standing biomass and canopy structure. The study is designed to mine and analyze LiDAR point clouds collected from a Terrestrial Laser Scanner (TLS). The study addresses the capability of high resolution TLS to capture the standing biomass by identifying and analyzing statistical properties of the frequency distribution, and regressing them against field collected biomass measurements. Sample plots containing monocultures of *Spartina alterniflora* will be randomly selected from three zones on the marsh platform representing elevations ranging from MSL to MHHW during the ebb tide. These zones are the creek-bank, mid-marsh, and high-marsh respectively. To reduce the effects of collinearity, principle components analysis (PCA) will be employed. PCA will identify which correlated variables load onto factors explaining variance within the observed dataset. Simple linear regression will be utilized to obtain the biomass

predictive model, defined here as a function of the populated factors. 3D canopy structure will be determined as a function of voxel analysis from discrete point returns. Voxels are defined here as millimeter scale cubes containing TLS returns fitted inside the sample plots. Retained voxels are expected to be representative of canopy structure and will be analyzed in the context of sample type and 10 cm elevation bin to determine structural characteristics. Applying recent technological advancements in remote sensing to saltmarshes, this research will enable more rapid and ecologically sound collection of field data.

Aquifer salinity mapping

Investigators: Tyler Evans, Dr. Scott White, and Dr. Alicia Wilson

Department of Earth and Ocean Sciences, University of South Carolina

Salinity is an important control on biogeochemical cycling in coastal environments. Knowledge of how fresh groundwater discharges to the ocean is therefore critical for monitoring export of nutrients, carbon, and other dissolved constituents to the coastal ocean. This project is designed to use electrical resistivity to map the extent of freshwater in the first three confined aquifers that extend seaward from the main island at Baruch. Results will inform graduate student Tyler Evans' regional groundwater models. This project is expected to conclude in 2016.

Quantifying the effects of the mud snail, *Ilyanassa obsoleta*, on the benthic microalgal community in a pristine saltmarsh

Investigators: Miranda Gore[1] and Dr. James Pinckney[1,2]

1 - Marine Science Program, University of South Carolina
2 - Department of Biological Sciences, University of South Carolina

Saltmarshes are among the most productive ecosystems globally; at North Inlet, about one third of the primary production comes from benthic microalgae. During the tidal cycle, the mobile microalgae vertically migrate through the upper 3mm of sediment. At low tide, the algae are vulnerable to predation by a variety of grazers, including the mud snail, *Ilyanassa obsoleta*, which is abundant in the tidal creeks. Many species of intertidal snails have been shown to significantly affect the community structure and concentration of microalgae within the sediment. While it is known that *I. obsoleta* consumes the microphytobenthos from the surface sediment, the magnitude of this grazing remains unclear within the ecosystem. Grazing effects will be measured in multiple habitat types within the North Inlet saltmarsh in order to quantify the impact of *I. obsoleta* on the important benthic producers. To do this, concentrations of total chlorophyll *a*, fucoxanthin, and other photosynthetic pigments will be measured within the grazed pathway of an individual *I. obsoleta*, and compared to ungrazed sediment in close proximity. This study will yield estimates of the impact of *I. obsoleta* on the concentration and community structure of the benthic microalgae within a pristine estuarine system.

Detecting genetic adaptation during a marine invasion

Investigators: Dr. Erik E. Sotka[1], Dr. Stacy A. Krueger-Hadfield[1], Dr. Allan E. Strand[1], and Dr. Courtney J. Murren[2]

1 - Grice Marine Laboratory, College of Charleston, SC
2 – Department of Biology, College of Charleston, SC

Biological introductions, defined as the establishment of species in geographic regions outside the reach of their natural dispersal mechanisms, have dramatically increased in frequency during the 20th century and are now altering community structure and ecosystem function of virtually all marine habitats. To date, studies on marine invasions focus principally on demographic and ecological processes, and the importance of evolutionary processes has been rarely tested. This knowledge gap has implications for management policies, which attempt to prevent biological introductions and mitigate their impacts. The red seaweed *Gracilaria vermiculophylla*, native to the northwest Pacific, has been introduced to every continental margin in the Northern Hemisphere, and preliminary data indicate that non-native populations are both more resistant to heat stress and resistant to snail herbivory. We will integrate population genetics, field surveys and common-garden laboratory experiments to address comprehensively the role of rapid evolutionary adaptation in the invasion success of this seaweed. Specifically, we will answer the following: What is the consequence of introductions on seaweed demography and mating systems? How many successful introductions have occurred in North America and Europe? Where did introduced propagules originate? Do native, native source, and non-native locations differ in environmental conditions? Do native, native source, and non-native populations differ in phenotype?

Development of monitoring and assessment tools for nitrogen and phosphorus in South Carolina coastal wetlands

Investigators: Dr. Dianne I. Greenfield[1,2], Dr. Robert Van Dolah[2], and students

1 - Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina
2 - South Carolina Department of Natural Resources

It is generally accepted that elevated levels of nitrogen (N) and phosphorus (P) are associated with eutrophication in a wide range of aquatic systems. Yet, surprisingly little is known about how variable nutrient levels affect phytoplankton community composition and the resultant primary productivity of coastal South Carolina estuaries. Elucidating the interactions between estuarine nutrient levels and phytoplankton communities in SC is central to understanding ecosystem function. In addition, this relationship is especially timely since coastal SC is experiencing rapid urbanization which contributes to the deposition and accumulation of nutrients and fertilizers, thus potentially making SC estuaries susceptible to nutrient loading, particularly from N. The goal of this project is to assess biological (phytoplankton) responses to various nutrient conditions across the SC coastal zone. Methods include interannual field monitoring and both field and laboratory experimentation. One of the experimental field sites is Thousand Acre Marsh (TA), on Hobcaw Barony. At TA, we are conducting seasonal, 48-hr nutrient addition bioassays over a 2-year time frame to assess phytoplankton community responses to a variety of nutrient conditions. This is accompanied by ISCO-based autosampling (24 hrs) and water quality data from deployable YSIs. Results will not only help us better understand the nutrient conditions of TA, they will also assist regulatory agencies in establishing numeric criteria for nutrient inputs to the SC coastal zone.

Effect of wrack accumulation on salt marsh vegetation

Investigators: Dr. Richard Stalter[1] and Dr. John Baden[2]

1 - St. John's University, NY
2 - US Army Corps of Engineers, NC, Retired

In this first study of the effect of wrack on the survival of salt marsh vegetation in a SC salt marsh, the objectives are to 1) investigate the effect of wrack coverage on salt marsh vegetation in five vegetation zones in a SC salt marsh, and 2) to monitor seedling establishment and survival in plots in five arrays during the growing season (2004 to present). Four arrays consisting of a string of permanent marsh plots were established in March 2004. A fifth array was established in a pure stand of *Spartina alterniflora* in March 2005. Each array was 1.8 m wide and consisted of eight 1.0 x 1.8 m plots in a row parallel to the water's edge. Within each of these plots, a central 0.5 x l.0 m sample plot was marked off, surrounded by a 0.25 m wide buffer zone including a 0.5 m buffer between adjacent sample plots. In early March 2004, wrack was collected and placed at a thickness of 15 cm (and held in place with 6.5 cm fish net) on each array except for one control plot. Sampling occurs throughout the growing season (April through October), vegetation within each examined experimental and control plot sampled (stem count per species) with three randomly located 20 x 20 cm quadrats located within the larger plots. Vegetation of all species within each quadrat is cut at ground level to determine standing crop (grams of vegetation/m^2). Preliminary analyses indicate that with the exception of *Spartina patens*, all salt marsh species experienced l00% kill after wrack cover for two months. *Spartina patens* experienced a 50-75% reduction in density, though some *S. patens* survived wrack cover for a period of one year. We continue to assess survival of wrack impacted plants and monitor recruitment and growth in specific wrack impacted zones.

The National Estuarine Research Reserve System Centralized Data Management Office

Investigators: Dr. Dwayne E. Porter[1,2], Melissa Ide[3], Jennifer Kessee[3], Amber Knowles[3], Brooks Folk[3], Lee Shutt[3], Dan Ramage[2], and Jeff Jefferson[1]

1 - Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina
2 - Arnold School of Public Health, University of South Carolina
3 - Baruch Marine Field Laboratory, University of South Carolina

NOAA's National Estuarine Research Reserve System (NERRS) acknowledges the importance of both long-term environmental monitoring programs and data and information dissemination through the support of the NERRS System-wide Monitoring Program (SWMP). The goal of the SWMP is to "identify and track short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purpose of contributing to effective national, regional and site specific coastal zone

management." This comprehensive program consists of three phased components: estuarine water quality monitoring (phase I), biodiversity monitoring (phase II), and land-use and habitat change analysis (phase III). The Centralized Data Management Office (CDMO) was established in support of the System-wide Monitoring Program involving 28 sites around the US and Puerto Rico. The purpose of the CDMO, housed at the North Inlet–Winyah Bay NERR, is the management of the infrastructure and data protocol to support the assimilation and exchange of data, metadata, and information within the framework of NERRS sites, coastal zone management (CZM) programs, and other education, monitoring and research programs.

Long-term monitoring of grass shrimp as a bioindicator of non-point source runoff in South Carolina watersheds

Investigators: Dr. Peter Key, Dr. Michael Fulton, James Daugomah, and Blaine West

NOAA Center for Coastal Environmental Health and Biomolecular Research, SC

Long-term ecological monitoring is important to developing fundamental understandings of both biogenic and anthropogenic effects on ecosystem health. Long-term monitoring may provide great insight into natural factors such as disease, pests, and weather (e.g., global climate change, drought, floods, and increased intensity of tropical storms and hurricanes), which may affect populations throughout a geographical region. In addition to population perturbations caused by natural stressors, is the complexity of differentiating anthropogenic effects of chemical and biological contaminants in aquatic ecosystems from natural background effects. There is a clear need to develop accurate ecological forecasts using long-term ecological data sets. Long-term ecological monitoring data thus can be used not only to ascertain effects of natural and anthropogenic stressors, but also when properly used in conjunction with GIS and advanced modeling techniques may enhance predictive capabilities. The grass shrimp, *Palaemonetes pugio*, is the dominant motile macrobenthic invertebrate in tidal creek systems of the southeastern United States and is an important prey item for higher trophic levels. The North Inlet Oyster Landing site is maintained as a long-term reference site for comparison to estuarine sites with other land uses. Grass shrimp populations are sampled monthly using a push-netting approach.

Within-season patterns of larval demersal fish abundance and distribution in tidal creeks

Investigators: Dr. Juliana M. Harding[1], Dr. Dennis M. Allen[2], and students

1 - Department of Marine Science, Coastal Carolina University, SC
2 - Baruch Marine Field Laboratory, University of South Carolina

Abundance and habitat use patterns of larval stages of demersal oyster reef fishes including the naked goby (*Gobiosoma bosc*), crested blenny (*Hypleurochilus geminatus*), feather blenny (*Hypsoblennius hentz*), freckled blenny (*Hyposblennius ionthas*), and striped blenny (*Chasmodes bosquianus*) are being examined. Regular ichthyoplankton collections will be used to describe short-term (tidal, diel) patterns in abundance, water column distribution, and demographics of larval fishes through fall 2015. These data will be used in combination with information about goby and blenny larvae cultured at known conditions during 2012 and 2013 to interpret patterns observed in the long-term zooplankton series (1981-present).

Saltwater intrusion monitoring

Investigators: Dr. Alicia Wilson[1] and Dr. William Clendenin[2]

1 - Department of Earth and Ocean Sciences, University of South Carolina
2 - SC Department of Natural Resources

Knowledge of the location of the freshwater-saltwater interface in coastal aquifers is critical for managing coastal groundwater resources, for predicting saltwater intrusion, and for calculating groundwater-related chemical exchange between aquifers and the coastal ocean. This project will install permanent wells to monitor salinity and saltwater intrusion in the upper (up to 100 ft depth) aquifers at North Inlet. These wells will become part of DNR's long-term coastal monitoring network. The well logs will improve knowledge of stratigraphy and, hence, geological history of the area, which records the long-term (thousands of years) response of salt marsh and estuarine systems to sea level rise. Graduate student Tyler Evans will also use the stratigraphy to build regional groundwater flow models. The models will be constrained by observed hydraulic head and salinity in the wells, in combination with resistivity data from surveys.

Spatial variability in carbon storage within and across marshes of the National Estuarine Research Reserve System (NERRS), USA: A comparison of methodologies and coastal regions

Investigators: Dr. Kristin Wilson[1] and Dr. Erik Smith[2,3]

1 - Wells National Estuarine Research Reserve, ME
2 - Baruch Marine Field Laboratory, University of South Carolina
3 - North Inlet–Winyah Bay National Estuarine Research Reserve

'Blue Carbon' refers to the organic carbon stored in coastal habitats, such as tidal marshes. The largest store of organic carbon in coastal habitats is in the sediment. A full accounting of global carbon storage in coastal marshes has been limited by a lack of data on how sediment organic carbon varies spatially, both within and across different marsh types. This is further complicated by some uncertainty in the way carbon content is often estimated and especially in how transferable this estimation approach is across broadly different marsh types. The objectives of this study are to directly measure sediment organic carbon, as well as assess the common approach for indirectly estimating sediment organic carbon (i.e., as % organic matter Loss on Ignition) in eight National Estuarine Research Reserves across the United States. These eight sites represented a range of marsh types, from freshwater wetlands to high salinity salt marshes. Mean sediment organic carbon, as a % of total sediment mass, showed significant spatial variability within most, but not all, marshes, as well as among most of the different marsh types. Overall, sediment organic carbon content ranged from 0.1 to 32.2% and was inversely related to sediment density, but not vegetation type. While a single predictive relationship could be used with some confidence to estimate organic carbon across all marshes, there were distinctly different relationships evident when considering spatial variability at finer scales. This study emphasizes the importance of considering spatial variability in carbon content within coastal marshes and offers an improved means of estimating organic carbon from common loss on ignition measurements.

Marsh surface pools as habitat for larval and juvenile estuarine fishes

Investigators: Alexandra Schwab[1] and Dr. Matthew E. Kimball[2]

1 - Department of Biology, Wofford College, SC
2 - Baruch Marine Field Laboratory, University of South Carolina

Pools on the marsh surface represent one of many habitats available to fishes in estuaries. Typically occurring at higher marsh elevations, their position in the marsh landscape determines their inundation frequency, which dictates their degree of connectivity with the greater habitat mosaic. Thus, fishes that use marsh pools may be isolated for long periods of time and forced to endure more extreme environmental conditions (e.g., higher salinity and temperatures, lower dissolved oxygen) relative to those in nearby tidally-connected (i.e., regularly inundated) estuarine habitats. Both transient and resident fishes have been found to frequent marsh pools year round. Studies examining fish use of marsh pools have focused on salt marshes in the northeastern US, where pools are a common landscape feature on the marsh surface. However, marsh pools can occur in estuaries elsewhere, including South Carolina. We will examine fish use of marsh surface pools in the North Inlet estuary and determine the spatial and temporal extent of habitat use by early life history stages, particularly larval and juvenile stages. A subset of marsh pools will be chosen to represent those in high marsh (infrequently inundated) and middle/low marsh (semi-regularly inundated) habitats where species composition, abundance, and richness will be compared.

Coastal training activities in the North Inlet–Winyah Bay National Estuarine Research Reserve: Protecting water and habitat quality through science-based community training

Investigator: Michelle LaRocco

North Inlet–Winyah Bay National Estuarine Research Reserve

Coastal training activities connect local decision makers to the emerging research and scientific knowledge generated to help the decision makers make more informed decisions on coastal environmental issues. The Coastal Training Program provides needs-based workshops, trainings, and tools to decision makers in Georgetown and Horry counties and these efforts especially target county and municipal staff and officials, and those decision makers that strongly influence local land use, such as planners, developers, engineers, and realtors, as well as those with a role in natural resource management within local counties and municipalities. The Coastal Training Program works to protect water and habitat quality in a region of rapidly developing coastal communities by providing science-based training events on the issues of stormwater management and low impact development principles, habitat protection and restoration, coastal hazards and climate change, and other emerging priority issues. The program

frequently partners with the ACE Basin NERR, SC Sea Grant Consortium, the Coastal Waccamaw Stormwater Education Consortium, the Clemson University Extension Service, and the Carolina Clear Program.

Retention of passive integrated transponder (PIT) tags and effects on survival of juvenile estuarine fishes

Investigators: April Richards[1], Dr. Matthew E. Kimball[2], and Dr. John Mark Dean[3]

1 - Rogers Fellow in Environmental Science, Cornell College, IA
2 - Baruch Marine Field Laboratory, University of South Carolina
3 - Department of Biological Sciences, University of South Carolina

Estuarine habitats serve as critical nursery areas for numerous fish species, including early life-history stages. While in the estuary, fishes often move within the mosaic of multiple interconnected habitats that include the vegetated marsh surface, marsh ponds and pools, intertidal and subtidal creeks, and open-water habitats. These movements are dictated by tidal, diel, and seasonal life-history strategies, which are largely species-specific. Historically it has been difficult to track the movement of juvenile fishes (< 100 mm TL) as they move within this habitat mosaic. Recent advances in passive integrated transponder (PIT) tagging technology have led to the development of small PIT tags (8 mm) that can be used with juvenile fishes. The few studies that have tracked juvenile fish movement in estuaries yielded interesting and promising results; however, these studies generally focused on a single species of economic or recreational importance. Therefore little is known about the effectiveness of using PIT tags to track the majority of estuarine fishes. A necessary first step in this process is to examine the retention rate and survival of fishes tagged with PIT tags. Thus, we plan to evaluate tag retention, growth, and survival of juveniles of common estuarine fishes (e.g., mullet, spot, croaker, silver perch, etc.) tagged with small PIT tags (8 and 12 mm) using *in situ* caging and laboratory experiments in the BMFL seawater facilities and subtidal habitats in the North Inlet estuary.

South Carolina Estuarine and Coastal Assessment Program (SCECAP)

Investigators: Dr. Denise Sanger[1], Martin V. Levisen[1], Stacie Crowe[1], Dr. Robert F. Van Dolah[1], and David E. Chestnut[2]

1 - South Carolina Department of Natural Resources
2 - South Carolina Department of Health and Environmental Control

The SC Department of Natural Resources (SCDNR) and the SC Department of Health and Environmental Control (SCDHEC) have been conducting an ongoing comprehensive collaborative coastal monitoring program (SC Estuarine and Coastal Assessment Program; SCECAP) since 1999. The goal of SCECAP is to annually monitor the condition of the state's estuarine habitats and associated biological resources. SCECAP integrates measures of water and sediment quality with multiple measures of biological condition at a large number of sites throughout the state's coastal zone. It also expands historical monitoring activities that have primarily focused on open water habitats (e.g., bays, sounds, tidal rivers) to include an assessment of conditions in tidal creeks, which serve as important nursery habitat for many species. The SCECAP program, combined with the other cooperating programs, provides a number of benefits including 1) the ability to identify areas of estuarine habitat that are impaired or degraded with respect to a suite of sensitive biological, chemical, and physical measures; 2) a cost-effective standardized protocol that is used by both SCDNR and SCDHEC that is consistent with protocols used in other US coastal states, thus allowing better regional prioritization of stressors and impacts; 3) more comprehensive periodic reports on the condition of water quality and habitat condition throughout the state's coastal zone than could be accomplished by the individual programs alone. As of the summer 2014, over 700 sites have been sampled statewide, with 9 located in the North Inlet estuary and an additional 31 stations located in the adjacent Winyah Bay.

Long-term measurements of production and physiological ecology of *Spartina alterniflora*

Investigators: Dr. James Morris[1,2] and Karen Sundberg[1]

1 - Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina
2 - Department of Biological Sciences and the Marine Science Program, University of South Carolina

Salt marsh grass, *Spartina alterniflora*, dominates the intertidal marsh in North Inlet estuary. Regular measurements of grass density and height allow for estimates of growth and primary production rates in both control and fertilized plots. Abiotic conditions that are measured include pore water salinity, phosphate, ammonium, sulfide, and iron concentrations to provide insights into factors that affect production. Large monthly and interannual variations in the amount of organic material produced by the cordgrass are related to such factors as sea level and precipitation patterns. This time series was initiated in 1986.

Individual personality is sufficient to determine and maintain dynamic spatial positioning within *Uca pugilator* herds

Investigators: Eilea Knotts and Dr. Blaine D. Griffen

Department of Biological Sciences, University of South Carolina

Individual animal personality plays an ecological role on the spatial dynamics of social groups. However, little is known about the effects of individual personality on the dynamic spatial positioning. The sand fiddler crab, *Uca pugilator*, is known to aggregate into groups and display individual variation in personality. Therefore, lab measurements of personality type with field observations of individual location within this species' herds were conducted. Our research explores, with computer simulation modeling, the simplest mechanism that may explain the observed patterns in the field. These results will provide a better understanding of how personality can influence spatial positioning and how exploratory intensity could be sufficient in explaining the position of individuals within social groups.

Characterization of triclosan resistance in *Vibrio* bacteria

Investigators: Keri Ann Lydon[1], Dr. Matthew Henderson[2], and Dr. Erin K. Lipp[1]

1 - Department of Environmental Health Science, University of Georgia
2 - United States Environmental Protection Agency, GA

One of the most ubiquitous antibiotic pollutants entering near shore coastal habitats via wastewater effluent is the antimicrobial triclosan, found in hand soap. There is supporting evidence that *Vibrio*, human and marine pathogens, are intrinsically resistant to triclosan. This study aims to characterize triclosan resistance amongst a range of *Vibrio* species and determine if *Vibrio* are selected for by triclosan in natural waters. Cultures of known *Vibrio* species from environmental and clinical sources (n=49) were examined through broth microdilution assays to determine triclosan minimum inhibitory concentrations (MIC). All but two *Vibrio* strains tested were resistant to triclosan with MICs ranging from 6-300 ug/mL, compared to 3.125 ug/mL found in the *Escherichia coli* control. To evaluate selection pressure, environmentally relevant concentrations of triclosan were tested in microcosms containing natural seawater from North Inlet Estuary (Georgetown, SC). Surface water was collected in sterile 1L containers at each station and assigned, in triplicate, to time zero controls, no treatment (NT) controls, 1 ppb triclosan, and 5 ppm triclosan. Time zero bottles were processed within 2 h of collection by spread plating onto TCBS for enumeration of *Vibrio*. All remaining treatments were processed the same way after 24 h exposures under ambient conditions. *Vibrio* counts were normalized to time zero to obtain mean relative *Vibrio* densities (T24/T0) and run through a one-way ANOVA, which indicated significant treatment effects ($p<0.0001$). Mean relative *Vibrio* densities were <5 fold increase for NT and 5ppb treatments for all locations, while 5ppm treatments exhibited higher mean relative *Vibrio* densities of 1696 fold higher. Tukey HSD analysis indicated mean relative *Vibrio* densities in 5ppm triclosan treatments were significantly higher in comparison with NT and 5ppb triclosan treatments ($p<0.0001$). Results suggest *Vibrio* are resistant to triclosan and that *Vibrio* are selected for when exposed to triclosan in natural waters.

An index for estimating abundance of juvenile gag, *Mycteroperca microlepis*

Investigators: Dr. Marcel Reichert and Paulette Mikell

Marine Resources Research Institute, South Carolina Department of Natural Resources

Gag grouper (*Mycteroperca microlepis*) spawn once a year with peak activity occurring during late March and early April along the southeast US coast. Gag larvae are planktonic for extended periods of time (mean = 43 days) before entering estuarine waters along the US east coast. Postlarval gag (mean size of 14 mm) enter SC inlets on flood tides during April and May each year. Juvenile gag are most commonly found associated with oyster banks and shell rubble. Young-of-the-year gag remain in estuarine waters throughout the summer months and move offshore as water temperatures decrease in the fall. The primary goal of this project is to develop a monitoring program to provide an annual index of juvenile abundance to predict future year class strength and serve as a management tool. Other objectives are to develop a method to estimate abundance of juvenile gag in estuarine nursery areas and describe factors that might be responsible for recruitment success. Sampling is conducted using Witham collectors (i.e., air-conditioner filter material folded over a PVC frame) deployed in tidal creeks (1 m below the surface, 30 m apart) at selected locations, landward of the ICW. Each site consists of four Witham collectors that will be sampled three times per week from mid-March through mid-June or until gag no longer recruit to this particular gear type. Gag will be measured (mm TL) and individuals will be brought back to the lab to confirm identification, as there is

the possibility of confusing gag postlarvae with black grouper (*Mycterperca bonaci*). All bycatch organisms will be identified to the lowest taxonomic level and released.

Experimental varying of the marsh platform and macrophyte response

Investigators: Dr. James Morris[1,2] and Karen Sundberg[1]

1 - Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina
2 - Department of Biological Sciences and the Marine Science Program, University of South Carolina

The objective of this study was to design a simple experiment to investigate how varying the marsh platform in relation to mean sea level would affect macrophyte production, stand dynamics, and biomass allocation patterns of salt marsh plants. One specific goal was to ascertain aboveground and belowground allocation patterns and quantify where the bulk of belowground biomass was located in relation to marsh elevation and sea level. The experiments were initiated in 2003. Currently there are three marsh planters ('marsh organs'), each with six treatment platform levels that span the upper half of the tidal range, and six replicates per treatment. In general, the marsh organs are planted in March with salt marsh plugs (currently *Spartina alterniflora*) collected nearby; stem height measurements are obtained monthly as an estimate of standing biomass; and plants are harvested at the end of the growing season, to determine aboveground and belowground productivity. In recent years, replicates have been selectively harvested such that we now have an age treatment in addition to the elevation treatment. The frequency of inundation results in significant variation in stand densities and plant heights, and we are observing different biomass allocation patterns with time. These changes in stand densities and macrophyte morphology may have profound effects on the ability of salt marshes to accrete allochthonous sediments and maintain pace with sea-level rise. Furthermore, allocation patterns may ultimately influence net annual primary productivity within salt marshes.

Stock structure of spotted seatrout: Assessing genetic connectivity at its northern latitudinal limits

Investigators: Dr. Jeffrey A. Buckel[1], Dr. Timothy A. Ellis[1], and Dr. Jan R. McDowell[2]

1 - Center for Marine Sciences and Technology, Department of Applied Ecology, North Carolina State University
2 - Virginia Institute of Marine Science, Department of Fisheries Science, College of William and Mary

Spotted seatrout (*Cynoscion nebulosus*) are one of the most economically important marine recreational fish species in the United States. Although heavily studied throughout the center of the species' geographic range, including in the northern Gulf of Mexico and along the Atlantic coast of Florida, there exists limited information on the stock structure of spotted seatrout in North Carolina and Chesapeake Bay. Based on tag-return data, populations in both North Carolina and Virginia were considered one unit stock in North Carolina's recent stock assessment. However, no comprehensive genetic analysis of spotted seatrout at its northern latitudinal limits has occurred, which is essential to determining if the current North Carolina spotted seatrout assessment is using an appropriately defined unit stock. We will use sensitive genetic markers (i.e., microsatellite loci) to assess the spatial and seasonal demographic independence of spotted seatrout inhabiting estuaries in North Carolina and Chesapeake Bay. In addition, we will expand our analysis to include samples collected from estuaries in South Carolina, Georgia, and Florida, in order to better understand the genetic connectivity of spotted seatrout throughout the US South Atlantic.

The Winyah Bay Master Naturalist Program: Transforming community members into active stewards of our diverse SC habitats

Investigator: Dr. Jennifer Plunket

North Inlet–Winyah Bay National Estuarine Research Reserve

The Winyah Master Naturalist Course is designed to train community members to become active volunteer stewards of our coastal environment. Participants gain skills in nature interpretation, research methods, and resource protection through 12 day-long field classes occurring on Fridays from March to June. The course involves field trips with expert interpreters to the mountains, forests, swamps and marshes that make South Carolina a unique and beautiful classroom for the nature enthusiast. Students will learn to 'read' the landscape through developing an understanding of the geology, ecology and human impacts on natural habitats. Participants completing the course and 30 hours of approved volunteer work will receive a Master Naturalist certification and will be eligible to join a local chapter and participate in advanced volunteer training courses. Participants do not need to have a background in the natural sciences; a diversity of backgrounds, skills and interests is welcomed.

Assessing the vulnerability of marsh birds to sea-level rise in South Carolina

Investigators: Nicolette Roach and Dr. Kyle Barrett
Department of Forestry and Environmental Conservation, Clemson University, SC

Our primary goal was to assess vulnerability of secretive marsh birds to sea-level rise in South Carolina. During the 2013 and 2014 breeding season we conducted occupancy and abundance surveys, using broadcast vocalizations, for four marsh bird species: Clapper Rail, Least Bittern, Seaside Sparrow, and Black Rail. We were interested in the landscape environmental variables that influenced occupancy and abundance of our focal species. We conducted call-playback surveys in Winyah Bay and the ACE Basin. Clapper Rails occupied 90% of all surveyed sites. Their highest abundances recorded were in Winyah Bay. Clapper Rail abundance was influenced by the interaction between distance to forest (+) and elevation (-). Least Bittern's occupied 33% of sites surveyed in Winyah Bay, and 27% of sites surveyed overall. Seaside Sparrows occupied 61% of sites surveyed in Winyah Bay and 32% of sites surveyed overall. Occupancy of Least Bittern and Seaside Sparrow was influenced by the interaction between forest (+) and proportion of marsh landscape within a 200 m buffer (+), and the additive effect of elevation (-) and proportion of marsh landscape within a 200 m buffer (+) respectively. We found no Black Rails at any of our sites. Marsh birds are good indicators of marsh ecosystem health. Predicted losses of up to 10% of salt marsh in South Carolina by 2050 represent a difficult challenge for coastal managers. Insight into the current habitat use of marsh birds will allow managers and conservation planners to make effective decisions regarding coastal wildlife.

Diurnal and seasonal changes in labile dissolved organic matter in a salt-marsh estuary

Investigators: Yuan Shen[1] and Dr. Ronald Benner[1,2]

1 - Marine Science Program, University of South Carolina
2 - Department of Biological Sciences, University of South Carolina

Dissolved organic matter (DOM) is ubiquitous in aquatic environments and plays a central role in regulating ecosystem biogeochemistry, including microbial metabolism, mobility of metals and pollutants, nutrient cycling, and carbon budgets. It has long been recognized that the concentrations and compositions of DOM in aquatic systems vary seasonally and annually with hydrological and productivity cycles. The short-term variability (<1 day) of DOM dynamics, however, has received much less attention, probably due to the relatively small variation and the challenges of high frequency sampling. The objectives of this project are to investigate the diurnal variations of concentrations, chemical compositions, and bioavailability of DOM in a salt-marsh estuary and to understand the seasonality of the diurnal cycle. Water samples will be collected in North Inlet, South Carolina, at 3-h intervals over a diurnal period during summer and winter. Bioassay experiments (4-6 weeks) will be set up for each sample collection to assess the bioavailability of DOM. Bulk and compound-specific analyses will be used to determine the concentrations of bulk dissolved organic carbon (DOC), chromophoric DOM (CDOM), and bioavailable DOM (e.g., amino acids) over the diurnal cycle and during the course of bioassay incubations. Results will reveal short-term dynamics of DOM in different seasons and help to explore possible controlling mechanisms. Furthermore, the bioassays will assess the quantitative relationship between bioavailability of DOM and its chemical compositions, which may have important implications for estimating DOM bioavailability from biochemical indicators without conducting labor-intensive bioassays.

Weather and climate measurements: Long-term monitoring at Oyster Landing pier

Investigators: Dr. Erik Smith and Tracy Buck

Baruch Marine Field Laboratory, University of South Carolina
North Inlet–Winyah Bay National Estuarine Research Reserve

As part of the North Inlet–Winyah Bay National Estuarine Research Reserve (NI-WB NERR), a fully functional meteorological station (National Weather Service installation) is located on the Oyster Landing pier at North Inlet. Wind speed and direction, air temperature, humidity, barometric pressure, solar radiation, and precipitation are recorded at 15 minute intervals. Data are telemetered via the NOAA GOES satellite system to the National Estuarine Research Reserve System (NERRS) Centralized Data Management Office, and made available in near real time at http://cdmo.baruch.sc.edu. For most parameters, records have been collected for more than 15 years. Long-term, continuous weather records provide data for determining the effects of climatology on the various biological and physical processes being studied in the North Inlet estuary.

Spatially variable habitat quality contributes to within-population variation in reproductive success

Investigators: Dr. Blaine D. Griffen[1,2] and Alexandra P. Norelli[2]

1 - Department of Biological Sciences, University of South Carolina
2 - Marine Science Program, University of South Carolina

Variation in habitat quality is common across terrestrial, freshwater, and marine habitats. We investigated how habitat quality influenced the reproductive potential of mud crabs across 30 oyster reefs that were degraded to different extents. We further coupled this field survey with a laboratory experiment designed to mechanistically determine the relationship between resource consumption and reproductive performance. We show a >10-fold difference in average reproductive potential for crabs across reefs of different quality. Calculated consumption rates for crabs in each reef, based on a type II functional response, suggest that differences in reproductive performance may be attributed to resource limitation in poor quality reefs. This conclusion is supported by results of our laboratory experiment where crabs fed a higher quality diet of abundant animal tissue had greater reproductive performance. Our results demonstrate that spatial variation in habitat quality can be a considerable contributor to within-population individual variation in reproductive success (i.e., demographic heterogeneity). This finding has important implications for assessing population extinction risk.

Factors contributing to interannual variability in the abundance of bay anchovy (*Anchoa mitchilli*) larvae

Investigators: Steven Vega[1], Dr. Ryan Rykaczewski[1], and Dr. Dennis M. Allen[2]

1 - Marine Science Program, University of South Carolina
2 - Belle W. Baruch Marine Institute for Marine and Coastal Sciences, University of South Carolina

Coastal ecosystems have been subject to increasing stressors over recent decades due to coastal development, human population growth, and climate change. Improving scientific understanding of the environmental factors which influence the productivity of fish populations in coastal ecosystems is vital to their prudent management, especially as the potential influence of anthropogenic climate change grows. Estuaries act as critical habitats for many fishes of primary ecosystem, economic, and recreational importance. One such fish, the planktivorous bay anchovy (*Anchoa mitchilli*), is abundant along the Atlantic and Gulf coasts and is a key prey resource for many estuarine and coastal piscivores. Within North Inlet–Winyah Bay Georgetown, SC, the bay anchovy historically was one of the most abundant fishes in the system. However, recent surveys have suggested their populations have declined over the past 30 years. To determine what has contributed to the interannual variability in the fish's abundance, we will utilize a suite of long-term data sets collected between 1981 and 2002 including biweekly collections of anchovy larvae, mesozooplankton including a calanoid copepod (*Acartia tonsa*), and chlorophyll-a (Chl-a) concentration as well as monthly river discharge. I plan to explore how variability in the timing of life events (phenology) of *A. mitchilli*'s prey, as measured by copepod density, could potentially influence interannual variability in larval abundance. I also will test how differences between *A. mitchilli* and copepod phenology could contribute to variability in *A. mitchilli* larval abundance. The influence of freshwater discharge on the interannual variability of *A. mitchilli* larval abundance will also be analyzed.

Indirect predation effects on *Crassostrea virginica* filtration rates within South Carolina intertidal oyster reefs

Investigators: Caitlin Sylvester, Dr. Keith Walters, and Dr. Eric Koepfler

Department of Marine Science, Coastal Carolina University, SC

A study designed to examine the indirect effects of the presence/absence of predators on the response of a common prey organism using mud and blue crabs and eastern oysters is being conducted in North Inlet estuary. Our purpose is to: 1) Determine if predator identity and presence affects oyster filtration, and if the effect significantly suppresses the ability of oysters to provide an ecosystem service, water quality improvement. 2) Establish if chemical compared to mechanical cues have a greater impact on *Crassostrea virginica* behavior. 3) Determine if oysters respond more to injured conspecifics or predator presence. To model the effect of indirect species interactions on oyster reef filtration capacity a series of controlled, manipulative experiments will be conducted within 20-L tanks (n>5). Oysters and decapods collected from North Inlet will be used to run various experiments over normal high tide intervals (~6 hrs). Draw-down or initial minus final readings for chlorophyll and total particulate organic matter will be recorded during experiments. The duration of the proposed study will be 3 months, starting in June 2015 and ending August 2015. Determination of indirect predation effects by decapods on oysters will increase the accuracy of ecosystem services estimates associated with oyster reefs.

Physical characteristics of estuarine waters: Long-term monitoring at four sites in North Inlet estuary

Investigators: Dr. Erik Smith and Tracy Buck

Baruch Marine Field Laboratory, University of South Carolina
North Inlet–Winyah Bay National Estuarine Research Reserve

As part of the National Estuarine Research Reserve System (NERRS) System-Wide Monitoring Program, the physical characteristics of the water in four tidal creeks of the North Inlet–Winyah Bay National Estuarine Research Reserve has been monitored using YSI 6600 ESD data loggers since 1994. These data loggers are deployed at 0.5 m above the sediment surface and record water depth, temperature, salinity, pH, dissolved oxygen, and turbidity at 15 min intervals throughout the year. The instruments are calibrated and deployed according to strict NERRS protocols. The consistent, long-term collection of this physical data allows for the characterization of short-term variability and long-term change in North Inlet waters, and provides base-line data critical for various studies of biological and physical processes in the North Inlet estuary. Data, along with detailed metadata, are sent to the NERRS Centralized Data Management Office (CDMO) for quality assurance and quality control. Data can be accessed via the CDMO website: http://cdmo.baruch.sc.edu.

Occurrence and parasite fauna of an understudied resident salt marsh fundulid: The spotfin killifish *Fundulus luciae* (Baird, 1855)

Investigators: Kristen Trevey[1], Dr. Erin J. Burge[2], Dr. Juliana M. Harding[2], and Dr. John J. Hutchens, Jr.[3]

1 - School of Coastal and Marine Systems Science, Coastal Carolina University, SC
2 - Department of Marine Science, Coastal Carolina University, SC
3 - Department of Biology, Coastal Carolina University, SC

The small estuarine spotfin killifish (*Fundulus luciae*) is notable for spending its entire life cycle on emergent intertidal salt marsh along the United States east coast. *F. luciae* is closely related to the mummichog (*F. heteroclitus*) which has been studied extensively in a variety of fields; however much less is known about the spotfin killifish. Our first objective has been to document populations of *F. luciae* in South Carolina–it appears that only one peer-reviewed article has done so, and was limited to two specimens. Monthly dip net collections from salt marsh pit traps began in August 2014 and will continue through summer 2015. Additional sites include Waties Island and Huntington Beach State Park. Spotfin killifish have been collected at all three sites. A subset of fish captured each month is preserved for subsequent parasite surveys. Examination of these *F. luciae* specimens will be performed to identify ecto- and endoparasites with emphasis on identification of monogenean flatworm species. Only two previous studies have surveyed parasites of this fish and these were limited to the metazoa and one protozoan dinoflagellate. Preliminary exams have documented new protist and flatworm host records, including a provisional new species of monogenean. This project will add to our understanding of local salt marsh fish communities, document new populations of *F. luciae* in the state, and contribute to the record of *F. luciae* parasite diversity, prevalence, and intensity.

Phylogeography and trait variation in North American *Viburnum*

Investigators: Elizabeth L. Spriggs and Dr. Michael J. Donoghue

Department of Ecology and Evolutionary Biology, Yale University, CT

This research is designed to assess population structure and clinal trait variation within multiple widespread *Viburnum* species. The main focus is on two taxonomically controversial species complexes (the *V. dentatum* complex and the *V. nudum* complex) whose ranges span continuously from northern Florida to Maine and display variation in multiple traits, particularly in leaf form. Multiple collections have been made across the full range extent of each complex, and although no collections were made at the Hobcaw Barony property itself, several populations were found near by. In total, over 200 individuals from more than 50 locations have been collected for this project. We have sequenced RAD (Restriction site Associated DNA) markers for 12 widely distributed accessions and preliminary results show strong population structure within each species complex. This fall we will conduct further sequencing to include more populations in our dataset and will compile extensive trait measurements for all collected individuals. We will then be able to definitively resolve species delimitations, investigate trait evolution within each species complex, and determine how the lineages have responded to Pleistocene glaciation events.

Seasonal patterns in water column and benthic ecosystem respiration and nutrient fluxes in North Inlet

Investigators: Dr. Brian Roberts[1] and Dr. Erik Smith[2,3]

1 - Louisiana Universities Marine Consortium, LA
2 - Baruch Marine Field Laboratory, University of South Carolina
3 - North Inlet–Winyah Bay National Estuarine Research Reserve

Due to the relatively shallow depths of most estuaries, the benthos plays a critical role in organic matter decomposition and nutrient cycling in estuarine ecosystems. In contrast to the growing body of biogeochemical rate measurements for the water column of coastal ecosystems, there is a general paucity of complementary data on benthic respiration and nutrient flux rates from estuarine and coastal ecosystems, including for the North Inlet estuary. Paired measurements of water column and benthic respiration and nutrient fluxes will be made using intact core incubations at ambient temperatures on replicate cores collected from the Oyster Landing and Debidue Creek long-term monitoring sites in North Inlet. At each site, cores will be collected from the primary subtidal channel and within an adjacent intertidal creek. Measurements will be made during spring, summer, and fall of 2014. Ecosystem respiration rates will be quantified by continue measures of dissolved oxygen using optical probes. Net benthic nutrient fluxes will be determined from the change in NO_3, NH_4, PO_4, and DON over time by collecting and filtering water just prior to the initiation of the dissolved oxygen incubation and then again at the termination of the incubation. After rate measurement incubations, cores will also be sampled for sediment organic carbon and nitrogen content and sediment grain size.

Influences of individual personality and habitat composition on the spatial distribution of *Uca pugilator*

Investigators: Eilea Knotts and Dr. Blaine D. Griffen

Department of Biological Sciences, University of South Carolina

An individual's adaptive dispersal decisions among habitats or within a group setting can be influenced by both personality and environment. In turn, this could have important effects on the spatial structure of populations. This project seeks to determine the effects both of these characteristics have on the spatial structure of the *Uca pugilator* population and the mechanism that drives them. Combining field and laboratory experiments, our research explores how the energetic state (i.e., short-term storage) of *U. pugilator* and their individual personalities influence their decisions to leave *Spartina alterniflora* covering to forage on the mudflat. This study will elucidate both the influences different environments have on the spatial distribution of populations, and the connection between the state of the organism and its behavioral decisions.

Decadal-scale assemblage changes of subtidal creek fishes in the North Inlet estuary

Investigators: Dr. Matthew E. Kimball, Dr. Dennis M. Allen, and Paul Kenny

Baruch Marine Field Laboratory, University of South Carolina

Estuaries support abundant and diverse fish assemblages, and serve as important nursery grounds for early life history stages of many species. Changes in environmental, physical, and biological factors, potentially operating at multiple temporal and spatial scales, may alter fish assemblages over time. A biweekly trawl survey was conducted from 1981 to 1984 as part of a LTER monitoring program to examine the salt marsh fish assemblage of the North Inlet estuary. In 2012 we re-initiated a 4-year trawl survey using identical protocols at the same tidal creek to determine if any changes occurred in the composition and demographics of the fish fauna. With more than three years of the current sampling completed, comparisons of the two datasets revealed significant changes in fish assemblages. Overall, the number of species was similar for the two sampling periods (past = 92; present = 88), but the recent total catch was six-fold lower (n = 3,825) than in the 1980s (n = 25,039). Of the ten most abundant species collected, eight declined in abundance. Bay anchovy, the most abundant species during the 1980s, saw a 177-fold decrease in abundance and is now nearly absent. Other species were dominant in catches during both periods (e.g., spot, Atlantic brief squid, Atlantic croaker), but collected in much-reduced numbers at present. The five most abundant species that accounted for 92% of the total catch each year in the 1980s, now account for 64%. The renewed biweekly effort will continue through December 2015 to establish a complete 4-year dataset. Analyses will evaluate relationships between changes in the nekton assemblage and environmental conditions 30 years later.

A geospatial inventory of stormwater ponds for the eight coastal counties of South Carolina

Investigators: Dr. Erik Smith[1,2], Dr. Denise Sanger[3], and Erin Koch[3]

1 - Baruch Marine Field Laboratory, University of South Carolina
2 - North Inlet–Winyah Bay National Estuarine Research Reserve
3 - South Carolina Department of Marine Resources

Stormwater ponds, especially detention ponds, are the most common best management practice (BMP) for controlling runoff in coastal South Carolina. There have been dramatic increases in both pond number and cumulative surface area along the coastal zone of South Carolina as a direct result of development, especially residential development along the coast. The current distribution of ponds existing in this region and their cumulative impacts are presently unknown, however. A quantitative inventory and classification scheme will provide the necessary foundation and context for understanding stormwater pond use and impacts in coastal SC as well as guide future pond management and research decisions. The objectives of this study are therefore to: 1) Create a geospatial inventory of coastal stormwater ponds currently existing in the eight coastal counties of SC; 2) Develop a preliminary classification of coastal stormwater ponds by intersecting pond inventory with a range of available geographic, environmental, and demographic datasets; 3) Conduct a change analysis for four intervals from 1994 to 2013 to identify time periods of pond construction and the relationship between pond construction rates and changes in land use and demographic patterns.

NERR emergent vegetation bio-monitoring: Effects of sea level on the spatial dynamics of salt marsh vegetation communities in North Inlet

Investigators: Tracy Buck and Dr. Erik Smith

Baruch Marine Field Laboratory, University of South Carolina
North Inlet–Winyah Bay National Estuarine Research Reserve

As part of a National Estuarine Research Reserve System (NERRS) system-wide initiative, the North Inlet–Winyah Bay National Estuarine Research Reserve is monitoring salt-marsh emergent vegetation with the aim of quantifying variability in t macrophyte community spatial structure (species composition, relative abundance, and biomass) along elevation gradients, from creek bank to upland edge, in response to changes in tidal height and flooding frequency due to sea-level rise. Long-term monitoring is conducted in accordance to established NERRS protocols using a stratified sampling approach of fixed transects and repeated measures within permanent sample plots. This consists of two marsh segments with 3 fixed transects and 20 sampling plots per transect. Surface Elevation Tables (SETs) have also been established adjacent to the lower and higher elevations of the creek-bank to forest-edge transects in each marsh region to determine changes in marsh surface elevation associated with long-term changes in vegetation and tidal dynamics. Sampling within each permanent plot includes: percent cover for each species or cover category; species' shoot/stem density; species' maximum canopy height; species' aboveground biomass by non-destructive sampling techniques; water table height at low tide; porewater salinity, and nutrient and sulfide concentrations. Soil organic content and bulk density adjacent to each plot were been determined in 2008 and will be resampled at 3-year intervals. Elevation data (mm scale vertical resolution) for each plot is determined at biannual intervals to allow for the calculation of duration and frequency of tidal inundation at each plot.

Characterization of oyster cement

Investigators: Dr. Jonathan Wilker[1] and Paul Kenny[2]

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2 - Baruch Marine Field Laboratory, University of South Carolina

Marine species such as mussels, barnacles, and oysters produce adhesive and cement materials for affixing themselves to surfaces. The strong bonding, wet adhesion capabilities, and biological origin of these materials indicate promise for developing new biomedical materials such as surgical glues and dental cements. In an effort to develop such applications, we are beginning by characterizing adhesive materials produced by marine organisms. Prior studies have determined some of the key chemical reactions and bonding motifs used by mussels for production of their adhesive. For the current project, our main objective is to characterize the chemistry within the cement of the Eastern or Atlantic oyster *Crassostrea virginica*. Oysters are collected near the Baruch Marine Field

Laboratory and then grown in laboratory aquaria. Chemical methodologies are used to analyze the cement, including wet chemistry and spectroscopic techniques. Insights gained will provide both fundamental understanding of how a marine biological material functions as well as providing insights for the design of new biomedical adhesives.

The allelopathic effects of domoic acid on natural phytoplankton species

Investigators: Elise Van Meerssche[1] and Dr. James L. Pinckney[1,2]

1 - Department of Biological Sciences, University of South Carolina
2 - Marine Science Program, University of South Carolina

Harmful Algal Blooms (HABs) have been one of the biggest environmental challenges in the past few years and will be for decades to come. There has been a clear increase in the frequency, magnitude, and geographical distribution of HABs. *Pseudo-nitzschia*, a ubiquitous diatom genus, recently reported along the South Carolina coast, can release domoic acid (DA), a neurotoxin, which can cause toxicity in fish and shellfish and also acute symptoms in humans. Most of our knowledge is based on the effect of DA on *Pseudo-nitzschia* consumers. However, nothing is known about its allelopathic effect on other phytoplankton species. The release of DA even at low concentrations could be a mechanism used by *Pseudo-nitzschia* to outcompete other phytoplankton species by inhibiting their growth. Furthermore, DA could also be used by mixotrophic organisms as an organic nutrient, thus stimulating growth of other mixotrophic species. In both cases, the release of DA could result in a change in the phytoplankton community composition. Bioassays with natural phytoplankton communities will be spiked with different concentrations of DA and incubated in both light and dark conditions. The possible allelopathic effects will be monitored by the measurement of pH, chlorophyll *a* fluorescence, cell abundances, DA, nutrients, photopigments and dissolved organic carbon (DOC) concentrations. This information will provide new insights into the impact of DA on phytoplankton community composition in coastal regions.

Marsh sedimentation and mapping research from North Carolina to Georgia: Insights from South Carolina

Dr. J.P. Walsh[1,2], Dr. Reide Corbett[1,2], Luke Stevens[1,2], Dr. Tom Allen[1], James Edwards[3], Dr. James Morris[4], and Dr. Clark Alexander[5]

1 - Institute for Coastal Science and Policy, East Carolina University, NC
2 - Coastal Studies Institute, University of North Carolina
3 - Marine Science Program, University of South Carolina
4 - Belle W. Baruch Institute of Marine & Coastal Science, University of South Carolina
5 - Skidaway Institute of Oceanography, University of Georgia

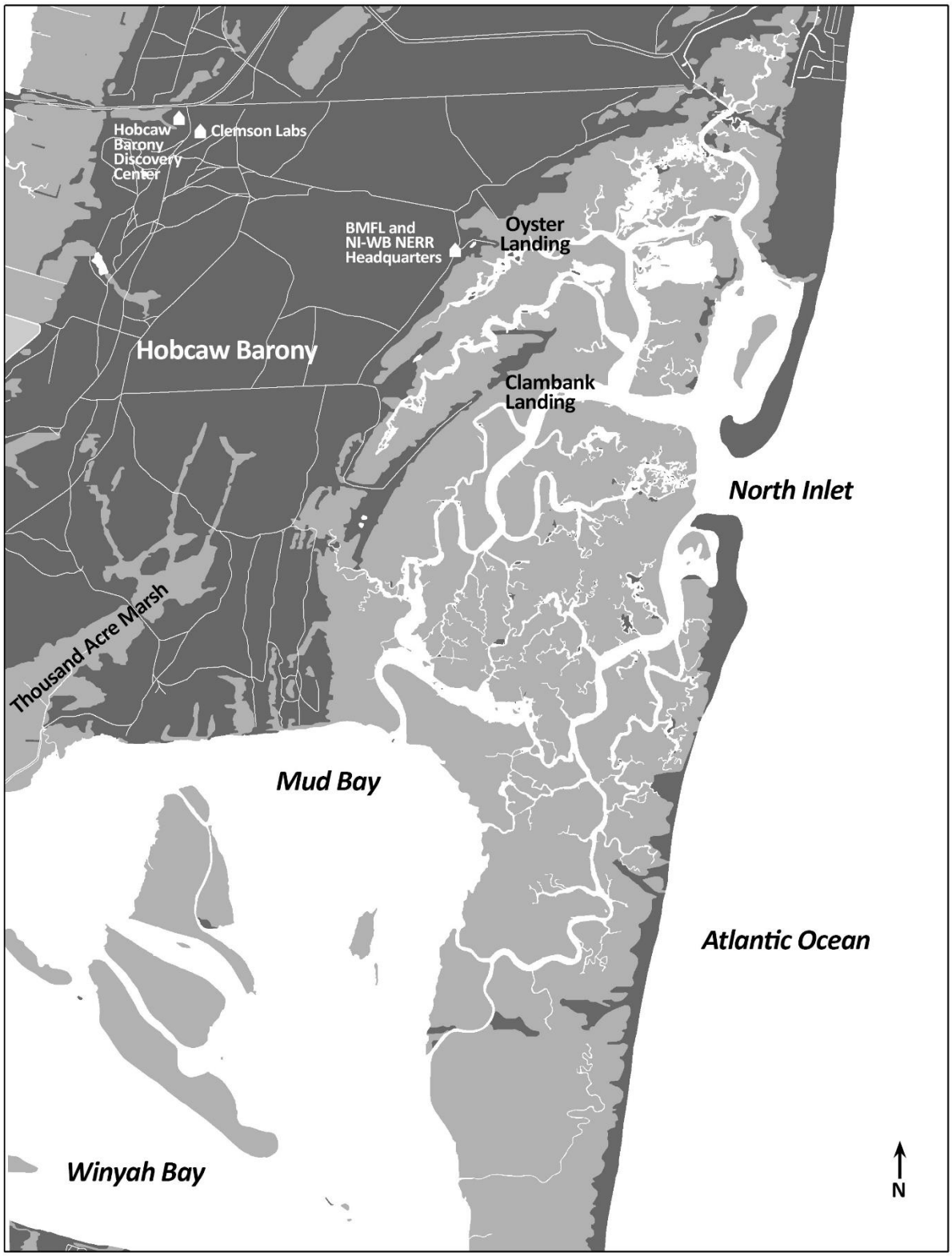
Marshes are critical habitat ecologically and economically. Their natural variation in type (vegetation, sedimentation) is considerable and hypothesized to be related to geological, hydrological, anthropogenic, and other factors. To better understand broad variations in marshes and associated sedimentation from NC to GA, we are examining marsh type and sedimentation along river-ocean gradients in areas with different tidal and fluvial forcings. In South Carolina, sedimentation will be studied using cores collected on transects in the Winyah Bay-North Inlet area, including two sites on the Hobcaw Barony property. A Russian corer will be used to sample the upper ~1 m of marsh. Sediments will be subsectioned with depth and analyzed for grain-size distribution, loss on ignition (proxy for organic material) and radioisotopes. Pb-210 and Cs-137 activities will be used to determine sedimentation rates. RTK-GPS will be used to determine core positions and elevations across the marsh zone. Field photographs and vegetation descriptions will serve to define the marsh vegetation and will aid in related efforts to classify LANDSAT imagery in the Southeast. The core analyses for this ongoing research are being conducted by an ECU MS student, Luke Stevens. This work is part of a larger project, funded by the South Atlantic Landscape Change Cooperative, involving Tom Allen (lead PI, ECU), Clark Alexander, James Morris, and J.P. Walsh.

Terrestrial response to sea-level rise as detected through dendrochronology, geomorphology and hydrology

Investigators: Dr. Raymond Torres[1] and Dr. Richard Keim[2]

1 - Department Earth and Ocean Science, University of South Carolina
2 - School of Renewable Natural Resources, Louisiana State University

We propose to evaluate the rates of salt marsh advance into the terrestrial landscape using dendrochronology. The corresponding tree ring chronology will be used to assess rates of geomorphic change of the terrestrial and intertidal landscapes and the patterns and dynamics of surface and near surface freshwater and salt water flows.


Hobcaw Barony Discovery Center
Clemson Labs
BMFL and NI-WB NERR Headquarters
Oyster Landing
Hobcaw Barony
Clambank Landing
North Inlet
Thousand Acre Marsh
Mud Bay
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Winyah Bay
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