**Southeastern Estuarine Research Society**

**Semiannual Meeting**

**April 11$^{th}$ – 13$^{th}$, 2012**

**North Carolina State University
Center for Marine Sciences and Technology
Atlantic Beach, NC
Duke University Marine Lab
Beaufort, NC**



**PROGRAM & ABSTRACTS**

# SEERS

The Southeastern Estuarine Research Society (SEERS) is a 501(c)(3)non-profit educational organization dedicated to the informal exchange of interdisciplinary information related to estuaries of the southeastern United States. SEERS promotes discussion of estuarine research, science, and management; promotes discussion of current research projects and management issues; and encourages participation of student colleagues. SEERS membership is largely, but not exclusively, from the states of NC, SC, GA and FL. SEERS typically meets twice per year, including the biennial Coastal and Estuarine Research Federation Conference. SEERS is an affiliate society of the Coastal and Estuarine Research Federation (CERF).
SEERS website: http://host.coastal.edu/seers/

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**YSI**
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# PROGRAM

Welcome to the Spring 2012 meeting of the Southeastern Estuarine Research Society (SEERS) on the Crystal Coast of North Carolina. The meeting will commence with registration and the poster social on Wednesday evening from 5:00- 8:00 p.m. at the NC State Center for Marine Sciences and Technology (CMAST) in Atlantic Beach. Presenters, please be by your posters beginning at 6:00 p.m. On Thursday, there will be oral presentations in the morning and afternoon at the Duke University Marine Lab (DUML) in Beaufort. The SEERS business meeting will be at the end of the oral sessions on Thursday. Thursday evening, the banquet will be held on the Crystal Coast Lady ship. Friday morning, the meeting will continue with further research presentations at DUML.

## Schedule at a Glance

**Wednesday, April 11 (at CMAST)**
| | |
|---|---|
| 5:00 p.m. | Registration opens |
| 6:00 - 8:00 | Poster session and social |
| 8:00 - 9:00 | SEERS Board Meeting |

**Thursday, April 12 (at DUML)**
| | |
|---|---|
| 8:30 - 9:00 a.m. | Registration opens |
| 8:45 | Welcome |
| 9:00  - 10:40 | Oral Presentations |
| 10:40 - 11:00 | Break |
| 11:00 - 12:15 p.m. | Oral Presentations |
| 12:15 - 1:20 | Lunch |
| 1:20  - 2:40 | Special Session |
| 2:40  - 3:00 | Break |
| 3:00  - 4:00 | Oral Presentations |
| 4:00  - 5:00 | Business meeting |
| 6:30  - 9:00 | Banquet & Student Presentation Awards |

**Friday, April 13 (at DUML)**
| | |
|---|---|
| 9:00 | Welcome |
| 9:20  - 10:20 | Oral Presentations |
| 10:20 - 10:40 | Break |
| 10:40 – 12:00 | Oral Presentations |
| 12:00 | Closing Remarks |

**SEERS T-shirts and stainless steel water bottles with the new SEERS logo will be available for purchase during all registration times, lunch and breaks. They make great Birthday gifts!**

POSTER PRESENTATIONS
**Listed Alphabetically by Primary Author, Presenting author is underlined**
  ➢ **Graduate student authors ( * ), Undergraduate student authors ( ** )**

**Primary Productivity and Respiration in Fresh-to-Oligohaline Tidal Creeks**
*Lauren Bohrer*, M. Mallin, M. McIver, L. Cahoon, University of North Carolina Wilmington*

**North Inlet -Winyah Bay National Estuarine Research Reserve sentinel site for examining impacts of sea level rise on salt marshes**
*T. Buck, E. Smith, Wendy Allen, North Inlet-Winyah Bay NERR*

**Effects of macronutrient variability in food sources on growth, oogenesis and regeneration in the marine polychaete *Laeonereis culveri***
*Kyle Dilliplaine**, M. Posey, J. Morgan, T. Alphin, University of North Carolina Wilmington*

**Impacts of reef substrate material on oyster demographic rates and Cliona boring sponge growth across a salinity gradient**
*Robert Dunn*[1], D. Eggleston[1], N, Lindquist[2], [1]NC State University CMAST, [2]UNC-Institute of Marine Sciences*

**Genetic diversity of northeastern North Carolina submerged aquatic vegetation**
*Benjamin Graham**, J. Phelps**, M. Crawford, M. Young, Elizabeth City State University*

**The effect of habitat fragmentation on the interaction of oysters (*Crassostrea virginica*) and pea crabs (*Pinnotheres ostreum*)**
*Marc Hanke*, M. Posey, T. Alphin, University of North Carolina Wilmington*

**Comparative study of finfish community structure in coastal Georgia using trawl sampling**
*Javar Henry**, M.C. Curran, Savannah State University Marine Sciences Program*

**Goin' fishing: Oceanic fish diversity among three barrier island systems in the southeastern United States**
*Kelley Jonske*, **M. Geiseking, **CJ Best, Augusta State University*

**Tuning into the sound: Habitat-associated estuarine soundscapes and invertebrate settlement response**
*Ashlee Lillis\*, D. Eggleston, D. Bohnenstiehl, NC State University*

**Pollutant source tracking in a coastal recreational community**
*Michael Mallin, M. McIver, M. Haltom, B. Song, University of North Carolina Wilmington Center for Marine Science*

**Monitoring of Transplanted Submerged Aquatic Vegetation (SAV) at Sandy Point, N.C.**
*Josh Phelps\*\*, B. Rubino, W. Eadus, M, Crawford, Elizabeth City State University*

**If you build it, will they come: Designing a marine reserve network for oyster restoration**
*Brandon Puckett\*, D. Eggleston, R. Guajardo, NC State University Center for Marine Sciences and Technology*

**A study of snail densities in conjunction with the relative health of *Spartina alterniflora* in two southeastern United States salt marsh systems**
*J. Reichmut, David Johnson\*\*, S. Morgan\*\*, Augusta State University*

**Do the densities of daggerblade grass shrimp *Palaemonetes pugio* vary between seasons and distance from the marsh edge in tidal creeks on the coast of Georgia?**
*Michele Sherman\*, M.C. Curran, Savannah State University Marine Sciences Program*

**Marine debris impacts to a tidal fringing-marsh in North Carolina**
*Amy Uhrin, J. Schellinger, NOAA Center for Coastal Fisheries and Habitat Research*

**Thursday 8:45 Welcome: Denise Sanger, SEERS President & Amanda Kahn, SEES Program Chair**

**PLATFORM PRESENTATIONS**
- ➢ **Presenting author is underlined**
- ➢ **Graduate student authors ( * )**
- ➢ **Undergraduate student authors ( ** )**

**Thursday 9:00- 10:40 a.m. Session I- Fish and Shellfish Biology & Ecology**
Moderator: David Kimmel, East Carolina University

**9:00 Characterizing the genetic population structure of Spotted Seatrout (*Cynoscion nebulosus*) along the southeast United States**
*Tim O'Donnell*, Tanya Darden, Mike Denson*

**9:20 Monitoring the movement patterns of the bonnethead *Sphyrna tiburo* using acoustic telemetry in Romerly Marsh Creek, Georgia, USA**
*Dontrece Smith*, Matthew Ogburn, Mary Carla Curran*

**9:40 Feeding ecology of the naked goby (*Gobiosoma bosc*): detecting an ontogenetic diet shift from meiofauna to macrofauna**
*Michelle C. D'Aguillo*, Daniel Zurlo**, Antony S. Harold*

**10:00 *Anguillicoloides crassus*, an invasive parasite in the American eel: survey and health effect on fish in selected estuaries in South Carolina**
*Jennifer L. Hein*, Steve A. Arnott, William A. Roumillat, Isaure de Buron*

**10:20 Shell microchemistry of juvenile *Mercenaria mercenaria*: spatiotemporal patterns and implications for modeling larval dispersal**
*Andrew M. Cathey*, Nathan R. Miller, and David G. Kimmel*

*BREAK 10:40 a.m.-11:00 a.m.*
*Please take time to check out the SEERS merchandise*

**Thursday 11:00 a.m. - 12:00 p.m. Session II- Ecosystems: Understanding & Monitoring**
Moderator: C. Ed Proffitt, Florida Atlantic University

**11:00 Is biodiversity nature's red tape?**
*Robert R. Christian*

**11:20 The Albemarle Sound pilot project for the National Monitoring Network**
*Michelle C. Moorman*

**11:40 Separating behavior from environmental interference: Controls in a marine acoustic telemetry study**
*Noelle C. Hawthorne\*, Matthew B. Ogburn*

**12:00 Phytoplankton in the surf zone: Developing methods to build baseline knowledge**
*Amanda Kahn* and *Lawrence Cahoon*

*LUNCH 12:15 p.m. – 1:20 p.m.*

**Thursday 1:20-. Special Session- Shoreline Change**
Moderator: M. Carla Curran, Marine Sciences Program, Savannah State University

**1:20 ESTUARINE shoreline mapping project update**
*Kevin McVerry*

**1:40 Guidance for Estuarine Shoreline Stabilization Policy: shoreline erosion rates and impact of stabilization structures on marsh surface elevation in eastern North Carolina**
*Carolyn Currin, Mark Fonseca, Michael Greene, Priscilla Delano, Amit Malhotra*

**2:00 Tracking restored marsh trajectories relative to a natural marsh reference condition**
*John Fear, Heather Wells, Byron Toothman*

**2:20 Evaluating the effects of shoreline stabilization on fish habitat value and erosion of estuarine shorelines in North Carolina**
*Gittman, Rachel K.\*, Bruno, John F., Peterson, Charles H.*

**2:20-2:40 Panel Discussion**

***BREAK 2:40 p.m. -3:00 p.m.***

## Thursday 3:00-. Session IV- Ecosystem changes
Moderator: Dennis Allen, Baruch Marine Field Lab, University of South Carolina

**3:00**    **Effects of hypoxia and low pH on mosquito insecticide toxicity in two commercial shellfish species**
*Robin N Garcia\*, Marie E DeLorenzo, Katy W Chung, Peter B Key, Louis E Burnett, Loren D Coen*

**3:20**    **Predicting N fluxes in the Altamaha River, Georgia, from anthropogenic activities**
*Sylvia C. Schaefer\* and Merryl Alber*

**3:40**    **When you just can't do field experiments: Using structural equation modeling to test cause-and-effect in ecological hypotheses**
*C. Ed Proffitt*

**4:00**    **A large loss of seagrass in Indian River Lagoon in 2011**
*Robert Virnstein, Lauren Hall, Lori Morris, Robert Chamberlain*

## Thursday 4:10-5:00 SEERS Business Meeting

## Thursday 6:30-9:00 Dinner aboard the Crystal Coast Lady-
## & STUDENT PRESENTATION AWARDS
## Ship departs at 7:00

**Friday 9:00 a.m.  Announcements**

**Friday 9:20- 10:20 a.m. Session V- Anthropogenic Impacts: Negative & Positive**
Moderator:  Michael Mallin, University of North Carolina Wilmington, Center for Marine Science

**9:20** **Phenological responses of some estuarine taxa to changing temperature regimes; Signs of impending changes in assemblage structure?**
*Dennis M. Allen* and *Virginia Ogburn-Matthews*

**9:40** **Hydrologic control of phytoplankton dynamics: a comparison of two coastal plain North Carolina estuaries**
*Benjamin L. Peierls, Nathan S. Hall, Hans W. Paerl*

**10:00** **Long-term changes in the ecosystem structure of Chesapeake Bay and consequences for fisheries**
*Kimmel D, Boynton WR, Roman MR*

***BREAK 10:20 a.m. -10:40***

**Friday 10:40- 11:40 a.m. Session V cont.- Anthropogenic Impacts: Negative & Positive**
Moderator: Sylvia Schaefer, University of Georgia

**11:00 Tidal creeks serve as sentinel habitats for assessing the impact of coastal development on ecosystem health in Southeastern and Gulf of Mexico US**
*DM Sanger, A Blair, G Riekerk, E Wirth, L Webster, AF Holland*

**11:20 Bringing estuarine research to the classroom: Examples of how to publish science as K12 activities**
*Mary Carla Curran*

**11:40 Assessing the success of oyster reef restoration in the St. Lucie Estuary, SE**
*C.E. Proffitt* and *E. Salewski**

**12:00 Closing remarks from the members of the Board**

# ABSTRACTS

**Phenological responses of some estuarine taxa to changing temperature regimes; signs of impending changes in assemblage structure?**
*Dennis M. Allen and Virginia Ogburn-Matthews; Baruch Marine Field Lab, Univ. of South Carolina, Georgeton, SC*
A significant increase in winter mean water temperature of 1.7$^o$C was observed in North Inlet Estuary, SC from 1980-2012. With a long-term mean of 11.1$^o$C and annual means varying over a range of 5.4$^o$C, interannual variations in the physiology of invertebrates and fishes can be expected. Changes in reproduction, migrations, growth, and other metabolic and behavioral functions are possible. Long-term trends were observed with significantly earlier occurrences of larvae of some resident estuarine taxa (naked goby, ghost shrimps) in the spring and earlier arrival of larvae of some ocean-spawned species (pinfish, brown shrimp) in the winter. Changes in timing were not observed for all taxa; however, significant relationships between first occurrence and temperature in the preceding months were determined for most. We also observed interannual variations in the arrival time of juveniles of some transient nekton species in the salt marsh nursery. Over the 28 year nekton time series, white shrimp arrived earlier and, along with spot, pinfish, striped mullet, and brown shrimp, were smaller when they arrived earlier. Dates of first occurrence for some juvenile nekton taxa were related to mean temperature during the previous season. These results indicate that life history patterns of some estuarine species might be influenced by changing temperature whereas others show more plasticity. Consequences of shifts in timing, growth, and other patterns of species are difficult to determine, but if changes occur in the organization of zooplankton and nekton assemblages, we might expect changes in community composition, biodiversity, trophic structure, and secondary production.

**Primary Productivity and Respiration in Fresh-to-Oligohaline Tidal Creeks**
*Lauren Bohrer\*, Michael Mallin, Matthew McIver, Lawrence Cahoon; UNCW*
One urban and two suburban freshwater-to-oligohaline tidal creeks were sampled monthly in 2011 for seven months to determine seasonal phytoplankton productivity and respiration. Ex-situ light-dark bottle productivity experiments were conducted in a controlled environment by placing sample water in BOD bottles in a flow-through pond at the UNCW Center for Marine Science for 4-5 hr periods centered at mid-day. Results to date have shown that average respiration per incubation had the highest levels in urban Burnt Mill Creek (36% watershed impervious coverage) in May, June, August, and September. This creek also experienced the highest net primary productivity per day (mg of Carbon) in May and June, and yielded higher average daily respiration compared with suburban Smith Creek (28% impervious coverage). Experiments were subsequently moved into a field situation, and seasonal productivity and respiration data are currently being obtained contemporaneously at Burnt Mill, Smith, and rural (<10% impervious coverage) Harrison's Creeks, respectively. Water quality data is being collected along with in-situ light-dark bottle experiments in order to assess environmental factors influencing primary productivity and respiration. At the completion of data collection, primary productivity data will be related not only to water quality data but to urbanization in terms of percent watershed development and percent impervious surface coverage.

**North Inlet - Winyah Bay National Estuarine Research Reserve sentinel site for examining impacts of sea level rise on salt marshes**
*Tracy Buck, Erik Smith, Wendy Allen; North Inlet-Winyah Bay NERR*
To assess the impacts of sea level change on salt marshes, the North Inlet - Winyah Bay National Estuarine Research Reserve (NERR) has established a sentinel site for the long-term monitoring of salt marsh spatial structure and vegetation community dynamics. Observational infrastructure involves multiple transects spanning an elevation gradient from creekbank to upland forest edge in each of two regions along a salt marsh creek basin. Permanent plots along each transect are routinely assessed for: plot elevation using RTK-GPS; plant species composition, stem density and canopy height; porewater chemistry (salinity, nutrients, and sulfide

concentrations); groundwater level; and sediment properties (% organic content, bulk density, grain size distribution, elemental analysis.) At upper and lower ends of each transect, fine-scale sediment dynamics are monitored using SETs and sediment deposition tiles. A tide gauge at the downstream edge of the site allows for the calculation of frequency and duration of tidal inundation at each plot. Preliminary analysis of monitoring data reveals pronounced regional variations in both vegetation and sediment measures despite similar elevation ranges between regions. While height and density of *Spartina alterniflora*, the dominant marsh species, show clear variation as a function of mean inundation period, overall community zonation patterns are a more complex function of the combined effects of elevation, inundation, porewater chemistry and sediment characteristics. This effort is part of a NERR System Sentinel Site Program involving other reserves and NOAA partners and is designed to inform adaptive management in response to climate impacts in coastal ecosystems and communities.

**Shell Microchemistry of Juvenile *Mercenaria mercenaria*:  Spatiotemporal Patterns and Implications for Modeling Larval Dispersal**

*Andrew M. Cathey*[*2], Nathan R. Miller[1], and David G. Kimmel[1,2]; [1]Department of Geological Sciences The University of Texas at Austin, [2]Department of Biology/Institute for Coastal Science and Policy East Carolina University,*

The incorporation of trace elements into biogenic carbonate has been used to investigate the larval dispersal of bivalves.  We investigate the applicability of this technique to the hard clam *Mercenaria mercenaria* within an estuarine system near Cape Lookout North Carolina, USA.  We assessed the spatial distinction (~12-40km) and temporal stability (spring vs. fall) of elemental concentrations within juvenile carbonate using inductively coupled plasma mass spectrometry (ICP-MS). Twelve elements were present in all samples Ca, Mn, Al, Ti, Co, Cu, Ba, Mg, Zn, Pb, Ni, and Sr. Discriminant function analyses (DFA) using Mn, Al, Ti, Co, Cu, Ba, Mg, Zn, Pb, Ni, and Sr to Ca ratios as independent variables correctly assigned juvenile hard clams to their site of collection with 100% success from fall and spring sampling events. Mn:Ca proved to be the most effective discriminator explaining 91.2% and 71.9% of our among group variance, respectively. The elemental concentrations of juvenile shell differed between seasons.  A combined DFA approach using juvenile clams from both sampling events obtains a classification success of 81.9%.  Mn:Ca explained the bulk of the among group variance (89.9%) and was consistently different among water masses during each season.  Our results are promising in that we demonstrate for the first time the existence of small-scale spatial differences (~12km) in the elemental chemistry of juvenile bivalve shell exclusively within an estuarine system.  If these signals can be validated for the larval form the potential should similarly exist to trace the dispersal trajectory of hard clams.

**Is biodiversity nature's red tape?**

*Robert R. Christian, East Carolina University*

It has long been recognized that systems often develop complexity as they mature.  This development of complexity can be seen across numerous kinds of systems through a variety of mechanisms.   Predictions for this development are that a system accumulates components and these components become more specific and limited in their options.  These predictions are demonstrated in such disparate systems as government and academic bureaucracies, traffic patterns and evolution of body plans.  Ulanowicz, in various publications, has described maturation through information theoretic equations and ascribed a system-level mechanism as autocatalysis.  He, E.P. Odum and others have predicted these patterns for ecosystems.  As food webs mature, the number of species with specialized niches is expected to increase.  This is analogous to the increase in bureaucracy and its red tape.  This analogy highlights two interesting points: (1) the details of recognized mechanisms may differ, although commonalities may produce similar results; and (2) common system properties may be valued quite differently by humans.

**Bringing estuarine research to the classroom: Examples of how to publish science as K12 activities**

*Mary Carla Curran, Marine Sciences Program, Savannah State University*

Ocean literacy concepts can be woven into a variety of K-12 activities. Collaborative efforts between a university scientist, university graduate students, and local teachers resulted in published activities that targeted pre-K through high school students. These activities focus on estuarine organisms and processes. For example, the food web is explained with a hands-on activity based on grass shrimp in marsh areas. Lessons describing the scientific method and the incorporation of deductive reasoning will be discussed. In addition to addressing national/state science standards, these lessons demonstrate that the ocean supports a great diversity of life (Ocean Literacy Principle #5). Because of collaboration with a teacher, one of the first student-driven recycling programs in a public school was started in Savannah, GA. One-on-one collaborations between a teacher and scientist can be productive, but the most rewarding collaborations occurred when the students were also participating in data collection or analysis. Larger partnerships, such as the NSF GK12 program at Savannah State University, provide greater possibilities to enhance science curricula and provide more opportunities to infuse estuarine research into K-12 activities.

**Guidance for Estuarine Shoreline Stabilization Policy: shoreline erosion rates and impact of stabilization structures on marsh surface elevation in eastern North Carolina**

*Carolyn Currin, Mark Fonseca, Michael Greene, Priscilla Delano, Amit Malhotra; NOAA NOS*

A study of shoreline erosion rates in the New River Estuary (NRE), NC showed that sediment banks had the highest shoreline erosion rates, and that fringing marsh associated with sediment banks significantly reduced erosion rates. Salt marsh shorelines occurred over a wide range of wave energy classes, but always had lower shoreline change rates than sediment banks in a similar wave energy climate. The combination of stone sills with fringing salt marsh, sometimes termed "living shoreline", is a stabilization approach recommended as a sustainable alternative to bulkheads. In Carteret County, NC, we measured surface elevation change and marsh vegetation at 4 sites with marsh-sill structures and adjacent reference marshes. Marsh surface elevation change in marshes behind sills was significantly greater than in reference marshes, and averaged 4.1 mm yr-1 during a period of static sea level (2005-2010). During that time, natural fringing marshes exhibited no net increase in surface elevation at the upper edge of the marsh, and a significant loss in elevation at the lower edge of the marsh (mean = -6.9 mm yr-1) . Fringing marshes with offshore oyster reefs exhibited less loss in surface elevation than those without reefs, and marshes adjacent to hardened structures or major navigation channels had the greatest loss in elevation. Although we did not detect any change in vegetation in the natural reference marshes, marshes behind stone sills showed a decrease in *Spartina alterniflora* % cover and an increase in upper marsh species.

**Feeding ecology of the naked goby (*Gobiosoma bosc*): detecting an ontogenetic diet shift from meiofauna to macrofauna**

*Michelle C. D'Aguillo\*, Daniel Zurlo\*\*, Antony S. Harold; College of Charleston Grice Marine Laboratory*

*Gobiosoma bosc* is a common goby in the Charleston Harbor estuary and is most abundant in structurally complex habitat such as intertidal oyster reef systems. The goal of this study is to describe the diet of *G. bosc* and examine if there is a threshold standard length at which the diet shifts from dominance by meiofauna to dominance by macrofauna. *Gobiosoma bosc* were collected from oyster reefs and adjacent sand and mud flats in the Charleston Harbor estuary by examination of mobile oyster shell and seine. To investigate diet composition, the digestive tract was removed from *G. bosc* individuals and prey times were identified to the lowest taxonomic level possible, measured, and enumerated. Results and interpretation from the 2011 field season and a joint study by Daniel Zurlo and Antony Harold indicate that an ontogenetic shift in diet may be occurring around 25 mm standard length, and percentage of meiofauna in the diet is inversely proportion to standard length. These results are ecologically intriguing because they explore a niche shift based on unique changes in predator behavior, from a substrate sieving

behavior to visual predation. Further objectives of this study will look at the potential secondary effects of habitat and latitude on the threshold length of a meiofaunal to macrofaunal diet shift.

## Effects of macronutrient variability in food sources on growth, oogenesis and regeneration in the marine polychaete *Laeonereis culveri*

*Kyle Dilliplaine\*\*, Martin Posey, Jeremy Morgan, Troy Alphin*

Polychaetes are a key link in most coastal food webs.  However, their growth and survival can be affected by many factors, including diet. Since most polychaetes are cryptic, often only exposed body parts are consumed by predators and the ability to regenerate may be dependent on nutrition. Eutrophication of estuaries also can cause a fundamental change in benthic food sources by causing dramatic shifts in the dominant primary producers.  The impact of changing food sources on growth and survival of benthic fauna, including polychaetes, is not well understood but may be critical to understanding consequences for food web dynamics.  This study aims to find out if varying the amounts and ratios of crude protein to crude lipid content of polychaete diets induces response in the overall growth, oogenesis and regeneration in the polychaete *Laeonereis culveri*.  In order to answer these questions, a lab study will be conducted using five different food items with varying protein to lipid ratios; ground *Ulva intestinalis* 59.65:1, shrimp pellets 6:1, blood worms 18.33:1, seaweed mixture 24.21:1, and fish flakes 4.35:1. Treatments will be applied to groups of polychaetes to measure growth and oogenesis and a separate group will have tail segments removed to measure time to regeneration.  It is expected that the food sources containing the highest levels of protein will increase growth, reproduction and regeneration. Shifting food quality can have trophic impacts; the data collected from this experiment will help explain the effect macronutrient availability has on growth, reproduction and survival for a common, representative polychaete taxa.

## Impacts of reef substrate material on oyster demographic rates and Cliona boring sponge growth across a salinity gradient

*Robert P. Dunn\*, NC State University; David B. Eggleston, NC State University/CMAST; Niels Lindquist, UNC-Institute of Marine Sciences*

Restored oyster reefs in high-salinity areas of Pamlico Sound, NC have recently experienced population crashes, potentially brought on by Clionid boring sponge infestation of oyster shells and the limestone marl reef substrate. The composition and porosity of limestone marl may make it particularly vulnerable to bio-erosion by sponges, so alternative substrates must be assessed for use in future reef building efforts. In this study, combined lab and field work is being used to investigate the efficacy of four reef substrate materials: oyster shell, limestone marl, granite, and concrete, from substrate-specific rates of oyster settlement, growth, and mortality, as well as boring sponge growth. Larval oyster settlement in the laboratory was highest on oyster shell, second highest on marl and concrete with no difference between them, and lowest on granite with almost zero settlers. Substrate materials were also deployed in two estuaries where noticeable differences in sponge growth were observed, with oyster shell and marl being more susceptible to sponge colonization than concrete or granite. There were also positive correlations between oyster mortality and salinity, as well as boring sponge growth and salinity. This work suggests the use of non-limestone substrate materials for future oyster reef construction in high salinity locations.

## Tracking restored marsh trajectories relative to a natural marsh reference condition

*John Fear, Heather Wells, Byron Toothman; North Carolina Coastal Reserve - National Estuarine Research Reserve, N.C. Division of Coastal Management*

A suite of parameters including vegetation metrics, elevation, and groundwater levels were tracked for three years in three restored marshes and compared to similar metrics collected from a natural marsh reference site in Carteret County, N.C.  These data were used to evaluate the success of the restored marshes and determine which metrics were critical to understanding the success of the restored sites.  This work was conducted as part of a NOAA Restoration Center funded project in partnership with 4 other National Estuarine Research Reserves located in Virginia, Rhode Island, Maine, and Oregon.  Results from all 5 project partners were combined into a single dataset to evaluate the best way to restore marsh habitats and track the success of

restoration projects. This talk will present the results from this effort as well as related projects conducted by the North Carolina Coastal Reserve and National Estuarine Research Reserve, NC Division of Coastal Management relative to shoreline stabilization.

**Effects of hypoxia and low pH on mosquito insecticide toxicity in two commercial shellfish species**

*Robin N Garcia\*[1], , Marie E DeLorenzo[2], , Katy W Chung[2], Peter B Key[2], Louis E Burnett[1], Loren D Coen[3]; [1]College of Charleston, [2] NOAA/NOS/CCEHBR, [3]Florida Atlantic University*

Mosquito insecticides are classified by their chemical class - frequently organophosphates (OPs) and pyrethroids. Concerns surrounding the use of mosquito insecticides include the known toxicity of pyrethroids to non-target species, contamination of aquatic areas, and the lack of knowledge on the combined effects of pesticide toxicity and abiotic stressors. Information about multistressor effects is important for commercial molluscan species that are found and grown in estuaries. To determine the effects of mosquito insecticides on molluscs, the median lethal concentration (LC50) will be determined at 96 h in the larval and juvenile stages of the eastern oyster, *Crassostrea virginica*, and the hard clam *Mercenaria mercenaria* using the pyrethroids, resmethrin and permethrin, and the OP, naled. Sublethal growth effects will also be determined in juvenile clams and oysters. Ocean acidification and global climate change may lead to decreases in pH and dissolved oxygen, beyond the normal range of estuarine conditions. Therefore, this study will also examine the effects of hypoxia, low pH, and a combination of the two with pesticide exposure to determine interactive effects on clam survival. Preliminary results show that juvenile clams were more sensitive to all three insecticides than larval clams, and that resmethrin was the most toxic insecticide in clams. Naled was the most toxic insecticide in larval oysters. Additionally, permethrin and naled decreased growth in juvenile clams. Ultimately, the results of this study will be used to assess whether shellfish early life stages are at risk from mosquito insecticide applications, and whether abiotic stressors modify insecticide toxicity.

**Evaluating the effects of shoreline stabilization on fish habitat value and erosion of estuarine shorelines in North Carolina**

*Gittman, Rachel K.\*[1], Bruno, John F[2]., Peterson, Charles H.[1]; [1]University of North Carolina at Chapel Hill Institute of Marine Sciences, [2]University of North Carolina at Chapel Hill, Department of Biology*

Climate change is adversely affecting coastal ecosystems. Higher shoreline erosion rates caused by increased frequency and intensity of storms may prevent coastal habitats from keeping up with rising sea level, forcing habitats to transgress landward. While shoreline armoring can reduce erosion, bulkheads placed landward of intertidal habitat can prevent transgression, resulting in habitat loss. Alternatively, marsh sills, intertidal low-crested breakwaters, may allow for transgression. To determine how armoring affects fish utilization and erosion of intertidal habitat, we sampled fish communities and quantified erosion of marsh, seagrass, and mudflat adjacent to armored (bulkhead or sill) and unarmored shorelines in North Carolina. Marshes with sills contained significantly higher fish abundance, biomass, and diversity than unarmored marshes. Mudflat adjacent to bulkheads supported significantly lower fish abundance and biomass than habitat adjacent to sills. To quantify erosion, we measured marsh surface elevation pre- and post-Hurricane Irene at sill and unarmored sites and surveyed shoreline damage post-Irene. Mean elevation of marshes at sill and unarmored sites increased by 2.3cm and 2.1cm, respectively. Of 21km of bulkhead surveyed, 33% showed damage or landward erosion, while sill shorelines suffered no damage. Marsh sills may sustain coastal habitats better than bulkheads and may also provide greater erosion protection.

**Genetic diversity of northeastern North Carolina submerged aquatic vegetation**

*Benjamin Graham\*\*, Josh Phelps\*\*, Maurice Crawford, Margaret Young; Elizabeth City State University*

Submerged aquatic vegetation (SAV) plays a crucial role in the North Carolina fishing industry. Underwater grasses provide protection for adolescent fish while they reach a level of maturity suitable for harvesting. A decline in SAV density in northeastern North Carolina (NENC) waterways can have devastating effects on the fishing industry which is worth millions of dollars

to the local economy.  Three species: widgeon grass (*Ruppia maritima*), wild celery (*Vallisneria americana*), and redhead grass (*Potamogeton perfoliatus*) were collected from NENC and southern Virginia waterways for genetic studies.  The DNA from the three species was extracted and quantified by A260/A280 spectrophotometry.  The mean DNA concentrations for *R. maritima*, *V. americana*, *P. perfoliatus* were 20.8 ng/µL, 8.6 ng/µL, and 31.6 ng/µL respectively.  The DNA from all three species was able to be amplified by PCR using primers for the RuBisCO protein.  The extracted DNA will be used in a genetic diversity study to be conducted over the next 18 months in order to determine the most common mode of reproduction for all species as well as their viability for recovery.  Determining the genetic diversity of these underwater grasses will be the first step in replenishing their populations.

**The effect of habitat fragmentation on the interaction of oysters (*Crassostrea virginica*) and pea crabs *(Pinnotheres ostreum*)**
*Marc H Hanke\*, Martin H Posey, Troy D Alphin; University of North Carolina Wilmington*
Declining oyster populations has led to increased habitat fragmentation within oyster reef communities, which increases the amount of edge on a reef. The pea crab (*Pinnotheres ostreum*) is a parasite of the eastern oyster (*Crassostrea virginica*) and very little is understood about how habitat fragmentation influences this interaction. The objective of this study is to determine the number and size of hard stage female pea crabs present on intertidal oyster reefs, the spatial distribution of female pea crabs across intertidal oyster reefs, specifically focusing on how parasitism rate differs between patch and fringing reefs, size of reef, and edge or interior reef habitat by season, and the impacts of pea crabs on oyster condition. Oyster populations were sampled in the spring and fall of 2011 from edge to most interior region for three different sizes of natural fringing and patch intertidal reefs in southeastern North Carolina. Pea crabs in the spring were greater in number, significantly larger, and a higher percentage was gravid females compared to the fall. There was no difference in utilization for the type reef, although overall utilization increased with increasing size of oyster reef. There was a strong positive relationship with edge in the spring. The pattern was consistent, but not significant in the fall. The condition of oysters was significantly reduced with the presence of pea crabs. Our results indicate that habitat fragmentation of oyster reefs can impact both the parasite and its host and contain a negative impact of pea crab on host oysters.

**Separating behavior from environmental interference: Controls in a marine acoustic telemetry study**
*Noelle C. Hawthorne\*, Matthew B. Ogburn;, Savannah State University*
Acoustic telemetry studies have provided new insights into the movement and behavior of marine species.  However, the results of these studies can be difficult to evaluate because the majority lacked sufficient controls for interference due to environmental variability.  Tag detection efficiency has been examined in a few short-term river and marine studies, but conclusive evidence as to why performance varied has not been found.  The purpose of the present study was to quantify environmental interference that affects the detection of an acoustic transmitter by a receiver.  The study was conducted over a 7-month period in Gray's Reef National Marine Sanctuary using submersible VEMCO LTD VR2W hydrophone receivers and stationary V13 range test transmitters.  Control tags transmitted a signal every 8 min and the maximum possible detections per hour was 7-8.  However, emitted signals were not always recorded by the receivers and actual detections ranged from 0-8 per hour.  The tag 100 m from the receiver had a mean of 4.07+/-0.05 detections/h while the tag 200 m from the receiver had a mean of 1.77+/-0.04 detections/h.  Control tag detections were found to vary strongly with flood/ebb tidal currents at a cycle length of 12.8 h and 91% of the variability in control tag detections was due to flood/ebb currents.  Thus, tidal patterns in animal detection data could be a product of environmental interference with the signal as well as animal movement.  We are currently working to develop a correction method for fish detection data to separate fish behavior from environmental variability.

***Anguillicoloides crassus*, an invasive parasite in the American eel: survey and health effect on fish in selected estuaries in South Carolina**
*Jennifer L. Hein\*[1], Steve A. Arnott[2], William A. Roumillat[2], Isaure de Buron[1]; [1] College of Charleston, [2] SC Dept of Natural Resources*
Reports of eel populations in South Carolina estuaries have shown a decline since at least 2001, when the SCDNR electrofishing survey began. The invasive parasite, *A. crassus*, infects the eel swimbladder and is considered one potential reason for the decline in American eel populations. This nematode is endemic to East Asia, where it infects the Japanese eel. It was first seen in the United States in 1995 in an aquaculture facility and one year later it was found for the first time in U.S. wild eel populations in Winyah Bay, SC. The parasite has since been reported in American eels along the Atlantic Coast but we have no information regarding the status of infection and impacts of this parasite on eel populations in South Carolina estuaries. The goal of this project is to survey the presence and health effects of the invasive parasite, *Anguillicoloides crassus*, on the American eel populations in the ACE National Estuarine Research Reserve (NERR), North Inlet NERR, Winyah Bay, and the Cooper River. Eels were collected from January 2011 through January 2012 to determine prevalence, intensities, and abundances of *A. crassus* at each sampling site. Damage to the swimbladder, including thickness, opacity, and presence of blood and pigmentation were evaluated using a ranking system. The validity of using eel vent coloration as a noninvasive diagnostic tool as an indicator of *A. crassus* infection is currently being tested. Funded by a SeaGrant/NERR: 2011 Coastal Research Fellowship Program

**Comparative study of finfish community structure in coastal Georgia using trawl sampling**
*Javar Henry\*\*, Mary Carla Curran; Marine Sciences Program, Savannah State University*
Trawl data are used to better understand the growth rate, habitat, and estimated amount of fish caught by commercial fisheries, as well as help predict the future abundance of species. Savannah State University (SSU) conducted combined research/education cruises to study long-term fish diversity and abundance trends along the coast of Georgia from September 2009 to December 2011. Fifteen minute trawls were conducted every other month. Out of a total of 16 trawls, 45 different fish species and 5,178 individuals were collected. Five species of the Sciaenidae family composed 79% of the catch. The five fish were Atlantic croaker (*Micropogonias undulates*), weakfish (*Cynoscion regalis*), stardrum (*Stellifer lanceolatus*), spot (*Leiostomus xanthurus*), and southern kingfish (*Menticirrhus americanus*). These results were compared to those obtained by the Georgia Department of Natural Resources (GADNR) Coastal Resources Division (CRD) during multiple fishery-dependent and independent sampling efforts from April 2005-May 2008. The GADNR data yielded 44 different species and 849,645 individuals out of 1,631 trawls. The same five species of the Sciaenidae family collected in the present study composed 78% of the catch by GADNR. Based on the results from both the present study and sampling conducted by the GADNR, sciaenids are the dominant members of the fish community in Georgia waters. Furthermore, smaller scale sampling efforts are successful in assessing species composition.

**Goin' Fishin': Oceanic fish diversity among three barrier island systems in the southeastern United States**
*Kelley Jonske\*, Melissa Gieseking\*\*, CJ Best\*\*, J. Reichmuth, B. Saul; Augusta State University*
Current research suggests that estuaries are subject to anthropogenic degradation. Many of the fish species that live in and use these estuaries are ecologically and economically important. An essential consideration within these estuarine environments is being able to compare these fish populations to gain insight into the dynamics of these valuable ecosystems. This study aims to compare the fish diversity among three barrier islands with varying human impacts. Both Hunting Island (SC) and Tybee Island (GA) are accessible by vehicle and open to the public; St. Catherines Island (GA) is only accessible by boat and not open to the public. Current sampling took place on Hunting and Tybee Islands and historical through present day data was used for comparison from ongoing research at St. Catherines Island. Each island was sampled by using two types of beach seines. Our preliminary findings suggest some differences in species collected, specifically, the capture of a grazer, the Sheepshead (*Archosargus*

*probatocephalus*), on both Tybee and Hunting Islands and never on St. Catherines Island. This could indicate that anthropogenic impacts, such as man-made structures, are a factor. This could be an indication of possible changes in trophic structure which could affect these coastal ecosystems and the dependent fish populations.  It is possible that these findings could help set better regional management practices and potentially influence better global management practices.

**Phytoplankton in surf zone: Developing methods to build baseline knowledge**
*Amanda Kahn, L. Cahoon, University of North Carolina Wilmington*

Measurements of primary production in surf zone habitats are relatively rare and often utilize simulation approaches, owing to the physical challenges of working in surf. Thus, there is little known about the baseline productivity of this ecosystem. This study examined primary production *in situ* at two open ocean beaches in southeastern North Carolina during relatively calmer summer conditions. *In situ* bottle incubations using $^{14}$C uptake methods were complemented by simultaneous measures of phytoplankton photo-physiology assessed by Fast Repetition Rate Fluorometry (FRRF) in flow-through mode at two beach sites across a spring-neap tidal cycle in July, 2010. The surf zone phytoplankton was dominated by small centric and pennate diatoms as well as cyanobacteria and chlorophytes with biomass concentrations of 3.63 – 9.23 mg chl a m$^{-3}$.  Primary productivity was relatively high, ranging from 31.5 - 88.0 mg C m$^{-3}$ h$^{-1}$ by $^{14}$C. Biomass-specific productivity averaged ~9.4 mg C mg (chl a)$^{-1}$ h$^{-1}$ by $^{14}$C, indicating healthy phytoplankton populations. These data suggest that the surf zone, although a spatially confined habitat, is a productive one that plays a significant role in coastal ocean ecology. The functional absorption cross section of photosystem II measurements via FRRF, were comparable to values reported by other investigators of open ocean phytoplankton. Averaged values of the maximum effective quantum yield correspond to proportions of photochemically competent PSII reaction centers of 62.6% to 72%, which generally indicates that the phytoplankton are nutrient – replete. Further investigation is needed to develop comprehensive baseline knowledge of the phytoplankton community composition in this unique environment and their photophysiological responses to changes in the environment.

**Long-term changes in the ecosystem structure of Chesapeake Bay and consequences for fisheries**
*Kimmel DG[1], Boynton WR[2], Roman MR[3]; [1]Department of Biology, Institute for Coastal Science and Policy, East Carolina University, , [2]University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, [3]University of Maryland Center for Environmental Science, Horn Point Laboratory*

The Chesapeake Bay has long been under the influence of human activity. Environmental changes include a long-term rise in water temperature and the volume of hypoxic water during the summer. These changes occurred during the same time period as increases in chlorophyll a concentration, declines in the landings of the eastern oyster *Crassostrea virginica*, and declines in abundance of the sea nettle *Chrysaora quinquecirrha*. A CUSUM analysis showed that each time-series experienced a change point during over the past 50 years. These changes occurred sequentially, with chlorophyll a concentration increasing beginning in 1969, water temperature and hypoxic volume increasing beginning in the early 1980s, more recent Maryland *C. virginica* landings begin declining in the early 1980s and *A. tonsa* and *C. quinquecirrha* declining starting in 1989. The drop in *C. quinquecirrha* abundance is associated with reduced predation on the ctenophore, *Mnemiopsis leidyi*, a key predator of the dominant zooplankter, the copepod *A. tonsa*. The long-term decline of *A. tonsa* has likely impacted trophic transfer to fish, particularly the zooplanktivorous bay anchovy (*Anchoa mitchilli*). A time-series of bay anchovy juvenile index showed a negative trend and the CUSUM analysis revealed 1993 as its starting point. Total fisheries landings, excluding menhaden (*Brevoortia tyrannus*), in Chesapeake Bay have also declined during the same period and this also began in 1993, further suggesting a potential fisheries impact from the decline in *A. tonsa* abundance.

**Tuning into the sound: Habitat-associated estuarine soundscapes and invertebrate settlement response**

*Ashlee Lillis\*, David Eggleston, DelWayne Bohnenstiehl, North Carolina State University*

Ambient underwater sound is a potentially important settlement cue for marine fish and invertebrate larvae, but relevant sound patterns and larval responses remain largely unknown. Sound is transmitted long distances and reflects the bio-physical characteristics of habitat, while other sensory cues are rapidly attenuated. In estuaries, the sound characteristics of oyster reefs are of particular interest because reefs are patchily distributed productive habitats that harbour many sound-producing organisms. Using subtidal oyster reefs in NC as a model system, stationary and drifting hydrophone-recording surveys demonstrated that reefs consistently produce distinct acoustic spectra, comprised of significantly more sound in the 1 – 20 kHz invertebrate-dominated frequency range, compared to adjacent soft-bottom habitats. This indicates that habitat-associated sound could provide useful sensory information for settling reef-dwellers. Moreover, recent laboratory experiments suggest that sound has a significant habitat-specific effect on oyster settlement rates: higher numbers of larvae settled in the presence of oyster reef sounds compared to soft-bottom or no sound. Settlement experiments are currently being conducted for larval hard clam, to compare the habitat-related sound response of a non-reef-dwelling bivalve. Field manipulations of sound will be performed in Spring and Summer 2012 to further evaluate the influence of sound on larval processes.

**Pollutant source tracking in a coastal recreational community**

*Michael A. Mallin[1], Matthew R. McIver[1], Mary I. Haltom[1], Bongkeun Song[2]; University of North Carolina Wilmington, Center for Marine Science, [2]University of North Carolina Wilmington, Department of Biology and Marine Biology*

An investigation was conducted to assess water quality in oligohaline Tiny Piney Creek, draining the Towns of Caswell Beach and Oak Island. Goals were to determine potential sources of fecal bacterial contamination to the creek and assess general water quality. Seven sites were sampled on five occasions, which included dry and rainy periods. The creek had elevated fecal bacteria counts in all areas except for a headwaters spring site. The highest fecal counts were seen in wet periods, indicating stormwater runoff pollution, but excessive counts at some locations also occurred in dry periods. The stations with worst fecal contamination included an Oak Island creek site located near where a few septic systems are in operation, and a site near a sewage lift station in Caswell Beach. Molecular techniques (PCR and T-RFLP) indicated that human fecal contamination was present in 83% of the samples collected. High concentrations of optical brighteners throughout were also indicative of human sewage or septic leachate. Ruminant (likely deer) contamination was found in 89% and canine fecal contamination in 29% of the samples, indicating stormwater runoff. The area has porous soils and a generally high water table, which exacerbates movement of bacterial and chemical pollutants into groundwater and into the creek. Lowest dissolved oxygen and highest fecal bacterial counts were found at the creek site near the septic systems and the site near the sewage lift station. Thus, both stormwater runoff and input from human sewage treatment facilities are sources of fecal microbial pollution to this creek.

**ESTUARINE shoreline mapping project update**

*Kevin McVerry, NC-DCM*

The goal of the ESMP is to create a continuous estuarine shoreline and to quantify the mileage of shoreline types and number of shoreline structures, with the intention of further understanding the effects of development along the shoreline and the effects of permitted activities on coastal residents and the environment. A detailed methodology was created and the estuarine shorelines were digitized using the most recent available aerial photography for each county. To date, 19 of the 20 CAMA counties have been digitized. The completed counties have been QA/QC'ed by DCM staff and are considered complete. Carteret County is the last to be delineated, out of the estimated 1,700 miles 850 miles have been digitized and all polygon structures have been digitized totaling 4,414. The digitization process is expected to be completed by June 2012. A basic statistics and summary analysis has been performed on the 12 completed counties. The analysis includes calculations of length of five distinct shoreline types,

length of the types of modified shoreline, and the number of modified structures.  In order to verify areas that were not discernible with aerial photographs we are currently collaborating with DCM field staff to assist with the field check process.

**Albemarle Sound pilot study of the National Monitoring Network for U.S. coastal waters and their tributaries**
*Michelle C. Moorman; U.S. Geological Survey, Raleigh, NC*
        The U.S. Geological Survey's (USGS) North Carolina Water Science Center has begun a four-year pilot project in the Albemarle Sound for the National Monitoring Network for U.S. coastal waters and their tributaries. The goal of the National Monitoring Network is to provide information about the health of our oceans and coastal ecosystems and inland influences on coastal waters for improved resource management. The Network integrates biological, chemical, and physical features and links uplands to the coastal ocean. The purpose of the Albemarle Sound pilot study is to:
1) Inventory current monitoring programs in the Albemarle Sound,
2) Conduct a gap analysis to determine current monitoring needs,
3) Implement a monitoring program to address data gaps, and
4) Create a web-based map portal of monitoring activities.
In the first year of the project, the USGS will be working with stakeholders to inventory current programs and design a monitoring program.  This presentation will provide more information about the project and will solicit input and contact information from interested stakeholders.

**Characterizing the genetic population structure of Spotted Seatrout (*Cynoscion nebulosus*) along the southeast United States**
*Tim O'Donnell\*[1], Tanya Darden[2], Mike Denson[2]; [1]College of Charleston, [2]SCDNR*
        Spotted seatrout, a recreationally important fish in SC, has recently suffered substantial population declines during the cold winters of 2000, 2009, and 2010 when water temperatures dropped substantially below long term averages.  These winter-kills appear to result in population bottlenecks and their repetitive occurrence over a short time scale has prompted the SCDNR to consider a stock enhancement program.  Prior to implementation of any management tactics, a full understanding of the population structure is required.  The first goal of my thesis research is to determine the genetic population structure across eight estuaries along the southeast U.S. spanning NC to GA using a suite of 13 microsatellite markers. Results suggest significant population differentiation between fish in NC compared to SC and GA.  Although we see a significant break in gene flow between these areas, the overall pattern throughout the sampling range represents a gradient in genetic diversification with the degree of geographic separation.  A lack of appropriate habitat between SC and NC is likely driving the differences as some gene flow is still occurring across the barrier. The use of a powerful suite of markers has allowed higher structure detection than previous projects, which will improve future management of spotted seatrout in SC.

**Hydrologic control of phytoplankton dynamics: a comparison of two coastal plain North Carolina estuaries**
*Benjamin L. Peierls, Nathan S. Hall, Hans W. Paerl; UNC-CH Institute of Marine Sciences*
        Nitrogen (N) inputs are generally assumed to drive estuarine phytoplankton dynamics, but freshwater discharge often plays a more direct role in biomass (chlorophyll a) accumulation since it simultaneously controls both phytoplankton residence time and N loading. Understanding this link is critical, given potential changes in climate and human activities that may affect discharge and watershed N supply. Phytoplankton-transport time scale relationships were examined in 4-year time series from two neighboring, shallow (discharge. Non-linear fits of chla to flushing time revealed unimodal relationships that reflected the changing balance between intrinsic growth and losses (grazing, sedimentation) across space and time. Maximum fitted biomass occurred at about a 10 day flushing time for both systems. Residual analysis of the fitted data revealed positive relationships between chla and temperature. Fitted curves had larger positive and smaller negative slopes at higher temperatures, suggesting enhanced growth rates. These results highlight the spatial and temporal differences in discharge impacts on

phytoplankton biomass and will help predict estuarine phytoplankton and ecosystem response to future climate and anthropogenic changes.

## Monitoring of Transplanted Submerged Aquatic Vegetation (SAV) at Sandy Point, N.C.
*Josh Phelps\*\*, Brian Rubino and Warren Eadus, Maurice Crawford*

We monitored the coverage of submerged aquatic vegetation (SAV) as part of an in-kind mitigation project for SAV impacts during the construction of a boat channel. A breakwater was also constructed to prevent wave action from disrupting the transplanted SAV. We collected data on SAV coverage in areas where SAV had been transplanted and in reference sites. Coverage data were taken at randomly selected stations stratified by depth using meter square quadrates. We found that the coverage of SAV in the transplanted site consistently exceeded that in the reference site

## When you just can't do field experiments:  Using structural equation modeling to test cause-and effect in ecological hypotheses
*Ed Proffitt, Dept. of Biological Sciences, Florida Atlantic University*

Controlled experiments are the best way to evaluate cause-and-effect in science, however factorial experiments with multiple dependent or independent variables rapidly become very cumbersome to perform, measure, and even analyze as the number of variables increases. Also, field experiments are nearly always limited in spatial or temporal scope, and often may not address cause-and-effect over ecologically relevant scales. Further, sometimes agencies may require monitoring of a project, but may not want to fund experiments. When using multivariate models developed *a priori*, it is possible to test ecological hypotheses from purely observational data using the analytical techniques of "directed graphs" and "structural equation modeling (SEM)."  The concept is simple.  Variables are arranged into a "directed graph" in a series of regression models that link all variables into a pattern that all together forms a multivariate hypothesis. See the example "directed graph" (or path diagram) below:

$$B \longrightarrow C \longrightarrow D$$
$$A \longrightarrow B$$
$$A \longrightarrow D$$
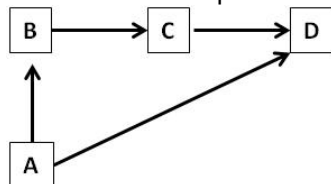
Here, single headed arrows indicating the direction of cause-and-effect   Variable A has a direct effect on D (the last path listed), but also indirect effects on D through the path A→B→C→D.  The arrangement of paths in this "directed graph" produces an implied covariance structure.  Your dataset of variables A, B, C and D will also have a 'real' covariance structure that you can easily calcualte. If the model-implied and real covariance structures are not significantly different, then this is hard evidence supporting the multivariate hypotheses that you posed (the set of paths listed above). Alternative plausible models can be posed as hypotheses and evaluated for "fit" to the data and all models that fit can be compared using AIC to choose the 'best model'. A real world example, and a discussion of latent (non-measured) variables, and software will be included in the presentation.

## Assessing success of oyster reef restoration in the St. Lucie Estuary, SE Florida
*C.E. Proffitt & E. Salewski, Florida Atlantic University*

Restoration of oyster reefs is one of the targets of the Comprehensive Everglades Restoration Plan for the St. Lucie River Estuary (SLE) in SE Florida. The SLE is a major distributary from Lake Okeechobee and anecdotal reports suggest that there has been a 99% reduction in oyster populations since discharge rates increased after the C44 and other canals were dug in the 1940's. Discharge affects salinities, imparts nutrients which causes algal growth, increases sedimentation rates, and introduces other pollutants which cause lesions on fish, dolphins, and other species. Martin County created >1,000 patches of cultch from fossil shell in 2009 and 2010 as part of the federal stimulus package. We assessed oyster and associated reef invertebrates recruitment throughout the estuary and used structural equation modeling (SEM) to assess major drivers of recruitment patterns.  Further, we conducted a field experiment to study

the separate and interactive effects of topographic relief and reef complexity. Oysters colonized reef sites to differing degrees during the two-year study. SEM indicated that FLOW decreased salinity, increased nitrogen, and had direct and indirect (through N) effects on CHL A. SALINITY and CHL A had negative effects on OYSTER abundance, and there were additional negative effects on FLOW on small and medium size classes of oysters. Other invertebrates were variously affected by FLOW but were enhanced by greater abundance of living oysters, not just the cultch material. The field experiments showed that RELIEF and COMPLEXITY had significant interactive effects on abundance and diversity of associated reef invertebrates.

**If you build it, will they come: Designing a marine reserve network for oyster restoration**
*Brandon Puckett\*, David Eggleston, Rodney Guajardo; North Carolina State University Center for Marine Sciences and Technology*

The global decline of oyster populations and resulting loss of fishery harvests and ecosystem services has fueled large-scale oyster restoration throughout the world. Restoration strategies range from planting shell-material, to hatchery-based stock enhancement, to construction artificial reefs protected from harvest and connected by larval dispersal (i.e., reserve network). The efficacy of reserve networks is dependent on site selection, whereby reserves are sited in areas that are biologically and economically optimal. In this study, we applied a GIS-based hierarchical optimization approach for site selection of oyster reserves using Pamlico Sound, NC as the model system. We created a grid of Pamlico Sound, assembled 16 GIS layers relevant to oyster biology (e.g., larval settlement) and artificial reef construction (e.g., bathymetry), partitioned layers into "exclusion" and "threshold" categories, developed scoring and weighting criteria for threshold layers, and calculated the suitability value for each grid cell across all threshold layers on a scale of 0 (least suitable) to 1 (most suitable). Based on exclusion layers (e.g., bathymetry), 37% of Pamlico Sound was unsuitable for oyster reserves. Of the remaining cells, the modal suitability value was ~0.5. The max suitability value was 0.81; 22 cells (0.36%) scored 0.80 or above. The most suitable cells were typically clustered. These results suggest that a GIS-based hierarchical approach to site selection is effective for (1) narrowing vast water bodies to a manageable number of sites for further empirical ground-truthing, (2) identifying restoration "hot spots" where high-valued cells are clustered, and (3) designing reserve networks for species restoration.

**A study of snail densities in conjunction with the relative health of *Spartina a.* in two southeastern United States salt marsh systems**
*Jessica Reichmuth, David Johnson\*\*; Spencer Morgan\*\*, Augusta State University*

Recent studies indicate that certain environmental stresses, such as drought and increased density of a snail grazer (*Littorina irrorata*), have played a significant role in the apparent *Spartina alterniflora* die-off in southeastern United States salt marsh systems. Close attention has been paid to snail's grazing activities since this activity increases the susceptibility to fungal invasion and infection. While it is evident that snails are in large numbers in these systems, the possibility of an unsustainable population has become a subject of much interest, in part because the cause may be linked to a declining number of the snail's predators. Herein, we investigate current population densities of *L. irrorata* in two locations along the southeastern U.S. coast: Hunting Island and Tybee Island. *S. alterniflora* abundance was also recorded in each system by use of a grading scale based on the number of stems per square meter and stem length. Furthermore, crab predator abundance was recorded. Surprisingly, snail densities were generally lower than reported in literature, and in both locations, we observed larger numbers of snails in areas of "short" *S. alternaflora*. Also, compared to other classes, the "short", "thin" *S. alternaflora* dominates marshes in both locations. Literature is lacking on current snail densities, and this study presents up-to-date information regarding the population density of *L. irrorata* and the relative abundance of *S. alterniflora* in two southeastern salt marsh systems. It is possible that news is not all bad for southeastern salt marsh systems, but could provide insight for future management plans.

**Tidal creeks serve as sentinel habitats for assessing the impact of coastal development on ecosystem health in Southeastern and Gulf of Mexico US**

*DM Sanger* [1,3], *A Blair* [3], *G Riekerk* [2], *E Wirth* [4], *L Webster* [4], *AF Hollan ;* [1]*South Carolina Sea Grant Consortium,* [2]*South Carolina Department of Natural Resources, Marine Resources Research Institute,* [3]*NOAA, Center for Human Health Risk,* [4]*NOAA, Center for Coastal Environmental Health and Biomolecular Research*

Tidal creeks have been used as a sentinel habitat to assess the impacts of coastal development on estuarine areas in the southeastern US. A conceptual model for tidal creeks in the southeastern US identifies that human alterations of upland in a watershed such as increased impervious cover (stressors) will lead to changes in the physical and chemical environment (such as microbial and nutrient pollution (exposures) of a receiving water body which then lead to changes in the living resources (response). Recently, the tidal creek classification framework and conceptual model linking tidal creek ecological condition to potential impacts of development and urban growth on ecosystem value and function was tested in the Gulf of Mexico US. The conceptual model was validated for the Gulf of Mexico US tidal creeks. The tidal creek classification system developed for the southeastern US could be applied to the Gulf of Mexico tidal creeks; however, some differences were found that warrant further examination. In particular, pollutants appeared to translate further downstream in the Gulf of Mexico US compared to the southeastern US. These differences are likely the result of the geographic differences between the two regions. *Tidal creeks appear to serve as sentinel habitats to provide an early warning of the ensuing harm to the larger ecosystem in both the southeastern and Gulf of Mexico US tidal creeks.*

**Predicting N fluxes in the Altamaha River, Georgia, from anthropogenic activities**

*Sylvia C. Schaefer\* and Merryl Alber, Department of Marine Sciences, University of Georgia*

Excess nitrogen loading from freshwater rivers is a major contributor to coastal eutrophication. Understanding the sources of nitrogen to rivers is therefore important for reducing nutrient loading from watersheds. We conducted a year-long monitoring study of Georgia's Altamaha River and its subwatersheds. Monthly samples were collected and analyzed for N and P, as well as a variety of other physical and chemical parameters. In-stream N concentrations ranged from 3-14% of inputs to the subwatersheds, which is in line with our previous results for southeastern rivers. Average annual loads of most nitrogen species were extremely well-correlated with population densities, as were average annual concentrations of NOx. Phosphorus concentrations and loads were low in the Altamaha River system, but were also best explained by population density. Urban area was also a good predictor of in-stream N loads. Agricultural sources of nitrogen such as crop production and fixation also explained differences in N loading, particularly NH4; however, the percentage of watershed land in agricultural use was not correlated with in-stream loads. Preliminary isotopic analysis of d15N in NO3 will also be discussed.

**Do the densities of daggerblade grass shrimp *Palaemonetes pugio* vary between seasons and distance from the marsh edge in tidal creeks on the coast of Georgia?**

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The daggerblade grass shrimp *Palaemonetes pugio* is one of the most prevalent macroinvertebrates along the East Coast of the United States and is an integral part of the estuarine food web. The purpose of this study was to determine the seasonal variations in densities of *P. pugio* as well as the differences in densities between marsh edge and non-marsh edge sites in tidal creeks on the coast of Georgia. Shrimp were collected near Savannah, GA at low tide using a 1 m3 drop-trap between 2008 and 2011. Sampling locations along with relative densities were mapped and projected in GA Stateplane East using ArcMap 10. Summer densities were greatest at Burnside (449.5±223.1 shrimp/m$^2$) and lowest at Tybee Island (49.3±1.8 shrimp/m$^2$). In contrast, fall densities were highest at Tybee Island (122 shrimp/m$^2$) and lowest at Burnside (21 shrimp/m$^2$). During both the summer and fall, shrimp densities were higher along the marsh edge (40.3-91.1 shrimp/m$^2$) than in the middle of the creek (5.5-58.4 shrimp/m$^2$), though the differences were not statistically significant. It is possible that *P. pugio* were found in

greater densities along the edges of the creeks during low tide because grass shrimp utilize the marsh grasses as protection from predators. In the present study, seasonal differences in densities were only determined during the summer and fall. Additional research is currently being conducted to determine how shrimp densities vary over the course of an entire year.

**Monitoring the movement patterns of the bonnethead *Sphyrna tiburo* using acoustic telemetry in Romerly Marsh Creek, Georgia, USA**

*Dontrece Smith*[1], Matthew Ogburn[2], Mary Carla Curran[1]; [1]Marine Science Program, Savannah State University, [2]Smithsonian Environmental Research Center*

Acoustic telemetry techniques have been used successfully to monitor the behavior and movement of elasmobranchs. The purpose of this study was to assess the residency and movement patterns of the bonnethead *Sphyrna tiburo* in Romerly Marsh Creek, Georgia. Acoustic transmitter tags were attached to the first dorsal fin with marine epoxy and cable ties. An array of 7 automated telemetry receivers were placed from the mouth to the end of the creek from August 18-November 22, 2011. Nine individuals, ranging from 72 to 122 cm total length (TL), were tagged and 7 were subsequently detected. A total of 29,294 detections were downloaded from the receivers. The last detection was recorded on October 18, 2011 when the sharks presumably left the area. Sharks exhibited a higher residency in September (43 ± 28% of days) compared to October (9 ± 12% of days). Individuals were detected most often at night (8:00 PM-5:00 AM). Sharks were present in the study area mostly at low tide (p<0.01), and it is thought that they left the area to enter smaller marsh creeks with the incoming tide. Similarly, sharks moved more during the night (p<0.01) and at low tide (p<0.01), which indicated that *S. tiburo* was most active during these periods. We determined that *S. tiburo* was a short-term resident and also demonstrated that a small-scale project using acoustic telemetry can provide reliable data on the movements of coastal shark species.

**Marine debris impacts to a tidal fringing-marsh in North Carolina**

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We evaluated injuries to *Spartina alterniflora* by debris items common to North Carolina coastal waters as a function of debris type (wire blue crab pots, vehicle tires, and anthropogenic wood) and deployment duration, and monitored *S. alterniflora* recovery following debris removal. Injuries sustained by *S. alterniflora* and subsequent recovery, varied considerably between debris types. Differences were likely due to dissimilarities in the structure and composition of debris. Tires caused an immediate (within 3 weeks) and long-term impact to *S. alterniflora*; tire footprints remained devoid of vegetation 14 months post-removal. Conversely, crab pot impacts were not as abrupt and recovery was short-term (<10 months). We suggest that removal programs specifically target habitats that are susceptible to negative impacts (e.g., salt marsh) and prone to debris accumulation. Management would benefit from the inclusion of habitat information in removal databases.

**A large loss of seagrass in Indian River Lagoon in 2011**

*Robert Virnstein[1], Lauren Hall[2], Lori Morris[2], Robert Chamberlain[2]; [1]Seagrass Ecosystems Analysts, [2]St. Johns River Water Management District*

In 2010-2011, the Indian River Lagoon, FL experienced a phytoplankton bloom of a marine microflagellated green alga. Chlorophyll a levels increased more than an order of magnitude. Light extinction coefficients increased by a factor of 4-5. Seagrass declined. In one stretch of about 60 km, virtually ALL the seagrass disappeared (maps are pending). The severity and extent of the phytoplankton bloom and subsequent seagrass loss are unprecedented. Recovery is unpredictable.

## Local Restaurants

| Restaurant Name | Phone | Description |
|---|---|---|
| *Beaufort Grocery | 252-728-3899 | Fine dining, deli and catering |
| *Clawson's 1905 Restaurant & Pub | 252-728-2133 | Casual dining in historic building features seafood, steaks, ribs, homemade soups |
| Coastal Cafe & Coffee | 252-838-1460 | Serving Breakfast and Lunch and featuring wide variety of coffees |
| *Finz Grill and Eatery | 252-728-7459 | Sandwiches and seafood inside on the deck |
| No Name Pizza & Subs | 252-728-4978 | Pizza, subs, gyros, burgers |
| *Net House Steam Restaurant | 252-728-2002 | Steamed, lightly fried and broiled seafood |
| *Queen Anne's Revenge | 252-504-7272 | Local seafood, fresh salads, pizza, craft beer |
| Cool Fish Bar and Grill | 252-728-3335 | Seafood, Steaks, and Drinks |
| Sandbar Restaurant | 252-504-7263 | Indoor/Outdoor waterfront dining at Town Creek Marina |
| *The Boardwalk Cafe | 252-728-0933 | Breakfast, lunch and dinner |
| *Spouter Inn | 252-728-5190 | Seafood, pasta, daily specials on Taylor's Creek |
| *Front Street Grill at Stillwater | 252-728-4956 | Fine Dining overlooking Taylor's Creek |
| *Sharpies Grill | 252-838-0101 | Fine Dining, large wine list-closed for season |

**Local Area Map**

**NOTES**