Southeastern Estuarine Research Society
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Semi-annual Meeting

March 7—9, 2019

Contributing over 40 years of estuarine and coastal research and management in the southeast

Center for Marine Science
University of North Carolina Wilmington
Wilmington, North Carolina

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: www.SEERS.org

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Southeastern Estuarine Research Society
March 7—9, 2019
Center for Marine Science, University of North Carolina Wilmington
5600 Marvin K Moss Lane, Wilmington, NC

Schedule at a Glance

Thursday, March 7

3:30 p.m. -- 6:00 p.m.	Registration
5:00 p.m. – 6:30 p.m.	Welcome Reception Hors d'oeuvres & beverages
6:30 p.m.	Welcome Remarks: Cassondra Armstrong, SEERS President Devon Eulie, UNCW, Local Host
6:45 p.m. - 7:30 p.m.	Keynote Address: **"Resilience Rising: Integrating Multidisciplinary Perspectives for Improving Ecosystem Resilience"** *Jess Whitehead, PhD, North Carolina Sea Grant*

Friday, March 8

8:00 a.m. – 9:30 a.m.	Student Networking Event and Breakfast
8:00 a.m. – 9:00 a.m.	Registration Coffee (for all attendees; hotels have continental breakfast)
9:30 a.m. – 9:40 a.m.	Welcome/Announcements
9:45 a.m. – 11:15 a.m.	Session 1: Special Session—Art of Resilience
11:30 a.m. – 1:00 p.m.	Lunch (for all attendees) Poster Set-up
1:00 p.m. – 2:15 p.m.	Session 2 Organismal Ecology and Ecosystem Processes
2:15 p.m. – 2:45 p.m.	Break

Friday, March 8, continued

2:45 p.m. – 3:45 p.m.	Session 3 Wetlands and Ecosystem Processes
3:50 p.m. – 4:30 p.m.	Break
4:30 p.m. – 6:00 p.m.	Poster Reception (presenters should stand by their posters – judging will take place at this time)
6:15 p.m.	Shuttles to the USS North Carolina and Dinner Banquet
6:30 p.m. – 10:00 p.m.	Dinner Banquet
9:00 pm	Shuttles start returning to hotels and UNCW

Saturday, March 9

7:45 a.m. – 8:30 a.m.	Breakfast (for all meeting attendees)
8:25 a.m. – 8:30 a.m.	Welcome/Announcements
8:30 a.m. – 9:45 a.m.	Session 4 Hydrodynamics and Ecosystem Processes
9:45 a.m. – 10:15 a.m.	Break
10:15 a.m. – 11:15 a.m.	Session 5 Water Quality and Ecosystem Processes
11:15 a.m. – 12:15 p.m.	Closing Remarks Business Meeting and Award Presentations

During registration times, breaks, and lunch, Please be sure to check out the SEERS gear available for purchase. They make great gifts!

Sales help to support student travel awards

SEERS would like to thank the following for their contributions to this meeting:

Our Sponsors:

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Our Local Host:

Devon Eulie, Ph.D., Assistant Professor
Department of Environmental Sciences, UNCW

Session Moderators and Anonymous Judges

SEERS Congratulates our Student Travel Award Winners:

Shannon Gregory – Clemson University
Allison Hartnett – Flagler College
Michael Laird – Augusta University
Chris Moore – East Carolina University
Courtney Morrison – Augusta University

Be sure to stop by the sponsor exhibition tables and say thank you to all our sponsors for their support of the Spring 2019 Meeting!

Thanks to our generous sponsors for their support!

Many thanks to instiutions that make up the Center for Marine Sciences at UNCW; our meeting would not have been possible without the donation of meeting spaces and facilities.

COASTAL CAROLINA UNIVERSITY
School of the Coastal Environment

Graduate Studies in Coastal & Marine Systems Science

https://www.coastal.edu/cmss/

M.S. in Coastal Marine & Wetland Studies	**Ph.D. in Marine Science: Coastal and Marine Systems Science**
Track culminating in an original research thesis OR Non-thesis track that includes additional coursework and may entail an internship or special project(s).	Facilitates students to work with faculty on original research expanding and applying knowledge of coastal systems.


WRIGHTSVILLE BEACH BREWERY
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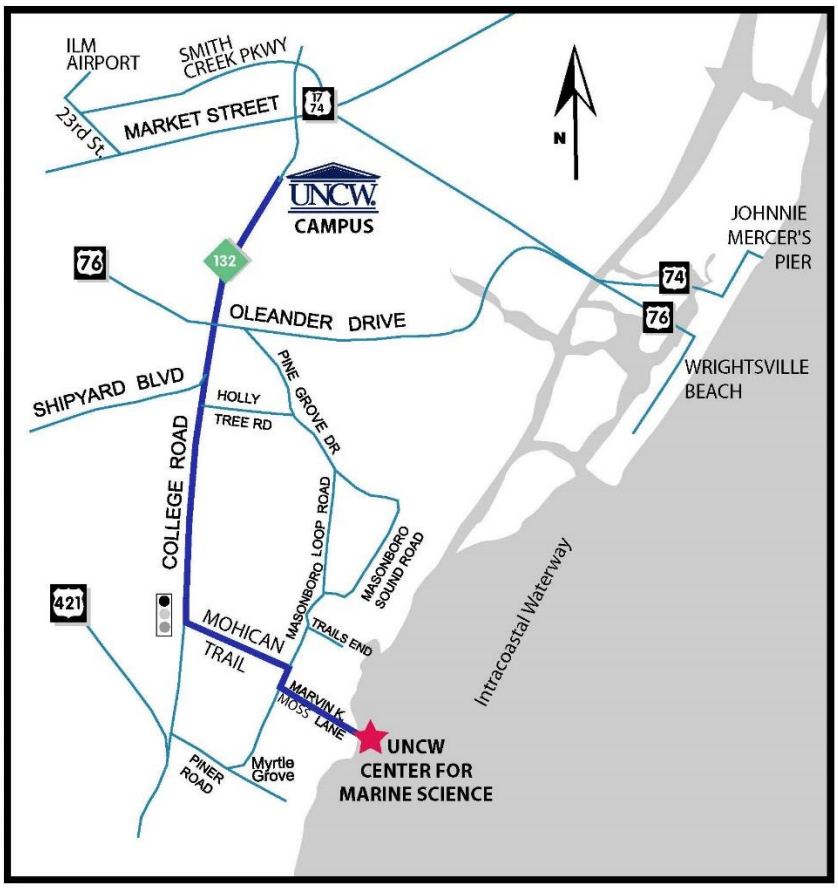
Directions to UNCW-Center for Marine Science

Travel 132 South (College Road) to the traffic light at **Mohican Trail**. Make **LEFT** onto Mohican, continuing straight until it ends at **Masonboro Loop Road**. Turn **RIGHT** onto **Masonboro Loop Road**. **Marvin K. Moss Lane** is about ½ mile on the **LEFT**. Our facility is at the end by the Intracoastal Waterway



Thursday Keynote Speaker:

Jess Whitehead, Ph.D., *Coastal Communities Hazards Adaptation Specialist, North Carolina Sea Grant*
Keynote Address: *Resilience Rising: Integrating Multidisciplinary Perspectives for Improving Ecosystem Resilience*

Biosketch: Jess Whitehead assists coastal users with integrating information about resilience to coastal weather and climate hazards into their decision-making processes. Her overall approach to her work is to facilitate collaboration among coastal decision-makers that help them integrate adaptive environmental, social, and economic solutions to improve whole community resilience. Whitehead's recent projects have included exploring the intersection of water, wastewater and public health risks of storms in Morehead City, NC. She also partners with the Town of Nags Head in developing implementation priorities to make public infrastructure and resources more resilient to sea level rise over the next 10 to 30 years. She is assisting with the development of public-private partnerships to improve risk communication and disaster recovery on Hatteras Island and throughout North Carolina as the state recovers from Hurricane Florence. Recently, she has also become more interested in using the arts to improve community understanding of and engagement with resilience. She was the science interpretation advisor on the RISING exhibition, which features fine art photography by photographer Baxter Miller and oral histories of coastal change in North Carolina collected by Ryan Stancil and Barbara Garrity-Blake, informed by coastal science and integrated in a multimedia experience. Prior to joining North Carolina Sea Grant, Whitehead was the regional climate extension specialist for the South Carolina Sea Grant Consortium, North Carolina Sea Grant and CISA. She earned her doctorate in geography and Master of Science degree in meteorology from the Pennsylvania State University. She also earned a Bachelor of Science degree in physics with a concentration in meteorology from the College of Charleston.

PLATFORM PRESENTATIONS

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

Friday, March 8

9:45 a.m. – 11:5 a.m. Session 1 Special Session – Art of Resilience

Moderator: Mackenzie Taggart, University of North Carolina Wilmington

9:45 **Experimental thin-layer sediment application to low-lying and fragmented marshes in North Carolina**
Carolyn Currin and Jenny Davis, NOAA NCCOS Beaufort Lab

10:00 **Surface elevation tables as sentinels of coastal resilience**
Jenny Davis, Carolyn Currin, and Anna Hilting, NOAA NCCOS Beaufort Lab

10:15 **Resilience of shoreline protection methods to Hurricane Florence**
Devon Eulie, Mariko Polk, University of North Carolina Wilmington; Rachel Gittman, East Carolina University; and Carter Smith*, University of North Carolina-Chapel Hill*

10:30 **Tidal marsh vulnerability to rising sea level along the southern coast of North Carolina: A 30-year record of change**
Elena Solohin, Taehee Hwang, and Christopher B. Craft, Indiana University*

10:45 **Ex-seeding expectations: Quantifying *Z. marina* seed quality over time**
Avonelle Combs, Jessie Jarvis, and Judson Kenworthy, University of North Carolina Wilmington*

11:00 **Multi-stressor effects of ultraviolet light, temperature, and salinity on the toxicity of Deepwater Horizon oil in the larval grass shrimp *Palaemonetes pugio***
*M.E. DeLorenzo, NOAA; C. Jean**, American University; P.B. Key, K.W. Chung, and E.F. Wirth, NOAA*

11:15 **Discussion/Closing Remarks**

11:30 a.m. – 1:00 p.m. LUNCH (all meeting attendees)

Friday, March 8, continued

1:00 p.m. – 2:15 p.m. Session 2 Organismal Ecology and Ecosystem Processes

Moderator: Sarah Benson, University of North Carolina Wilmington

1:00 **Settlement response of *Crassostrea virginica* in proximity to shellfish mariculture**
*Jessica Carlton**, Troy D. Alphin, and Martin H. Posey, University of North Carolina Wilmington*

1:15 **Living shorelines in Northeast Florida buffer erosion caused by high energy storm events**
*Taryn Chaya**, Flagler College*

1:30 **Prevalence of microfiber plastic in crab stomach and the Matanzas River Estuary**
*Racheal Cecil** and Ed McGinley, Flagler College*

1:45 **Using parasite diversity to quantify the success of coastal habitat restoration**
Christopher Moore and April Blakeslee, East Carolina University*

2:00 **Ecological consequences of Hurricane Florence in Masonboro Sound, North Carolina**
Aaron Ramus and Larry Cahoon, University of North Carolina Wilmington*

2:15 p.m. – 2:45 p.m. BREAK (coffee/snacks)

2:45 p.m. – 3:45 p.m. Session 3 Wetlands and Ecosystem Processes

Moderator: Shannon Gregory, Clemson University

2:45 **Investigation of the structure and persistence of temperate and sub-tropical seagrasses located at the transition zone between their geographic distributions**
Amy Bartenfelder, Jessie Jarvis, Judson W. Kenworthy, University of North Carolina Wilmington; and Brandon Puckett, NC National Estuarine Research Reserve*

3:00 **Changes in carbon storage of an Eastern North Carolina pocosin following phosphorus addition**
Sydni Law and Enrique Reyes, East Carolina University*

Friday, March 8, continued

3:15 Effects of removed carbonic anhydrase activity on estuarine benthic microalgal communities
Eilea R. Knotts, University of South Carolina and James L. Pinckney, Baruch Institute for Marine and Coastal Sciences*

3:30 Quantifying relationships within water quality and land use using statistical machine learning to improve resource management, policy, and planning
Tricia Kyzar, University of Florida*

3:45 Closing Remarks/Announcements

3:50 p.m. – 4:30 p.m. BREAK

4:30 p.m. – 6:00 p.m. POSTER SESSION

6:30 p.m. – 10:00 p.m. DINNER BANQUET/SOCIAL

Saturday, March 9

7:45 BREAKFAST/COFFEE (for all meeting attendees)

8:25 Welcome and Announcements
Cassondra Armstrong, SEERS President; Jessica Reichmuth, SEERS Program Chair

8:30 a.m. – 10:15 a.m. Session 4 Hydrodynamics and Ecosystem Processes
Moderator: MacKenzie Taggart, University of North Carolina Wilmington

8:30 Death by a thousand cuts: Restoring Dover Creek by closing Noyes Cut in the Satilla River estuary
Clay L. Montague, University of Florida

8:45 It all started at a SEERS meeting: Researchers and citizen scientists join forces to investigate multi-decadal issues in the Satilla Estuary, GA
A.Loren Mathews, Risa A. Cohen, John Carroll, Georgia Southern University; Amy Abdulovic-Cui, Chris Bates, Stacy Bennetts, Jeffrey Fischer, Joseph Hauger, Bruce Saul, and Jessica M. Reichmuth, Augusta University

Saturday, March 9 – Continued

9:00 **Floats and codes: Using an Arduino-based GPS-tracking sonde to measure hydrologic flow in an estuary**
*Courtney Morrison**, Michael Laird**, Joseph Hauger, and Jessica M. Reichmuth, Augusta University*

9:15 **Codes and floats: Developing and testing an Arduino-based GPS-tracking sonde**
*Michael Laird**, Courtney Morrison**, Joseph Hauger, and Jessica M. Reichmuth, Augusta University*

9:30 **Satilla's towering *Spartina***
*Stacy T. Bennetts, Shandon Johnson**, and Jessica M. Reichmuth, Augusta University*

9:45 – 10:15 **BREAK (coffee/snacks)**

10:15 a.m. – 11:15 a.m. Session 5 Water Quality and Ecosystem Processes
Moderator: Eilea Knotts, University of South Carolina

10:15 **Variations in *Spartina alterniflora* morphology along an elevation and inundation gradient**
Q. A. Walker, CSS Inc. and C. A. Currin, NOAA NCCOS Beaufort Lab

10:30 **Influence of flow from the C-44 Canal on the water quality of the South Fork of the St. Lucie Estuary, Florida**
M. Dennis Hanisak, Kristen S. Davis, and Bryan Botson, Harbor Branch Oceanographic Institute at Florida Atlantic University

10:45 **Collective BMPs reduce pollutant loading in a coastal resort town**
Michael A. Mallin, Amy E. Grogan, and Matthew R. McIver, University of North Carolina Wilmington*

11:00 **Dissolved oxygen patterns in a heavily managed, sub-tropical estuary in south Florida (St. Lucie Estuary)**
Christopher Buzzelli, Coastal Ecosystems LLC and Peter H. Doering, Coastal Ecosystems Section, South Florida Water Management District (Retired)

11:15 a.m. – 12:15 p.m. BUSINESS MEETING & AWARD PRESENTATIONS

POSTER PRESENTATIONS

- **Presenting author is underlined**
- **Graduate student authors (*)**
- **Undergraduate student authors (**)**
- **Special Session: Art of Resilience (≈)**

POSTER PRESENTATIONS (by poster number)

1≈ Comparison of shoreline stabilization approaches within North Carolina
Kelsey Beachman, Mollie Mason*, Mariko Polk* University of North Carolina Wilmington; Carter Smith*, University of North Carolina --Chapel Hill; and Devon Eulie, University of North Carolina Wilmington*

2 Application of novel wave attenuation devices to save riparian resources
Sarah Benson, Kayla McNeilly*, Mariko Polk*, Dr. Devon Eulie, University of North Carolina Wilmington; Randy Boyd, North State Environmental; and Jim McKee, North Carolina Historical Site*

3 A diverse and abundant fish assemblage revealed using SharkCam underwater video off Cape Fear, North Carolina
*Erin J. Burge, Jessica A. Pollack**, Faith M. Saupe**, and Nicholas C. Coleman**, Coastal Carolina University*

4 Where do they goby?: The study of *Gobiosoma bosc* behavior in response to visual implant elastomer tags
*Corey Winkler**, Chris Moore*, and April Blakeslee, East Carolina University*

5 Association behavior between sand tiger sharks (*Carcharias taurus*) and round scad (*Decapterus punctatus*) may be mutually beneficial
*Nicholas C. Coleman** and Erin J. Burge, Coastal Carolina University*

6 Flatfish assemblages and population differences between the Saint Catherines Island and Satilla River Estuaries
*Kathleen Coleman**, Abigail Bickle**, Jessica Reichmuth, and Bruce Saul, Augusta University*

7≈ Evaluating the resilience of seagrass beds to disturbance in the presence of a facultative mutualist
Sarah Donaher, UNC - Chapel Hill, Institute of Marine Sciences and Rachel Gittman, East Carolina University*

8 Indicating potential intersex through vitellogenin expression in the blue crab, *Callinectes sapidus*
Shannon Gregory, Clemson University; Jessica Reichmuth, and Jennifer Cannon, Augusta University*

9 **Time series analysis of hydromedusae within a pristine estuarine system**
*Josiah Grzywacz**, University of South Carolina; Dennis Allen, Baruch Institute; and Joshua Stone University of South Carolina*

10 **Seasonal variation in Eastern oyster sex ratios**
*Juliana M. Harding and Zachary Smith**, Coastal Carolina University*

11 **Grain size distribution of a mesotidal beach with potential implications for ghost crab ecology**
*Brittany Hartley** and Bradley Craig, Coastal Carolina University*

12 **An investigation of water quality associated with a river restoration project in a subtropical temperate estuary**
*Matthew Brown, Allison Hartnett**, and Westly Woodward**, Flagler College*

13≈ **Tracking shoreline change at Fort Caswell**
Alina Herron, Marc Cruciani*, and Devon Eulie, University of North Carolina Wilmington*

14 **The effects of human approach on sanderling foraging behavior**
*Anne Hobdy** and Eric Rosch, Coastal Carolina University*

15 **MATLAB applications in Marine Science Data Visualization**
*Carson Berry** and Diane B. Fribance, Coastal Carolina University*

16 **Best management practices for post-construction restoration of rights-of-way in saltwater marshes, estuaries, and other tidally influenced areas**
Jason Christian MMC Engineering; S. Sonny Kim, Stephan A. Durham, and Iman Salehihikouei, University of Georgia*

17 **Estuarine macroinvertebrate community diversity in non-indigenous macroalga *Gracilaria vermiculophylla***
Timothy S. Lee and April M.H. Blakeslee, East Carolina University*

18 **Reconstructing anthropogenic impact in a barrier island salt marsh using multiple proxies**
Kristopher Maedke-Russell, Savannah State University; Jay Hodgson, Georgia Southern University; and Carol Pride, Savannah State University*

19 **Long-term assessment of macrobenthic estuarine communities in the Cape Fear River, NC**
Alexis Marti, Martin Posey, and Troy Alphin, University of North Carolina Wilmington*

20 **Assessment and comparison of distribution and impacts of microfiber plastics between the Northern Coast of South Carolina and Bimini, Bahamas**
*Jessica Myers**, Coastal Carolina University*

21 **An analysis of population density and body condition in the fiddler crabs (Genus: *Uca*) compared between areas of high and low levels of human disturbance**
*Ann-Marie Pase** and Eric Rosch, Coastal Carolina University*

22 **Measuring soil sulfide reactions and redox potential modifications under nutrient manipulations in a pocosin wetland**
*Blake Rogers**, Sydni Law*, and Enrique Reyes, East Carolina University*

23≈ **Vegetation, soil and pore-water characterization of saltmarshes located in Savannah, Georgia**
Iman Salehihikouei, Sung-Hee Kim, Stephan Durham, University of Georgia; Jason Christian, MMC Engineering; Katy House*, University of Georgia*

24 **Distinct personality types in *Littoraria irrorata* and the implications for predator escape behavior**
Christina Salerno, University of North Carolina Wilmington*

25 **Examining territoriality in the Atlantic ghost crab, *Ocypode quadrata*, based on burrow characteristics**
*Mackenzie Scheuermann**, and Eric Rosch, Coastal Carolina University*

26 **How nekton utilization of aquaculture varies with presence to natural habitat**
Hannah R Thurlow, Troy D Alphin, and Martin H Posey, University of North Carolina Wilmington*

27 **Community structure of epiphytic diatoms in the Satilla River Estuary**
*Elise N. Thomas** and Jessica M. Reichmuth, Augusta University*

28 **A tale of two snails: how Noyes Cut affects snail populations in the Satilla River Estuary**
*Skyler Walker** and Jessica M. Reichmuth, Augusta University*

29 **Assessing the impact of eutrophication on the relationship of *Littorina irrorata* and *Spartina alterniflora* and its ecological effects on salt-marsh estuaries**
*Lauren Wheeler**, Elise Thomas**, and Jessica M. Reichmuth, Augusta University*

30≈ Comparing the performance of alternative reef substrates in halting salt marsh erosion and supporting oyster reef development
E.H. Wellman, East Carolina University; R. K. Gittman, East Carolina University; and B.J. Puckett, NC National Estuarine Research Reserve*

31 Osmoregulation in juvenile sandbar sharks (*Carcharhinus plumbeus*) in Winyah Bay, SC
J.A. Wingar, D.C. Abel, G.E. Boneillo, Coastal Carolina University; and P.H. Yancey, Whitman College*

ABSTRACTS FOR ORAL PRESENTATIONS
(in alphabetical order by authors' last name)

Investigation of the structure and persistence of temperate and sub-tropical seagrasses located at the transition zone between their geographic distributions

Amy Bartenfelder, Jessie Jarvis, Judson W. Kenworthy, University of North Carolina Wilmington; and Brandon Puckett, NC National Estuarine Research Reserve*

Seagrasses provide critical ecosystem services to coastal areas, including nursery habitat for fisheries species, a food source for grazers, improvement of local water quality conditions, and sediment stabilization. North Carolina is located at the transition zone where *Zostera marina*, a temperate seagrass, is at its southern boundary and *Halodule wrightii*, a tropical seagrass, is at its northern limit. Climate change can alter the abundance and distribution of seagrasses, often favoring those more stress-tolerant and opportunistic. A shift towards these species in North Carolina could result in a dominance shift towards sub-tropical/eurythermal species. The number of days that water temperature exceeds the thermal tolerance of *Z. marina* has increased by 50 days since 2008. This thermal stress likely will cause a decline in the distribution, density, and biomass of *Z. marina*, while *Halodule wrightii* and *Ruppia maritima* may increase. A temporal decline in *Z. marina* cover as already been observed, with meadows that were persistent (found all 12 months) in 1978, losing their *Z. marina* cover by September in 2017 and 2018. The research described here will quantify the current status of NC seagrass meadows in order to compare the current status to historical data from the 1980s to identify dominance shifts.

Satilla's Towering *Spartina*

*Stacy T. Bennetts, Shandon Johnson**, and Jessica M. Reichmuth, Augusta University*

The purpose of this investigation is to assess and monitor the impacts of Noyes Cut before, during, and after its proposed closure by the US Army Corps of Engineers in 2018. Healthy estuaries protect productive coastlines and support diverse ecosystems through the provision of migratory routes and nursery areas for many ecologically and economically important fish and invertebrate species. The salt marsh is a key foundation for this ecosystem and serves one part of a multifaceted approach focusing on vegetative and substrate dynamics at four locations adjacent and downstream of Noyes Cut in the Satilla River Estuary (SRE). Plant species diversity, density, soil texture and chemistry parameters have been sampled since June 2014 at all locations: Todd Creek (reference), Parsons Creek, Piney Bluff Node (adjacent to Noyes Cut), and Noyes Cut (human-made). Silt has accumulated significantly in the past 80+ years since Noyes Cut was constructed, supporting observations of disrupted water flow. Due to this abundance of nutrient rich silt, *Spartina alterniflora* is significantly taller and denser at Noyes Cut than the other sites. However, plant diversity is highest in the sandier environment of Parsons Creek compared to all other the sites. With the expected closure of Noyes Cut, the silt delivery system that has been created would be shut off, with the silt being evenly distributed among the sites downstream of Noyes Cut.

Dissolved oxygen patterns in a heavily managed, sub-tropical estuary in south Florida (St. Lucie Estuary)

Christopher Buzzelli, Coastal Ecosystems LLC and Peter H. Doering, Coastal Ecosystems Section, South Florida Water Management District (Retired)

The south Florida landscape has been heavily modified with ~2000 km of canals radiating from Lake Okeechobee, intensive agriculture, and dense coastal development. The St. Lucie Estuary (SLE) is a managed water body to the east of the Lake discharging to the southern Indian River Lagoon and Atlantic Ocean. The extensively developed upstream and coastal watersheds of the SLE result in a disproportionately large amount of nutrient loading into the relatively small estuary (22 km2). These circumstances can promote phytoplankton blooms and bottom water hypoxia (<3.0 mg L-1) in many estuaries. This study examined dissolved oxygen (DO) patterns and the potential for hypoxia in the North Fork of the SLE. Vertical profiles of temperature, salinity, DO, in situ chlorophyll a, pH, and turbidity were obtained at 18 locations across the 10 km2 area approximately monthly from May 2016 to Nov 2017. Recordings were averaged at 0.25 m vertical increments and used to examine spatial patterns, assess seasonality, and estimate hypoxic volume in the North Fork. Hypoxia occurred in 64 of of 2327 (2.8%) observations among the 16 surveys. Most of these observations were from near-bottom in June, July, and August 2017 and accounted for ~1.5 x 106 m3 of hypoxia, or, 0.6% of the total North Fork volume.

DO concentrations declined with increasing temperature but were unrelated to inflow, salinity, or in situ chlorophyll a. A DO budget constructed for the North Fork pointed to combined mixing and flushing as the physical mechanisms which suppress hypoxic conditions.

Settlement response of *Crassostrea virginica* in proximity to shellfish mariculture
*Jessica Carlton**, Troy D. Alphin, and Martin H. Posey, University of North Carolina Wilmington*
Oysters have played an important role in the history and heritage of North Carolina, and wild populations have been on the decline throughout their range since the late 1800's. Shellfish cultivation can be a useful strategy for reducing the pressure on wild resources and enhancing coastal economies that have been negatively impacted by the loss of wild resources. The increase in oyster cultivation has raised questions regarding their potential influence on wild shellfish health and ecosystem services through the addition of structure and increased biomass. One concern is that these activities will interfere with oyster larval settlement. The purpose of this study was to investigate spat settlement with proximity to oyster (*Crassostrea virginica*) cultivation operations within the North Carolina National Estuarine Research Reserve at Masonboro Island, NC. The operations are relatively small, ~2 acres with roughly 400K oysters in cages. Spat settlement tiles were placed within wild oyster reefs adjacent to the oyster cultivation sites, at control reefs, and reefs within an adjacent embayment containing no oyster cultivation. Racks were deployed in 2017 and 2018 (from June – December) to target peak settlement periods. Settlement patterns show clear annual variation and pre and post storm impacts are evident, but there has been little evidence of a settlement response with proximity to cultivation operations.

Prevalence of microfiber plastic in crab stomach and the Matanzas River Estuary
*Racheal Cecil** and Ed McGinley, Flagler College*
In 2017 the US produced 50.4 metric tons of resin plastic. Plastic is prone to accumulation because it can never fully break down therefore remains persistent in the environment. Studies demonstrate marine organisms consume plastic and when that plastic is fragmented, the potential for ingestion increases. Contamination in controls has been a recurring issue with similar studies that have been conducted. The goal of this study was threefold: 1) Develop a method to reduce contamination in our lab, 2) catalog the microplastic presence in the Indo-Pacific swimming crab (*Charybdis hellerii*), and 3) quantify the deposition of microplastic fibers/particles in the Matanzas River Estuary. Results indicate an average of 0.5 fibers per control. Fibers were found in our reagents and when prefiltered, a dramatic decrease in fibers were found in the controls. This indicates that the reagents themselves may be a source of contamination in microplastic studies. Plastic fibers >5 mm and <5mm have been found inside the stomachs of Indo-Pacific swimming crabs but no micro fragments were found. The average number of plastic fibers per crab stomach before correcting for contamination was 0.67 and for crab gills it was 0.56. After correcting the stomachs had 0.17 and the gills 0.06. Finally, the average pieces of plastic per liter of water near Fort Matanzas was 1.24 and near the wastewater treatment plant effluent it was 3.73 suggesting this effluent could be a source of microplastic pollution.

Living shorelines in Northeast Florida buffer erosion caused by high energy storm events
*Taryn Chaya**, Flagler College*
Constructed oyster reefs or "living shorelines" can protect against erosion and loss of habitat, but can they prevent erosion during high-energy storm events such as hurricanes? Oyster reefs were constructed at the Guana Tolomato Matanzas National Estuarine Research Reserve (GTM Research Reserve) in Northeast Florida to stabilize the shoreline sediment and prevent the erosion of an archeological site. Sediment cores (~22 cm) were collected behind constructed oyster reefs at the GTM Research Reserve before and after hurricanes Matthew (2016) and Irma (2017) to study changes in sediment particle size distribution due to these high-energy storms. Pre-hurricane data was collected in 2016 from three different constructed reefs, as well as three control sites where no reef is present. Pre-hurricane sediment profiles behind the constructed reefs consist of the finer sediments, ~35.9% silt and clay, in the surface ~10-12 cm, with decreasing silt and clay (~17.9%) and increasing sand content as depth increases. This is significantly different than the sediment from the control sites with ~4.3% silt and clay in all depths sampled. Like the sediment profiles before the high energy storms, the recently collected sediment data shows a clear layer of finer sediment ~10-12 cm over coarser sediment. Although they were high-energy storms, Hurricanes Irma and Matthew did not significantly mix the sediment behind the constructed oyster reefs at the GTM Research Reserve. Sediments remained stable during these storms but may not remain

stable during the next storm without some intervention because the oyster reefs sustained significant damage.

Ex-seeding expectations: Quantifying *Z. marina* seed quality over time

Avonelle Combs, Jessie Jarvis, and Judson Kenworthy, University of North Carolina Wilmington*

As anthropogenically driven climate change continues to occur, warming ocean temperatures call into question natural resilience provided by seed banks of temperate seagrass *Zostera marina* Temperature related stress events have resulted in large scale die-offs of *Z. marina* near to the species southernmost limits along the North American east coast. Recovery was initiated from seed germination from the sediment seed bank. To understand the natural variability in seed quality (e.g. viability) in *Z. marina* meadows and the impacts of that variation on seed bank function and meadow resilience, seeds were collected from three seagrass meadows near Hampstead NC. Seeds were collected during the flowering season (March-May) to categorize seed size (length (mm), width (mm), weight (mg)) and composition (protein (%), starch (mg/L)) Additional seeds were collected during the period of maximum flowering in May and examined for lipid concentration based on seed size. Finally, seeds were kept in controlled conditions to measure change in viability over time to quantify impacts of time on seed persistence. Information on basic seed physiology collected as part of this research on resilience provided by seed banks, will help coastal policy makers make more effective decisions concerning seagrass conservation and management.

Experimental thin-layer sediment application to low-lying and fragmented marshes in North Carolina

Carolyn Currin and Jenny Davis, NOAA NCCOS Beaufort Lab

Salt marshes are vulnerable to a variety of physical, biological, and geological drivers, including rising sea level, increased erosion, marsh dieback, and pond formation. On Marine Corps Base Camp Lejeune in North Carolina, results from an 8-year monitoring and research study identified salt marshes adjacent to the Atlantic InterCoastal Waterway as being especially at risk. Low-lying marshes in one area were vulnerable to increased inundation, while in another location marshes higher in the tidal frame were vulnerable to pond formation and shoreline erosion. In 2017, a thin-layer application (8-15 cm) of dredged sediment was added to 300 m2 treatment plots in low-lying *Spartina alterniflora* salt marsh. Control and untreated plots were also established. Surface elevation, *S. alterniflora* stem density and height, and porewater chemistry were monitored on a bimonthly basis. The treatment plots showed a positive plant response to the sediment application, as well as increased porewater nutrients. In April 2018, a dredged sediment application (20-25 cm) was made to an isolated pond in a fragmented *S. alterniflora* marsh, and in June was planted with *Spartina alterniflora*. A 2x2 factorial design was used to test the effects of fertilizer and clumped planting design on transplant stem density and height. Fertilizer had a significant positive impact on plant growth, while there was no difference in row vs. clumped planting. Lessons learned and an evaluation of thin-layer sediment application approaches to increase marsh resilience will be presented.

Surface elevation tables as sentinels of coastal resilience

Jenny Davis, Carolyn Currin, and Anna Hilting, NOAA NCCOS Beaufort Lab

Surface Elevation Tables (SETs) provide a mechanism for tracking changes in marsh surface elevation with mm-scale resolution. The use of SETs as a monitoring tool has increased exponentially over the past decade in response to concerns over the ability of coastal marshes to keep up with relative sea level rise (RSLR). In this presentation, we describe a nascent effort to build a statewide network of SETs in North Carolina for the purpose of monitoring marsh surface elevation across the state's coastal plain. The ultimate goal of this effort is to shed light on the drivers of marsh surface elevation change and how they vary across geomorphic settings, tidal regimes, and vegetation types. We also present preliminary results from a subset of these devices in which we compare rates of marsh surface elevation change to local changes in sea level. The SETs included in this analysis all have associated data records of 10-14 years and are installed across a range of marsh settings that include both *Juncus romerianus* and *Spartina alterniflora* dominated-marshes. Results to date indicate that few of these sites have increased in elevation at a pace that is commensurate with local RSLR rates during the study period. These results illustrate the value of SET networks and long term data records for predicting the resilience of coastal marshes.

Resilience of shoreline protection methods to Hurricane Florence

Devon Eulie, Mariko Polk, University of North Carolina Wilmington; Rachel Gittman, East Carolina University; and Carter Smith*, University of North Carolina—Chapel Hill*

The popularity of nature-based approaches to coastal resilience, such as living shorelines, has increased substantially over recent years. Recent studies have addressed some of the ecosystem services and erosion control benefits of these approaches in comparison to more traditional hard structures. However, one of the challenges in designing shoreline protection methods is the spatial and temporal variability associated with natural and anthropogenic drivers of erosion. One example is the impact of high-intensity, but low-frequency events such as hurricanes. On September 13, 2018, Hurricane Florence made landfall as a strong category 1 in New Hanover County, North Carolina, then moved south along the coast over the next three days. During that time it produced rainfall in excess of 50 cm and a storm surge of 3 m in some areas. This project collected post-storm data in the form of RTK-GPS surveys of shoreline position at previously occupied living shoreline and natural control sites across North Carolina. Many of those sites were surveyed for shoreline position and other physical and ecological characteristics in July and August of 2018, as part of another project, presenting a unique opportunity to assess the impact of the storm on these living shoreline sites. The original baseline survey data and preliminary post-storm results are presented here. Overall, living shorelines were found to not be significantly impacted by the Hurricane Florence storm event.

Influence of flow from the C-44 Canal on the water quality of the South Fork of the St. Lucie Estuary, Florida

M. Dennis Hanisak, Kristen S. Davis, and Bryan Botson. Harbor Branch Oceanographic Institute at Florida Atlantic University

The St. Lucie Estuary (SLE) is a part of the larger Indian River Lagoon (IRL) system, one of the most diverse estuarine environment in North America. Over the last 100 years, the SLE and its watershed have been modified to allow navigation, flood control, and water supply. Intermittent freshwater discharges from Lake Okeechobee via the C-44 Canal have negatively impacted the SLE and the connected Indian River Lagoon, including severe reductions in salinity; elevated turbidity, nutrients, and contaminants; and increasingly harmful algal blooms of the cyanobacterium *Microcystis*. Continuous real-time monitoring of water quality by the Indian River Lagoon Observatory Network of Environmental Sensors (IRLON; https://fau.edu/hboi/irlo/irlon.php) for two years (May 2016-April 2018) revealed that water quality in the South Fork of the SLE near the S-80 lock on the C-44 canal changes rapidly with discharges from Lake Okeechobee. The location of IRLON's SLE-SF2 site is unique compared to other IRLON sites because conditions can change rapidly based on the flow, or lack of flow, of freshwater from the C-44 canal. The parameters most impacted in the SLE are salinity, pH, phosphate, and dissolved oxygen. During periods of heavy discharge, salinity plummets and the site is in essence a flowing river of fresh water. However, when there are prolonged periods without flow, the site is essentially a stagnant brackish lake, with increasingly anoxic conditions as time since discharge increases. When precipitation occurs, and the S-80 is not discharging, this site is positioned to capture the effects of local runoff, such as the spike of phosphate levels during the first flush in June 2017. These high-frequency, continuous observatory data are enabling better quantification and modeling of relationships between environmental factors and biological processes in an estuary with tremendous climate-related interannual variability These real-time data enable researchers to follow environmental changes in the SLE and IRL, assist resource and planning managers to make informed decisions, model and correlate environmental data to biological, chemical and physical phenomena, and contribute to education and public outreach on the lagoon.

Multi-stressor effects of ultraviolet light, temperature, and salinity on the toxicity of Deepwater Horizon oil in the larval grass shrimp *Palaemonetes pugio*

*M.E. DeLorenzo, NOAA; C. Jean**, American University; P.B. Key, K.W. Chung, and E.F. Wirth, NOAA*

The early life stages of marine organisms have been found to be the most vulnerable to developmental toxicity from polycyclic aromatic hydrocarbons (PAHs), which are constituents of naturally weathered crude oil. PAHs are known to increase in toxicity in marine organisms by 10 to 100 times in the presence of ultraviolet (UV) light. The purpose of this research is to determine the role abiotic stressors such as UV light, temperature, and salinity play on the survival of grass shrimp larvae in co-exposure with oil. The study will examine effects of dissolved oil (high energy water accommodated fractions (HEWAF)), under UV and no UV light conditions, and climate change stressors such as high temperature, and high and low

salinity conditions on larval grass shrimp mortality during 96 hour duration tests. The research shows that the presence of UV light magnified the toxicity of crude oil approximately 6-times compared to no UV conditions. UV light combined with a high temperature of 32 ℃ resulted in a 6.67-fold increase in oil toxicity compared to the 4.5-fold increase in toxicity under the standard temperature of 25 ℃. At 10 ppt, mortality increased more under UV conditions than no UV conditions. UV light combined with climate change stressors had a significant effect on the photo-induced toxicity of crude oil. Although estuarine organisms are adaptable, climate change will affect the estuaries these organisms live in by changing salinity levels and increasing thermal stress, which may alter how estuarine organisms take up and metabolize contaminants.

Effects of removed carbonic anhydrase activity on estuarine benthic microalgal communities
Eilea R. Knotts, University of South Carolina and James L. Pinckney, Baruch Institute for Marine and Coastal Sciences*
Recent studies have focused on carbon concentrating mechanisms and enzymes associated with them (e.g. carbonic anhydrase) to better understand the efficiency of carbon fixation and its uptake rates in photoautotrophs. Benthic microalgae (BMA) and benthic diatom mats are currently associated with carbon limitation, but how global carbon changes may affect those communities has only been explored to a limited extent. The purpose of this research was to examine BMA community responses to removed carbonic anhydrase (CA) activity using an inhibitor, ethoxyzolamide. Microcosm experiments were performed on intertidal muddy sediments from North Inlet Estuary, SC. Exposure to ethoxyzolamide resulted in a reduction of primary productivity without a reduction in total BMA biomass. Furthermore, removed CA activity caused BMA cumulative production to shift toward the surface in the sediment column. Active CA is necessary to maintain high production rates in these communities and allows motile BMA to use a wider portion of the sediment column. Given the well-documented role of BMA in the trophodynamics of estuaries, if global carbon changes lead to higher CO2 availability at the sediment-air interface, structure and function of these BMA systems may change.

Quantifying relationships within water quality and land use using statistical machine learning to improve resource management, policy, and planning
Tricia Kyzar, University of Florida*
High nutrient loads are a consistent problem in many waterbodies in Florida. These can lead to harmful algal blooms, increased bacterial concentrations, restricted fishing and shellfish harvesting areas, and even waterbody closures. Additionally, it is difficult in complex ecosystems, to find a definitive source or sources of elevated nutrient levels. Runoff from agricultural areas, residential neighborhoods and leaky septic tanks are commonly seen as the largest land use type contributors to nutrient pollution. While many studies have looked at relationships between land use type and nutrient concentrations in adjacent waterbodies, it has been difficult to quantify these relationships because of the many contributing factors. This project applies multiple methods of statistical machine learning (SML) to land use data and water sampling data collected over a 5-year period, from four collection locations within a coastal research reserve in northeast Florida. The SML methods include Multiple Linear Regression, Lasso, Principal Components Regression, Partial Least Squares and Random Forest, each using five-fold cross-validation to calibrate tuning parameters and evaluate out-of-sample prediction error. Applying SML methods to water quality and land use datasets is not yet widely practiced and comparing results from multiple methods can provide valuable information on 1) how well SML methods predict relationships within water quality and land use parameters, and 2) what is the quantified nature of those relationships. Statistical Machine Learning provides improved modeling over traditional statistical modeling by learning from the data itself about the affect and effect between variables as opposed to applying rules to the data and formulating an outcome. This research presents new information to modeling the relationships within water quality and land use types that can contribute to improved decision making for water management strategies, land use planning, and policy making.

Codes and floats: Developing and testing an Arduino-based GPS-tracking sonde
*Michael Laird**, Courtney Morrison**, Joseph Hauger, and Jessica M. Reichmuth, Augusta University*
We have developed and tested a Lagrangian style surface drifting sonde capable of recording position and time for deployments lasting several days using an Arduino-based microcontroller interfaced to a Botletics LTE-M Global Positioning System (GPS) sensor with real-time transmission capability. The

electronics are housed in a floating, waterproof enclosure and periodically transmit location and time data via Message Queuing Telemetry Transport (MQTT) to a website where information is stored for analysis. Because the location is transmitted in real-time, the device can be retrieved at the end of the sampling period. Design parameters including the housing, electronics, and power-saving techniques will also be presented.

Changes in carbon storage of an Eastern North Carolina pocosin following phosphorus addition
Sydni Law and Enrique Reyes, East Carolina University*
Wetlands store ~25-30% of the earth's soil pool of carbon. Seventeen percent of the US' wetlands are found in North Carolina (NC) and 70% of NC's freshwater wetlands are pocosin peatlands. Pocosins are known for their thick peat layers that store substantial amounts of carbon and other nutrients, particularly nitrogen. Since the 1920s, 50% of NC's pocosins have been degraded for agricultural purposes. This research was carried out in a pocosin peatland located on East Carolina University's West Research Campus (ECU-WRC) that drains into the Neuse and Tar Rivers, contributing to downstream river health by retaining large amounts of nutrients. The aim of this research was to determine how these freshwater ombrotrophic peatlands budget and store carbon when the availability of phosphorus, the limiting nutrient, increases following different fertilization treatments. CO2 concentrations were collected from static greenhouse gas chambers at set time intervals to calculate CO2 flux, an indicator or net ecosystem metabolism and overall carbon storage in plant tissue and soil. Above- and belowground biomass was collected and burned to determine carbon lost on ignition and respective biomass allocation. Comparisons of biomass allocation and CO2 flux between treatments were used to determine how increasing phosphorus availability in the soil changed the overall carbon budget of this wetland. Results showed that increasing the limiting nutrient in pocosins initially decreases the flux of carbon as CO2 out of the system under low PO4 fertilization, but as PO4 concentrations increase, so does the CO2 flux. Demonstrating changes in carbon budgeting within a pocosin following nutrient application can provide insight into the fate of degraded peatlands and their potential influence on rivers downstream, such as the ones that occur along the southeastern Coastal Plain of the U.S.

Collective BMPs reduce pollutant loading in a coastal resort town
Michael A. Mallin, Amy E. Grogan, and Matthew R. McIver, University of North Carolina Wilmington*
The Town of Wrightsville Beach, N.C. is an island resort community with beaches and other waterways used by the public for water-contact recreation. This community has had elevated fecal bacteria counts in some local waterways, and waterways adjacent to but outside of the town boundaries have had shellfish bed closures due to elevated bacteria counts. To combat such pollution the town collaborated with the North Carolina Coastal Federation, the University of North Carolina Wilmington, and various engineering firms to install various best management practices (BMPs) designed to retain, treat, and reduce stormwater discharges to local estuarine waters during 2014 through 2018. These BMPs include a series of low-cost rain gardens and water retention structural modifications, replacement of standard pavement with pervious pavement, and two types of installed infiltration devices. Depending on the BMP, stormwater load reductions of 40-90% were achieved, TSS load reductions of 40-99% were achieved, and a new set of BMPs reduced TN and TP loads by 86% and 70%, respectively. The latter is particularly important as coastal waters are quite nutrient-sensitive. The major unifying factor among the BMPs is taking advantage of sand, porous coastal media, as part of the design. Some BMPs do not necessarily reduce pollutant parameter concentrations, but the reduction in load is a very significant factor in improving receiving water quality. Challenges to such coastal BMPs is local buy-in from the town management and affected property owners, regulatory agency approvals, and approval from impacted highway departments and utility companies.

It all started at a SEERS meeting: Researchers and citizen scientists join forces to investigate multi-decadal issues in the Satilla Estuary, GA
A.Loren Mathews, Risa A. Cohen, John Carroll, Georgia Southern University; Amy Abdulovic-Cui, Chris Bates, Stacy Bennetts, Jeffrey Fischer, Joseph Hauger, Bruce Saul, and Jessica M. Reichmuth, Augusta University
Eight artificial cuts were made through the marshlands of the Satilla River Estuary, Georgia (USA) in the early 1900s to improve navigation and facilitate timber transport. Although the cuts are no longer all maintained for their original purposes, their long-term impacts on the flow and quality of water and

resulting habitat suitability are still in question today. For decades, local interest groups have raised concerns about shoaling problems resulting from the shifting channel configurations. Subsequent investigations have repeatedly identified Noyes Cut as the primary cause of increased sedimentation, disturbed salinity gradients, and decreased water quality in the Dover-Umbrella-Parsons Creek system that it connects to the Satilla River. These hydrological and physical-chemical changes are believed to negatively impact the abundance and distribution of commercially and recreationally valued fish, crabs, and shrimp as well as the organisms that they feed or otherwise depend on. A presentation on these issues at the spring 2013 SEERS meeting launched a collaborative holistic assessment of the ecological effects of Noyes Cut by researchers at two universities, members of local interest groups, and a multitude of citizen scientists and student volunteers. Since June 2014, monthly sampling events have identified spatial and temporal patterns in both bottom-up parameters (e.g., water chemistry and flow, light availability, phytoplankton abundance, salt marsh plant diversity, and sediment microbial diversity) and top-down forces (e.g., fish/mobile invertebrate diversity, crustacean population structure, and food web analysis). The project continues to bring attention to issues related to the pending federal restoration plans for the area.

Death by a thousand cuts: Restoring Dover Creek by closing Noyes Cut in the Satilla River estuary

Clay L. Montague, University of Florida

Thousands of navigation cuts connect tidal creeks in estuaries. Some degrade fish habitat. Closing certain cuts may achieve effective restoration. Doing so is easier when a damaging cut is obsolete, a responsible party is willing, and locals support the idea. Noyes Cut in the Satilla River estuary connects the main estuary across 0.9 km of tidal marsh to the upper reach of Dover Creek, a large marsh-creek system receiving freshwater input along the estuary's northern bank. But Noyes Cut allows an enormous volume of tidewater to enter the upper reach of Dover Creek, pushing back against the tide that enters normally from downstream. Backdoor entrance of water degrades habitat two ways: 1) sedimentation at tidal collision points creates shallows that can impede and misdirect fish migrations; and 2) obliteration of the salinity gradient destroys directional cues, likely redirecting migrating animals away from fresher headwaters. Continuously-expanding shallows also interfere with boating and fishing, so locals have complained for over 80 years. Though unmarked and obsolete, Noyes Cut remains under authority of the US Army Corps of Engineers (USACE). Encouraged by State of Georgia and Satilla Riverkeeper actions, the USACE can now use ecosystem restoration authorization to close the cut. The feasibility study is complete: cost $8 million, 75% paid by USACE; shovel ready; completion in two years; wanted by Georgia DNR, environmental nonprofits, many legislators, and local residents. Finding the 25% match is the challenge. Monitoring the outcome should spur far-reaching effort to restore habitat by closing other damaging navigation cuts.

Using parasite diversity to quantify the success of coastal habitat restoration

Christopher Moore and April Blakeslee, East Carolina University*

Trophically-transmitted parasites require multiple hosts to complete lifecycles, and parasite and host abundance are often tightly correlated. Previous studies have shown that parasite prevalence in more easily sampled intermediate hosts (e.g. mollusks, crustaceans, and small fish) has good predictive power for the community diversity of other taxa required for the parasite to complete its lifecycle (e.g. birds, fish, terrapins). In collaboration with North Carolina Sea Grant and the National Estuarine Research Reserve, we are using parasite diversity as a proxy for overall community diversity to evaluate the success of different coastal habitat restoration techniques within North Carolina's Rachel Carson Estuarine Reserve. Portions of the Reserve were restored using a block design incorporating three replicates of three different treatments: control (no restoration), shell bags, and oyster catcher material. Pre-restoration sampling of parasite diversity (January – May 2018) showed no significant differences among treatment sites, and post-restoration monitoring is on-going and planned for an additional 2-3 years. Many host organisms are elusive (e.g. diamondback terrapins), or time-intensive and costly to sample using traditional survey methods (e.g. shorebirds, large demersal fishes). However, because of the tight co-evolutionary relationship between hosts and their parasites, parasite diversity in easily collected upstream hosts can provide clear evidence that the necessary downstream hosts are recruiting to the restored habitat. Parasites thus offer a promising assessment tool for quantifying biodiversity and environmental health, particularly in sensitive ecosystems subject to frequent monitoring.

Floats and codes: Using an Arduino-based GPS-tracking sonde to measure hydrologic flow in an estuary

*Courtney Morrison**, Michael Laird**, Joseph Hauger, and Jessica M. Reichmuth, Augusta University*

Hydrologic flow in estuaries may be responsible for sediment transport, altered salinity gradients, and variations in nutrient availability. We have used a low-cost custom-built Arduino-based Lagrangian style surface drifting sonde to measure such flow in the Satilla River estuary. Our sonde is capable of recording position and time for deployments lasting several days using a Global Positioning System (GPS) sensor with real-time cell network communications capability. Results from multiple successful deployments in the Satilla River estuary will be reviewed.

Ecological consequences of Hurricane Florence in Masonboro Sound, North Carolina

Aaron Ramus and Larry Cahoon, University of North Carolina Wilmington*

Hurricane Florence made landfall in North Carolina on September 14, 2018 and passed directly over our research site in Masonboro Island NERR, where we had established experimental plots to investigate the ecological effects of the invasive seaweed *Gracilaria*. Storm surge inundated the low-lying barrier island and flushed the lagoon with large volumes of seawater, which is thought to have caused the widespread dislodgement of *Gracilaria* thalli necessary to explain the decline to <1% areal cover. The hurricane delivered record-breaking rainfall throughout the region over the next 4 days, causing unprecedented flooding in southeastern NC. Floodwaters inundated watersheds and impacted water quality downstream at the coast. Masonboro Sound is a coastal lagoon that supports a myriad of seabird, benthic invertebrate, and commercially and recreationally important finfish and shellfish species. We investigated the responses of the Sound's fauna and recovery of *Gracilaria* following this massive disturbance using before and after measurements in plots, along with periodic surveys at 3 spatial scales (cm, m, km) to elucidate potential mechanisms underlying *Gracilaria's* recovery. Data collected prior to Hurricane Florence provide a critical baseline against which to test the hypothesis that the inhabitants of Masonboro Sound are resilient to significant physical, hydrological, chemical, and ecological perturbation caused by this natural disturbance regime. Our preliminary results indicate that the abundance and richness of nekton (fishes and decapod crustaceans) increased slightly following the storm. This may be due to immigration of individuals other areas to avoid adverse low salinity and hypoxic conditions. This trend was not observed in either seabirds or benthic invertebrates. *Gracilaria* recovery did not differ across spatial scales. However, *Gracilaria* recovered faster in the presence than in the absence of the infaunal polychaete *Diopatra cuprea* (primary foundation species, 1*FS) that occurs in abundance on mudflats of Masonboro Sound and facilitates *Gracilaria* (2*FS) by incorporating fronds into its tube caps. *Diopatra* may thus help to facilitate the regrowth of *Gracilaria* following major disturbance events. These preliminary findings suggest that: (i) acute phase mortality of the focal faunal groups was low, indicating that the inhabitants of Masonboro Sound may be resilient to diverse perturbation caused by this natural disturbance regime; and (ii) a native foundation species may facilitate the recovery of an invasive foundation species following catastrophic reduction in abundance.

Tidal marsh vulnerability to rising sea level along the southern coast of North Carolina: A 30-year record of change

Elena Solohin, Taehee Hwang, and Christopher B. Craft, Indiana University*

Tidal marshes are increasingly threatened by global climate change and anthropogenic activities. Future rates of sea level rise (SLR) and altered sediment supply due to land use change may impact wetland's ability to keep pace with rising seas in the future. We used a combination of in-situ biomass measurements, and remote sensing techniques to estimate how tidal marsh biomass health and resilience has changed over time in a Southeast estuary of Cape Fear River, North Carolina. We established a relationship between in-situ biophysical variables and biomass estimates, derived from remote sensing data. Non-parametric trend analysis using the Theil-Sen slope revealed statistically significant negative trends in biomass and in the retreat of marsh margins. Largest decline in biomass occurred between 1997 and 2002 and between 2005 and 2015. This decline correlated with drought frequency and severity trends. Additionally, declines in marsh biomass were positively correlated with decreasing sediment supply, indicating that human activity plays a role in declining primary production. The loss of marsh area through landward marsh edge erosion ranged from ~ 0.6 m to 3 m yr^{-1}. Our 30-year analysis of NC tidal marshes is supported by real time kinematic global positioning system elevation data, which suggest that NC marshes have lower elevation in tidal frame, relative to many SE Atlantic

tidal marshes, making them more susceptible to sea level rise. Understanding the response of marshes to changes in land use and human disturbances will inform coastal adaptive management in the face of climate change and SLR.

Variations in *Spartina alterniflora* morphology along an elevation and inundation gradient
Q. A. Walker, CSS Inc. and C. A. Currin, NOAA NCCOS Beaufort Lab
Concerns about increased atmospheric CO2 have raised interest in the potential for salt marshes to act as Carbon (C) sinks. Salt marshes are a tidally flooded environment and while flooded, plants may not be able to freely exchange gases with the atmosphere. Correcting for inundation is a challenge that methods for measuring C flux must address. We examined the relationship between *Spartina alterniflora* morphology (plant height and density), marsh surface elevation and tidal elevation in a fringing salt marsh in North Carolina. We found a positive relationship between marsh surface elevation and plant density and a negative relationship between marsh surface elevation and plant height. In addition, we derived a new variable, plant elevation, by adding plant height to marsh surface elevation. We found plant elevation to be consistent regardless of the marsh surface elevation. This 'target' plant elevation occurred above mean higher high water (MHHW) allowing plants to remain exposed at high tide. Additionally, we examined the distribution of *S. alterniflora* photosynthetic tissue in relation to the plant's height. *S. alterniflora* plants distribute their photosynthetic tissue in a pattern that increases the duration of exposure during tidal flooding. We used these relationships between plant morphology and marsh surface elevation to model plant inundation across the marsh surface elevation and inundation gradient. This model not only has implications for C flux, but C budgeting and sediment trapping as well.

ABSTRACTS FOR POSTER PRESENTATIONS
(in alphabetical order by author's last name)

Comparison of shoreline stabilization approaches within North Carolina
Kelsey Beachman, Mollie Mason*, Mariko Polk*, University of North Carolina Wilmington; Carter Smith*, University of North Carolina-Chapel Hill; and Devon Eulie, University of North Carolina Wilmington*
North Carolina's estuarine shoreline habitats provide numerous functions and services, yet are increasingly threatened by natural and human pressures. One of the greatest challenges for managing these types of habitats is that drivers of habitat loss and degradation often occur over multiple temporal and spatial scales. This project strives to quantify the spatial and temporal changes in nearshore habitats that occur as a result of estuarine shoreline stabilization; specifically hard bulkheads and soft or nature-based living shoreline approaches. By implementing a multidisciplinary approach the project seeks to: 1) assess long-term patterns of shoreline and coastal habitat change; 2) identify socio-ecological mechanisms responsible for shoreline and habitat change; and, 3) test a novel, low-cost, citizen science-based approach for future shoreline monitoring. This project intends to utilize geographic information systems (GIS) science, low-cost remote sensing and aerial mapping technologies, waterfront homeowner surveys, and citizen science to accomplish its objectives. The results of this study will advise future coastal management, establish a system to educate homeowners on shoreline conservation and management strategies, and enable development of shoreline monitoring procedures that are long-term, cost-effective, and spatially adaptable.

Application of novel wave attenuation devices to save riparian resources

Sarah Benson, Kayla McNeilly*, Mariko Polk*, Dr. Devon Eulie, University of North Carolina Wilmington; Randy Boyd, North State Environmental; and Jim McKee, North Carolina Historical Site*

Brunswick Town/Fort Anderson (BTFA) is a North Carolina Historical Site located on the banks of the lower Cape Fear River. The site is unique in that offers both ecological benefit and cultural and historical significance to the area. Artifacts that had been preserved in the sediment of the riverbank have been exposed from a growing erosion problem caused by anthropogenic pressures, including storm surge and cargo ship traffic on the river. To manage bank erosion, the site has installed various shoreline stabilization structures. Most recently, novel wave attenuation structures that have never been used in North Carolina or within a tidal river environment were installed. The structure allows the movement of water and sediment to facilitate sediment accretion while dissipating oncoming wave energy. This study is currently monitoring geomorphological response in shoreline characteristics quarterly over the course of a year; specifically, changes in shoreline position, sediment volume, composition, and wave energy if front of and behind the wave attenuators. The study employs multiple methodologies, including sediment grab samples, real time kinematic (RTK)-GPS surveys, robotic scanning total station surveys, pressure sensors, and daily images. The outcome of this study will help guide future management decisions at this site and others. To date, initial quarterly results are promising, indicating sediment retention along the shore zone, positive vertical growth of the marsh platform, and a reduction of wave energy by an order of magnitude. Full results will be reported in June 2019 at the conclusion of the study period.

A diverse and abundant fish assemblage revealed using SharkCam underwater video off Cape Fear, North Carolina

*Erin J. Burge, Jessica A. Pollack**, Faith M. Saupe**, Nicholas C. Coleman**; Coastal Carolina University*

SharkCam is a publicly accessible, underwater streaming webcam installed on the base of Frying Pan Tower, 60 km off the coast of Cape Fear, North Carolina. The camera is attached near the bottom in 15 m of water and surveys an expansive area of natural hard-bottom reef and anthropogenic debris rich in marine biodiversity. Public viewers, undergraduate students and professional researchers have so far identified 113 species of fish that frequent the area, including 8 species of sharks. The camera feed is available live over the web and has an invested public viewership with in excess of 1M public views, and the associated discussion forum has received over 71,000 comments. The camera is utilized for research by cohorts of students that data mine the archived footage for occurrence and relative abundance information on the fish assemblage. An identification guide book has been developed using still photos and excerpted video clips with detailed species descriptions, commonly confused species, and relative size and frequency of occurrence information. From over 800 video segments of 20 minutes each we have compiled approximately 12,000 occurrence records for 93 species of fishes. These records are being used to characterize the fish assemblage in terms of frequency of occurrence, seasonality, relative abundance (for 59 species), and environmental correlates. These observations will help describe fish community structure at Frying Pan Tower within the larger ecosystem and contribute to knowledge of diversity and abundance within the wider biogeographic region.

Association behavior between sand tiger sharks (*Carcharias taurus*) and round scad (*Decapterus punctatus*) may be mutually beneficial

*Nicholas C. Coleman** and Erin J. Burge, Coastal Carolina University*

SharkCam is a publicly accessible underwater camera sited on the bottom in 15 m of water and located on Frying Pan Tower, approximately 60 km off the coast of Cape Fear, North Carolina. The camera is used to survey a diverse temperate and tropical fish assemblage associated with the underlying hard-bottom reef. To date the camera has observed 113 fish species from over four years of fish assemblage data. This large dataset collected from SharkCam and the diversity of fishes at the site facilitates the observation of ecological interactions. Sand tiger sharks (*Carcharias taurus*) are listed on the IUCN Red List as vulnerable and are frequently observed (in approximately 20% of observation intervals) on SharkCam. Archived videos were used to investigate the potential mutually beneficial association of round scad (*Decapterus punctatus*) around sand tiger sharks. Round scad are small (10-20 cm) planktivorous fish commonly preyed on by larger demersal and pelagic fishes. They are an essential link between the plankton and nekton communities found around Frying Pan Tower. These small, pelagic bait fish have been observed to aggregate around sand tiger sharks, and of the more than 150 video observations of sand tiger sharks, approximately 80% feature associated round scad. This relationship is

hypothesized to be mutually beneficial by decreasing vulnerability of the round scad to their predators and may also increase the potential predation opportunities for sand tiger sharks. Understanding this association could provide more information on the poorly documented feeding behavior of sand tiger sharks.

Flatfish assemblages and population differences between the Saint Catherines Island and Satilla River Estuaries

*Kathleen Coleman**, Abigail Bickle**, Dharma Thiruvaiyaru, Sekar Sethurman, Jessica M. Reichmuth, and Bruce Saul, Augusta University*

St. Catherines Island is a pristine uninhabited barrier island off of the coast of Georgia. It is believed to have experienced less anthropogenic pollution when compared to mainland estuarine habitats. In contrast, the Satilla River estuary has been historically affected by human activity, especially during the construction of many navigational "cuts" through the marsh in the early 1900s. These ditches were used for timber transport and they were also dredged for boats to use these shortcuts. It is hypothesized that differences exist in the intensity of human disturbances between the St. Catherines Island and Satilla River estuaries, and these may be reflected in fish assemblages. We compared abundance levels of various resident flatfish species captured when trawling and using gill nets in these two systems. As benthic species, flatfish abundance may be especially affected by anthropogenic pollution and disturbances of the estuarine substrates. This study provides insight into the effects of human disturbances on benthic fish species populations and assemblages. We compared catch-per-unit effort for six flatfish species between St. Catherines Island and Satilla River data, across seasons, between 2015 and 2018. We also looked at environmental variables when comparing the abundance of these fish species. The data from each area are reflective of differences that exist in resident flatfish populations, and this condition could be explained by many years of anthropogenic activities.

Evaluating the resilience of seagrass beds to disturbance in the presence of a facultative mutualist

Sarah Donaher, UNC - Chapel Hill, Institute of Marine Sciences and Rachel Gittman, East Carolina University*

Seagrasses are known to attenuate water flow and reduce erosion, provide valuable nursery habitat for many commercially and recreationally important fish and invertebrates, and improve water quality by stabilizing sediments and providing habitat for filter-feeding bivalves. We examined the resiliency of seagrass beds to a press disturbance (nutrient-loading) in the presence of a facultative mutualist Mercenaria mercenaria, the hard-shell clam. Excess nutrients in the water column can promote overgrowth of epiphytes on seagrasses and reduce water quality, resulting in reduced seagrass growth, biomass, and overall fitness. We hypothesized that negative effects on seagrass fitness as a result of excess water column nutrients would be mitigated by clam filtration of nutrients from the water column and subsequent biodeposition of nutrients in the sediment. We found that late summer growth rates of *Zostera marina* and *Halodule wrighitii* increase with longer inundation periods ($p < 0.05$). While clam or nutrient addition did not have an effect on growth rate during the first summer, we will continue to monitor these plots and suspect that subsequent years will show that the presence of hardshell clams in seagrass beds promotes bed resiliency and recovery to disturbance. Additional analysis will be completed on examining the effects of clam presence and nutrient loading on epiphyte load of seagrasses.

Indicating potential intersex through vitellogenin expression in the blue crab, *Callinectes sapidus*

Shannon Gregory, Clemson University; Jessica M. Reichmuth, and Jennifer Cannon, Augusta University*

The Satilla River, located in southeastern Georgia, provides valuable water resources to multiple communities. Wastewater and runoff containing potential contaminants including endocrine disrupting compounds, enters the Satilla River headwaters and flows toward the coast, eventually making it to the Atlantic Ocean. Detection of contaminants in aquatic systems and organisms can be costly, creating a need for cost effective methods to determine exposure. Endocrine disrupting compounds could potentially cause males to express the vitellogenin gene, a protein precursor to egg yolk production. We hypothesized that vitellogenin production could be detected in male blue crabs, *Callinectes sapidus*, from the Satilla River Estuary (SRE) using polymerase chain reaction (PCR). The hepatopancreas was dissected from ten male blue crabs from five locations. Using RNAzol, RNA was extracted, reverse transcribed, and used in a real time PCR to determine vitellogenin expression. All crabs from each of the

collection sites were found to express the vitellogenin gene, but concentrations were not significantly different among collection sites. The vitellogenin expression indicates that the sampled crabs may have been exposed to endocrine disrupting compounds. Projected closure of Noyes Cut could redistribute contaminants in wastewater, potentially exposing other organisms in the estuary, thus further monitoring should be conducted.

Time series analysis of hydromedusae within a pristine estuarine system

*Josiah Grzywacz**, University of South Carolina; Dennis Allen, Baruch Institute; and Joshua Stone University of South Carolina*

Hydromedusae (Cnidaria: Hydrozoa) are a common but often overlooked group of marine and estuarine gelatinous zooplankton found globally. They can periodically become very abundant and have significant impacts on food webs within coastal ecosystems. However, their ecology and phenology in many of the world's estuaries is vastly understudied. In order to examine the ecological role of hydromedusae in the coastal waters of the Mid-Atlantic Bight, we identified and quantified hydromedusae in biweekly zooplankton tows taken with a epi-benthic sled fitted with 365 mm mesh from North Inlet Estuary, SC. We used a dissecting microscope to identify and quantify (individuals m-3) the hydromedusae present over two periods, from 1981-1983 and 2010-2013. Temperature, salinity, and dissolved oxygen data were also collected in conjunction with zooplankton net tows. We identified X species present in the samples across the 6 years analyzed. Some species showed seasonal changes in abundance, with some more abundant in warmer, summer months and others in spring or winter. There were also changes in phenology, as we observed variability in the timing of peak abundance between years. We also compared changes in salinity and water temperature to hydromedusae abundance to determine if there are potential environmental drivers of the inter-annual variability in hydromedusae abundance. Preliminary calculations of the predation impact that hydromedusae may place on lower trophic levels in the estuary are also discussed. We found that hydromedusae are a seasonally important predator in North Inlet, and should be considered in food-web models of the region.

Seasonal variation in Eastern oyster sex ratios

*Juliana M. Harding and Zachary Smith**, Coastal Carolina University*

Eastern oyster (*Crassostrea virginica)* population sex ratios integrate local growth conditions and are fundamental to population dynamics. Oysters are sequential protandric hermaphrodites where the sex ratio is directly related to demographics. This reproductive strategy, which promotes transitions from small male to intermediate hermaphrodite and then to larger females, optimizes reproductive effort across size classes under prevailing conditions. The transition size is the shell height where more than 50% of oysters are producing eggs (female or hermaphrodite or functional females). At least 100 oysters were collected from subtidal natural fringing reefs in Clambank Creek, North Inlet, SC for sex ratio determinations in 6/6/2011, 8/5/2011, 3/13/2012, 5/30/2012, 8/8/2012, 3/13/2013 and 6/14/2013. Oyster shell heights ranged from 10 to 134 mm. Simultaneous hermaphrodites were rarely observed. The fraction of females increased with shell height and biomass in every sample. Season specific differences in the transition size from male to functional female were observed. In March and June, oysters transitioned from males to females at ~ 75 mm shell height. The protandric shift in August collected oysters was observed at 58-60 mm shell height. The observed transition size differences will be related to other population parameters.

Grain size distribution of a mesotidal beach with potential implications for ghost crab ecology

*Brittany Hartley** and Bradley Craig, Coastal Carolina University*

The study of geological processes is imperative to understanding the geomorphology for coastal environments. Depositional processes influence grain size, shape, and distribution. A preliminary study created a high-resolution surface sediment map of a beach environment at Waties Island, an undeveloped barrier island on the northern border of South Carolina. Dominant grain sizes were found via sieving sediment samples from the backshore, foreshore, and nearshore beach zones. Nearshore and foreshore zones contained coarse-grained sand, but additionally had a substantial fine grain component. As a result, the sizes present in all three beach zones were on average fine-grained sand. Hurricane Florence may have brought fine grained surface sediment from the dune base through all three zones. An ongoing study is investigating the rebuilding of Waties Island's shoreline and tracking changes to the sediment distribution, in addition to examining the relationship between grain size and ghost crab,

Ocypode quadrata, burrow distribution and depth. Changes in grain size composition could potentially affect depth, shape, and location of the crab burrows. Ghost crab burrows have been shown to be related to the health of the population and are a standard bioindicator of the beach ecosystem in general. An alteration of dominant grain size in surface and subsurface sediment could affect the population density and fitness of these animals, which may in turn lead to detrimental effects on the rest of these vital ecosystems.

An investigation of water quality associated with a river restoration project in a subtropical temperate estuary

*Matthew Brown, Allison Hartnett**, and Westly Woodward**, Flagler College*

Water quality is sensitive to alteration by sediment removal and deposition that may be initiated by development plans or a restoration project. The occurrence of projects of the sort is increasing as coastal populations rise along with the necessity to monitor coastal waters for their impacts. The Summerhaven River is south of the Matanzas Inlet in northeast Florida. A restoration project began in January 2017 to restore the flow of the Summerhaven River after numerous tropical storms breached the dune line and filled the river with sand. Following the approval of the project in late 2016, the current study began as a water quality sampling program to collect water quality data for evaluation of potential alterations in water quality parameters as the Summerhaven River restoration project was launched and completed. Samples were taken twice a month at six sites beginning in November 2016, two months before the river restoration began. The bimonthly sampling took place over a two year period, ending in October 2018. Samples were analyzed for chl-a, major nutrients, turbidity, TSS and other water quality parameters, such as salinity and dissolved oxygen. Chl-a analysis resulted in values between 2.34 ug/l and 24.88 ug/l, and demonstrated much variation between sites as did turbidity and TSS. Two major natural storm events occurred during the study period, Hurricane Irma and a subsequent 5 day nor'easter. Therefore, a comparison of potential water quality impacts associated with the restoration project and those associated with natural processes over the study period will be made.

Tracking shoreline change at Fort Caswell

Alina Herron , Marc Cruciani*,and Devon Eulie, University of North Carolina Wilmington*

Fort Caswell Coastal Retreat and Conference Center management is concerned about erosion of their beach. Since the last erosion study conducted in 2011, there have been several events that have affected their eastern end of Oak Island. The owners are particularly concerned with the effects of nourishment on Caswell Beach, which is adjacent to Ft. Caswell. Our study looks at beach erosion and accretion at Ft. Caswell and provides baseline data for future research. We found that the beach has lost 16,709.15 m3 of sand volume but gained 10,030.75 m2 in total area from the winter to fall of 2018. The inlet and ocean-sides of the beach showed different erosional patterns. The increase in beach area was particularly noticeable at the point where ocean and inlet meet. We hypothesized that two major effects were driving this change: the seasonal movement of sand on the beach, and sand transport from up-shore beach nourishment projects. One additional dataset is needed to complete the yearlong study; one more winter dataset to be collected in January or February of 2019.

The effects of human approach on sanderling foraging behavior

*Anne Hobdy** and Eric Rosch, Coastal Carolina University*

During low tide, sanderlings (*Calidris alba*) forage on small invertebrates in the sand of the intertidal zone. As a result, these common shorebirds frequently come into contact with humans who visit the beaches for a variety of activities, such as fishing or jogging. Here, the effects of three different approach types (undisturbed, passive, and aggressive) on sanderling foraging behavior were examined to help understand how human activities may be affecting their ability to search for food. At two local beaches, locomotory rate was recorded in addition to obvious changes in initial behavior. Treatments were defined as follows: 1) Undisturbed – sanderlings observed from a distance that does not influence their behavior 2) Passive - a human approached by walking at a steady walking pace from a predetermined distance 3) Aggressive - a more assertive approach at a noticeably faster speed from a closer distance. In general, sanderlings exposed to an aggressive approach moved at the highest rate, while the rates of birds approached passively or not at all did not differ significantly from each other. This was true for birds found at both locations. These results show a correlation between intensity of human approach and sanderling response, potentially impeding their ability to forage. The similarities between sites suggest that

sanderling populations move frequently between local beaches and are therefore likely to show similar responses to the presence of humans regardless of beach location.

MATLAB applications in Marine Science Data Visualization

*Carson Berry** and Diane B. Fribance, Coastal Carolina University*

Visualization and data processing of large data sets is an integral skill for modern marine scientists. Unfortunately for many undergraduates, it can be intimidating to use advanced software programs, or they do not have the time to invest in learning them as part of a typical marine science course. This leaves these students at a disadvantage if they are limited to spreadsheet-based programs for generating figures to represent ocean observations. Fortunately, it is now possible to introduce students to these capabilities in a more intuitive way through the use of an app. Software like MATLAB® allows students to utilize a point-and-click interface to generate advanced visualizations through customized apps. Here we present an example generated by a summer undergraduate project, currently being used by students in an upper level marine science course to explore generating different types of visualizations from the same data set. This approach has educational value both for the student developer(s) and for students utilizing the app as part of their coursework.

Best management practices for post-construction restoration of rights-of-way in saltwater marshes, estuaries, and other tidally influenced areas

Jason Christian MMC Engineering; S. Sonny Kim, Stephan A. Durham, and Iman Salehihikouei, University of Georgia*

In the southeastern U.S., coastal saltwater marshes provide not only critical ecosystem services, but coastal protection, flood protection, and water quality improvements through removal of harmful pollutants. Construction, reconstruction, and maintenance of road infrastructure in Georgia's coastal counties commonly generate disturbances of coastal marshes. The Georgia Department of Transportation's (GDOT's) current construction standards do not specifically require documenting or restoring any prior soil properties, nor the re-establishment of native or existing vegetation that would maintain and/or improve the functionality and ecology of impacted areas. This research will identify efficient and cost-effective procedures to restore the soil properties of post-construction saltwater marshes to imitate prior conditions and reduce the time required for re-establishing natural vegetative cover and ecological functionality of the disturbed areas. This research has characterized the soil properties of several Georgia saltmarshes, and developed soil mixtures using inland soils and dredge spoil to replicate saltmarsh geotechnical properties and will evaluate vegetation growth in designed soil mixtures. A greenhouse study has been designed to investigate the plant success of several target species using the soil design mixtures. Mesocosms will mimic the physical and chemical conditions of saltmarsh soils (e.g., pH, salinity, redox, bulk density, and organic matter content) found at each of the coastal sites under evaluation. The experiment is projected to begin in mid-February 2019, and growth will be monitored by measurements of stem count, leaf color, plant height, and number of leaves for approximately seven months. This research will determine if the soil mixtures will be effective in post-construction restoration projects.

Estuarine macroinvertebrate community diversity in non-indigenous macroalga *Gracilaria vermiculophylla*

Timothy S. Lee and April M.H. Blakeslee, East Carolina University*

The red seaweed *Gracilaria vermiculophylla*, native to the coastal habitats of east Asia, has been introduced widely throughout the eastern U.S. This macroalga provides a three-dimensional structural complexity that hosts high abundances and diversity of benthic macroinvertebrates including crustaceans, gastropods, bivalves, and annelids. Estuarine mudflats of North Carolina and Virginia that traditionally lacked macroalga with three-dimensional complexity have now been colonized by *G. vermiculophylla*, which provides novel niche for macroinvertebrates. While studies of macroinvertebrate diversity associated with *G. vermiculophylla* on local scale has been conducted, no studies yet have assessed biogeographic patterns of macroinvertebrate diversity in this macroalga. In late summer 2018 we sampled six shorelines in Virginia and North Carolina frequented by *G. vermiculophylla*. From each site we collected macroalga at low tides in both emerged and submerged segments of shorelines. We weighed *G. vermiculophylla* samples for wet biomasses and separated benthic macroinvertebrates associated with *G. vermiculophylla* for taxonomic classification. Our preliminary results indicate that macroinvertebrate

abundance and diversity are much greater in *G. vermiculophylla* when it is submerged. Amphipods of Gammarus genus dominated the macroinvertebrate communities in *G. vermiculophylla*, representing over 70%, followed by mysids (>18%) and decapods (>3%). The colonization of estuarine coastlines of the eastern U.S. by *G. vermiculophylla* is relatively novel and its structural complexity can host large diversity of macroinvertebrates, many of which are in larval stages and serve commercial and ecological importance. Determining biogeographic patterns on how this macroalga is affecting coastal macroinvertebrate diversity is critical in understanding long-term projections of macroinvertebrate communities.

Reconstructing anthropogenic impact in a barrier island salt marsh using multiple proxies
Kristopher Maedke-Russell, Savannah State University; Jay Hodgson, Georgia Southern University; and Carol Pride, Savannah State University.*
Salt marsh habitat provides ecological services including mitigation of the effects of sea level rise and storms on inland areas. Although Ossabaw Island, GA is highly protected, salt marsh there has been impacted by the installation of roads and isolation of large swaths of salt marsh from tidal inundation. Rocket Pond is one such impoundment and the purpose of this study was to describe the ecology of this site before and after the impediment of tidal activity. Sediment cores (76 cm) were collected from Rocket Pond. Loss-on-ignition was performed and diatom assemblages were described for each 1 cm core interval. Additionally, tree-ring cores were collected from Loblolly pine (Pinus taeda) on both tidal and isolated sides of the impounding causeway. Tree-ring width was standardized using a negative exponential linear regression and tested for correlation with climatic variables. Assuming constant radioisotope-derived sedimentation rate during the closed phase of Rocket Pond, tidal impediment resulting from the installation of Willows Road occurred approximately 243-297 YBP and is signified by a diatom regime shift from neritic and episammic species to freshwater and epipelic species. Sedimentary organic and carbonate content were low before causeway installation ($\bar{x}$=0.02) and increased thereafter ($\bar{x}$=0.46 and $\bar{x}$=0.08, respectively). Marsh-adjacent tree-ring growth is significantly correlated to AMO and ENSO indices (p=0.001 and p=0.006, respectively), while pond-adjacent tree-ring growth is significantly correlated to precipitation (p=0.014).

Long-term assessment of macrobenthic estuarine communities in the Cape Fear River, NC
Alexis Marti, Martin Posey, and Troy Alphin, University of North Carolina Wilmington*
Road installation changed Rocket Pond from an open brackish system to an ephemeral freshwater impoundment. Spatial disparity in tree-ring growth suggests terrestrial ecology has also been impacted." Starting in late 1995, the Lower Cape Fear River Program (LCFRP) has continuously monitored water quality and benthic fauna in the Cape Fear River estuary. Throughout this monitoring effort the river has experienced a number of both acute and chronic weather-related perturbations on the system. However, an integrated assessment has yet to be conducted on the resistance and resilience of this community. This project looks to explore relationships between the macrobenthic community and general water quality trends, sediment characteristics, and climate data from 1996 – 2015, utilizing data from the LCFRP as well as historical weather data. The objectives of this project are to 1) describe the benthic community of the estuarine region of the Cape Fear River over the last twenty years including temporal trends in dominance and composition, 2) investigate the relationships between the benthic community and physio-environmental variables, and 3) determine community response to disturbances in this system, particularly those weather related. Four categories of data – benthic community structure, water quality (including water temperature, salinity and dissolved oxygen), sediment grain size, and weather (precipitation, drought periods, and extreme rainfall events) will be utilized to test the hypotheses that 1) dominant benthic structure exhibits a directional change over time, 2) opportunistic species will dominate after disturbances, and 3) temporal changes in the benthic community will be reflected by correlations between the benthic community and changing physio-environmental variables. Multivariate analytical methods will be utilized to determine temporal trends, discrete responses, and correlations among factors over time.

Assessment and comparison of distribution and impacts of microfiber plastics between the Northern Coast of South Carolina and Bimini, Bahamas

*Jessica Myers**, Coastal Carolina University*

Microfiber plastics are a growing problem that threatens the health of marine ecosystems, organisms, and humans. In this study, the distribution and concentration of microfibers were observed between regions with differing population densities: Bimini, Bahamas and coastal waters of South Carolina (Waites Island and Winyah Bay). Surface water samples were collected in glass jars from coastal and estuarine environments and filtered through gridded 0.45-micron filters. Microfibers were counted using a dissecting microscope. Results show that microfibers were found within all samples. The average amount of microfibers found in the Bahamas was 254 plastics per liter. In Winyah Bay, the average concentration of microfibers was 307 plastics per liter. The highest concentration in Winyah Bay was 1,972 microplastics per liter found after Hurricane Irma impacted the area. Tap water collected from Coastal Carolina University contained a mean concentration of 8 microplastics per liter. To assess contamination, water samples were filtered through Milli-Q Q-Pod system with the Bio-Pak Polisher, Millipak, or no attachment. Results from this study will be a part of the ever-growing data on microplastic pollution and could lead to educated, region-specific management plans.

An analysis of population density and body condition in the fiddler crabs (Genus: *Uca*) compared between areas of high and low levels of human disturbance

*Ann-Marie Pase** and Eric Rosch, Coastal Carolina University*

Evidence is growing that human activities are having detrimental effects on the growth and reproductive rates of marine organisms. A useful measure of animal health and condition is body mass index, where the mass of an organism is compared to its size. Many factors influence BMI, including available food resources and stress levels. Animals found in areas of lower food quality and higher levels of stress (predation pressure, disturbance, environmental extremes, etc.) tend to have lower BMI and lower overall fitness. Here, fiddler crab (genus *Uca*) burrow densities and body density (body mass divided by body volume) were measured in specimens collected from a highly disturbed area and a near-pristine environment. The purpose of this study was to ascertain the effects of anthropogenic impact on the health and fitness of fiddler crabs. Because fiddler crabs serve vital ecological roles in marsh ecosystems, impacts on their fitness will have far-reaching effects on the rest of the marsh community. Burrow densities were nearly double in the disturbed site compared to the undisturbed location and body densities were consistently higher in the undisturbed site. These findings imply that crabs forced into stressful, high-density situations pay a cost in decreased body density, which may have substantial effects on their abilities to grow, regenerate, and reproduce effectively. This may be particularly true for males such that if less energy is available to be put into the growth and maintenance of the enlarged cheliped, they will likely have reduced mating success.

Measuring soil sulfide reactions and redox potential modifications under nutrient manipulations in a pocosin wetland

*Blake Rogers**, Sydni Law*, and Enrique Reyes, East Carolina University*

Peatlands account for less than 3% of the Earth's surface, but store ~30% of soil carbon and are responsible for ~40% of global methane emissions. These massive carbon storage pools have contributed to global cooling over millions of years and if disturbed by global warming or anthropogenic activity, peatland carbon stores pose a substantial risk for large CO2 and CH4 fluxes to the atmosphere and hydrologically connected systems. Recent biogeochemical studies have revealed the importance of sulfur cycling in peatlands, where dissimilatory sulfate reduction is thermodynamically favored and can account for nearly 50% of anaerobic carbon mineralization, effectively mitigating methane flux. Anthropogenic activities constitute a substantial threat to peatlands as development for agriculture and other uses have significantly altered critical biogeochemical processes. This study intends to quantify changes to soil sulfide biogeochemistry in response to increased availability of phosphorus, the proximal limiting nutrient in pocosins, along a phosphorus fertility gradient. This research was conducted at a pocosin located at ECU's West Research Campus. This pocosin drains into the Neuse and Tar-Pamlico River Basins, influencing riparian and estuarine water quality. Groundwater samples were collected two weeks after the application of phosphorus fertilizer. Spectrophotometric analysis was used to determine the concentration of sulfide species in samples. Measuring soil sulfide changes following nutrient influx

could provide insight into the biogeochemical consequences of anthropogenically-induced pocosin degradation and assist in predicting the impact this will have on hydrologically connected systems.

Vegetation, soil and pore-water characterization of saltmarshes located in Savannah, Georgia
Iman Salehihikouei, Sung-Hee Kim, Stephan Durham, University of Georgia; Jason Christian, MMC Engineering; Katy House*, University of Georgia*
Influences from tidal flooding and freshwater inundation from upland watersheds creates an environmentally and ecologically significant biome as saltwater marsh along coastlines. Saltwater marshes are able to provide a large number of fauna and flora with the biologically desirable environment, and also operate as a sink for sequestering a large amount of carbon. Salt-water marshes which have the highest value of net primary productivity among terrestrial and wetland ecosystems are adversely impacted and threatened by sea-level rise and land-use change. Any serious action for the purpose of loss prevention or restoration practice requires well-established databases characterizing these coastal areas based on vegetation, soil, and water. In this study, field-based experiments have been conducted in order to characterize the native halophytic species and pore-water properties. And also, lab-based experiments have been carried out to identify texture, bulk density, nitrogen to carbon (N:C) ratio, trace elements and the mineralogy of the hydric soils of eight saltmarshes located in Savannah, Georgia. The results demonstrate that diversity and density of halophytes depend on salinity and redox potential of pore-water as well as soil properties such as texture, structure, and mineralogy. Soil texture and structure can influence oxygen availability in the system and as such, have a significant impact on redox potential value and the thickness of the oxic layer which can be taken into account as a sink for reduced components and a nest for facultative microorganisms.

Distinct personality types in *Littoraria irrorata* and the implications for predator escape behavior
Christina Salerno, University of North Carolina Wilmington*
This study was conducted to determine if periwinkle snails, *Littoraria irrorata*, exhibit individual personality types, and whether these behaviors vary when in the presence of a predator. Baseline personality types of 25 snails were determined using outdoor mesocosms in their natural habitat. To do so, 3 randomly selected snails were placed in the center of a bucket containing 3 cm of seawater. Every 5 minutes for a total 15 minutes the height of each snail was recorded. To test whether individuals exhibited consistent behaviors (in this case, maximal height climbed) across multiple trials, each trial was repeated 5 times for each snail. To test predator escape behavior, experimental trials were run as described above, with the inclusion of the common marsh predator, the blue crab, *Callinectes sapidus*. It was found that periwinkle snails do in fact have distinct personalities which significantly influence their predator escape response.

Examining territoriality in the Atlantic ghost crab, *Ocypode quadrata*, based on burrow characteristics
*Mackenzie Scheuermann**, and Eric Rosch, Coastal Carolina University*
Ghost crab, *Ocypode quadrata*, burrows are well-established bioindicators of beach health. They are also useful indices for assessing several aspects of ghost crab ecology and behavior, such as general morphology and population dynamics. Ghost crabs are known to be highly territorial, but studies examining this component of their biology are sparse. In this study, measurements, such as depth, diameter, and distance between burrows, were taken from three beach locations in South Carolina (Waties Island, Myrtle Beach State Park, and Huntington Beach State Park). There is strong evidence of a seasonal effect on territoriality with increased levels observed in the late summer/early fall, compared to spring. Burrow sizes between neighbors were directly related to the distance between them. Additionally, burrow diameter differences and distances between then appeared to vary by beach zone. These results suggest that ghost crab territoriality shows patterns in terms of season, beach zone, and size differences between neighbors and that examining burrows is a useful tool to investigate this aspect of their behavior. Because the burrows of these animals are a major focal point of their ecological success, disruptions in their territorial behavior surrounding these burrows may have significant effects on their overall fitness and the beach ecosystem.

Community structure of epiphytic diatoms in the Satilla River Estuary

*Elise N. Thomas**, Augusta University; A. Loren Mathews, Georgia Southern University; and Jessica M. Reichmuth, Augusta University*

Diatoms are a diverse group of microscopic marine algae that make up a large portion of the phytoplankton found in aquatic environments. Currently there is a lack of research on diatoms in the Satilla River estuary and the purpose of this study is to assess the community structure of epiphytic diatoms on the marsh grass Spartina alterniflora at four sites: Noyes Cut, Piney Bluff Node, Parsons Creek, and Todd Creek. Collection took place from February to August 2018. Five S. alterniflora stems with leaves were collected from the water column near the edge of the tidal channel. Stems and leaves were scraped with a rubber policeman, rinsed with deionized water into glass containers, and stored in a freezer. All samples were analyzed within a week to accurately identify the diatom community at the time of collection. Five wet mounts for each site were examined under a compound microscope and diatoms were identified to genera. To assess the diversity of sites from month to month, the Shannon and Simpson's diversity indices were used. Averages for the total diversity at each site were calculated using Simpson's diversity index and comparisons among sites were made. The Parson Creek diatom community exhibited the highest diversity and was the most even relative to the other sites. Average genus richness for each month of collection was calculated. Richness increased significantly from February to August, with August having the highest richness. Noyes Cut had the highest total genera richness of 36 while Todd Creek had the lowest richness of 21.

How nekton utilization of aquaculture varies with presence to natural habitat

Hannah R Thurlow, Troy D Alphin, and Martin H Posey, University of North Carolina Wilmington*

Cultivation of oysters, specifically *Crassostrea virginica*, is increasing along southeastern United States coast. Oyster aquaculture operations are typically bottom cultch plantings, rack and bag or floating cages. The oysters, cages and other structures found in aquaculture operations have been shown to provide habitat to various nekton. There have been several studies examining how aquaculture structures compare to natural habitats but the question of how nekton utilization of aquaculture varies with landscape, especially with presence to various natural habitats, has not been fully explored. This is an important question for both managers and growers in siting operations since it may influence the ecological benefits or impacts of aquaculture efforts. My research seeks to explore this question through placement of experimental aquaculture units adjacent to various other common habitat types. Twelve units will be placed adjacent to three different habitat types (seagrass, natural oyster reef and sand flat) with each habitat type having three replicates. Each unit will have ten floating cages (6m x 4m total area) with typical culture density (120 oysters/cage) and will be at a fixed distance (5 m based on literature) from the natural habitats. Experiments will be deployed in spring (April/May) and sampled in summer (July/August) and then again in the fall (October/November). Each sampling period will consist of two sampling methods: surround nets and light-weight trawls. If the outcome of my research proves there is a benefit to placing aquaculture near certain natural habitat, our future siting decisions should also consider these locations so that a further ecological benefit is provided alongside the economic benefit.

A tale of two snails: how Noyes Cut affects snail populations in the Satilla River Estuary

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The Satilla River, a 200-mile water system, runs toward the southern part of coastal Georgia creating a marine estuary that is home to two species of snails, *Littorina irrorata* and *Melampus bidentatus*. *Littorina irrorata*, known as the periwinkle snail, has a diet that consist of algae and diatoms. This diet provides a balance within the estuary by helping to prevent harmful algae blooms. *Melampus bidentatus*, the Eastern Melampus, is a native species to North American coastal regions and aids in waste management by feeding on dead saltmarsh cordgrass. Due to a cut made to one of the estuary's many tidal creeks, environmental changes, such as altered tidal flow and salinity gradients, are believed to have influenced both species abundance and distributions since the formation of the cut. To determine these changes, data collection on the two species occurred from November 2017 to December 2018. For each snail species, transects were performed by counting the presence of snails and random heights. Analysis showed that snail abundance at Noyes Cut and Piney Bluff Node were low for both species. At Todd Creek and Parsons, snail density for both species was significantly higher. Because of lower salinity and monotypic stands of *Spartina alterniflora* at Piney Bluff Node and Noyes Cut, these conditions exclude

Melampus bidentatus from these communities. Closure of Noyes Cut should restore the estuarine conditions and eventually lead to Melampus bidentatus returning to these sites.

Comparing the performance of alternative reef substrates in halting salt marsh erosion and supporting oyster reef development

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Nationwide, critical estuarine salt marsh and oyster reef habitats are being degraded or lost. One common substrate used to restore these habitats is a shell bag, a plastic mesh bag filled with oyster cultch. However, bags are a potential source of marine debris and require large amounts of clean, recycled oyster shell. We compare the ability of shell bags and Oyster Catcher™ to stabilize an eroding salt marsh and promote a self-sustaining oyster reef community. Oyster Catcher™ is a biodegradable material made from plant-fiber cloth coated in cement, which can be shaped and pre-seeded with juvenile oysters to suit restoration needs. In May 2018, we constructed oyster reefs out of shell bags (n=8) and Oyster Catcher™ (n=8) on Carrot Island, located in the Rachel Carson Reserve. Reefs are divided evenly between two shorelines: an erosive high-energy shoreline facing Back Sound, and a low-energy tidal creek shoreline. Four control sites were also established along each shoreline (n=8). We will monitor the recruitment and growth of oysters on all reefs to assess the sustainability of the reef community. We will also perform stem counts, quantify below- and aboveground biomass, and measure tagged stems to determine the impacts of reef presence on *Spartina alterniflora* marsh vegetation. Finally, we will evaluate changes in both the surface elevation and lateral position of the marsh shoreline using a high-resolution GPS mapping system. Project results will assess the effectiveness of both substrates in enhancing marsh and oyster habitat and will inform future restoration of both systems.

Assessing the impact of eutrophication on the relationship of *Littorina irrorata* and *Spartina alterniflora* and its ecological effects on salt-marsh estuaries

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Increased nutrient input, specifically nitrogen, can cause excessive algal growth and hypoxia in estuaries, which threatens the health and survival of plant and wildlife species. Specifically, this can be harmful to species such as the eastern salt marsh snail, *Littorina irrorata* and the cordgrass, *Spartina alterniflora*. The periwinkle snail, *L. irrorata*, is an important primary consumer in regards to the Spartina via fungus farming but due to the chance of being exposed to eutrophication, it is likely to experience significant effects in regards to growth and behavior. Under high nutrient conditions, we expect *L. irrorata* to have reduced shell growth, mortality, and reduced movement. In laboratory mesocosms with new growth Spartina stems, snails were exposed to low, medium, and high concentrations of dissolved nitrogen; each mesocosm had three replications ranging from low, medium and high. Exposure to increased nutrients ended when the mortality reached 50% (LD50). Mortality was significantly higher in the high concentration mesocosm which suggests that *L. irrorata* is very sensitive to eutrophic conditions, which has major implications for the salt marsh carbon and nitrogen cycles.

Osmoregulation in juvenile sandbar sharks (*Carcharhinus plumbeus*) in Winyah Bay, SC

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Juvenile sandbar sharks (*Carcharhinus plumbeus*) have been caught in salinities ranging from 13-40 ppt. In Winyah Bay, a partially mixed estuary in SC, juvenile sandbar sharks tidally alternate between lower salinities in middle bay and higher salinities in lower bay. To test whether duration spent in lower salinities was sufficient to change plasma osmolality and osmolyte concentrations, we measured sodium, chloride, urea, and trimethylamine oxide (TMAO) concentrations and total osmolality in plasma of juvenile sandbar sharks caught on longlines set at either flood or ebb tide from May-August, 2018. All variables differed significantly ($p<0.001$; ANOVA) in juvenile sandbar sharks between salinity groups (15 – 19.9, n=6; 20 – 24.9, n=13; 25 – 29.9, n=9; and 30 – 35 ppt, n=15). Sodium and chloride concentrations in the lowest salinity group (LSG) were 245.5 ± 4.9 and 237.4 ± 4.1 mM, respectively, and increased to 276.9 ± 2.2 and 278.4 ± 1.8 mM, in the highest salinity group (HSG). Between the LSG and the HSG, urea increased from 262.2 ± 5.9 mM to 340.3 ± 7.2 mM, and TMAO increased from 47.3 ± 3.4 mM to 76.9 ± 4.3 mM. Total osmolality in the HSG was 987.3 ± 11.4 mOsm/kg and 802.8 ± 3.4 mOsm/kg in the LSG. Post hoc Tukey tests of all variables revealed that the HSG was significantly different than the other three salinity groupings. These results suggest that juvenile sandbar sharks exhibit osmoregulatory plasticity as they

move through changing salinities, and represent the first evidence of osmo- and ionoconformity in this species.

Where do they goby?: The study of *Gobiosoma bosc* behavior in response to visual implant elastomer tags

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The naked goby (*Gobiosoma bosc*) is a small benthic fish that inhabits western Atlantic estuaries, where it ranges from Texas to Rhode Island. Previous work has found limited gene flow between and among estuaries in the western Atlantic, but much less is known about local movement patterns within populations. Because adult naked gobies are benthic and relatively sedentary, it is assumed that they do not travel far beyond areas with well-structured habitat, but this hypothesis has not yet been tested in the field. The goal of our study is to examine any possible differences in naked goby behavior as a result of the subcutaneous injection of a marking tag to ultimately use that information for future field-based mark-recapture studies. The marks used in the project are visual implant elastomer (VIE) tags, which have been shown useful for tagging small fish. However, prior to any field trials involving marked individuals, the potential changes to behavior (i.e., differential shelter use or predator susceptibility) in marked and unmarked fish had to be fully evaluated in a lab setting. Naked gobies were collected from Mallard Creek at Goose Creek State Park (along the Pamlico River near Washington, NC) throughout the summer of 2018 and separated into marked and unmarked treatments. Each replicate contained 10 individuals that were video recorded for several hours with only a 30-minute period being used for analysis. Preliminary results suggest that no significant behavioral changes occur in naked gobies after being marked with VIE tags.

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