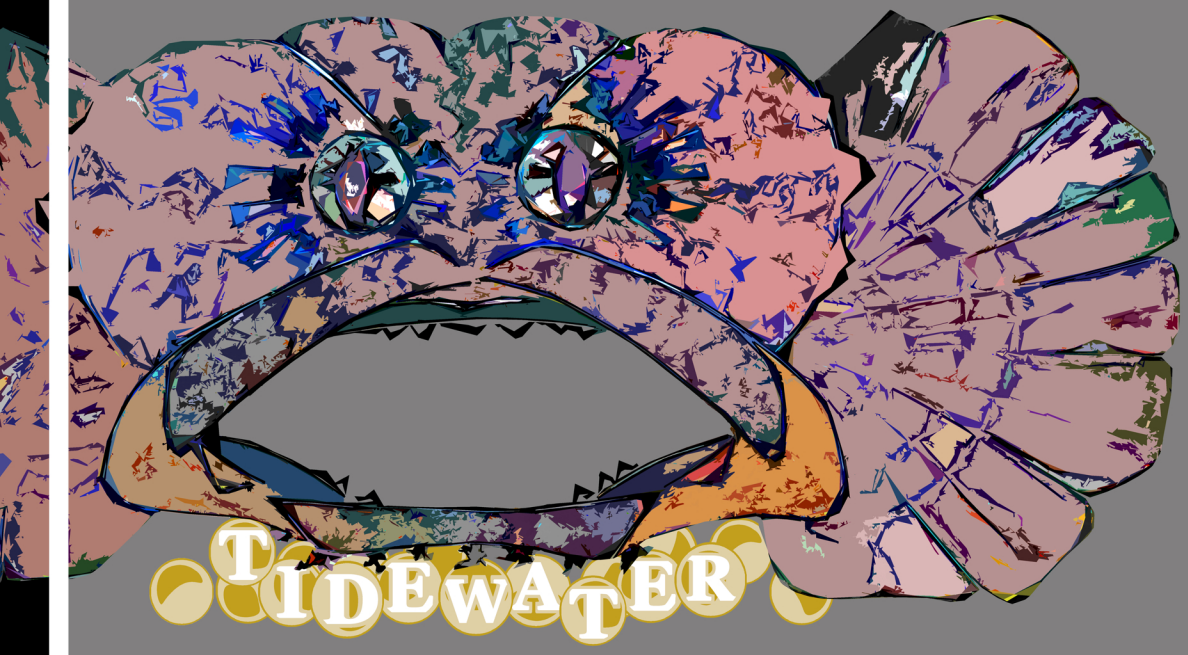
American Fisheries Society

35th Annual Tidewater Chapter Meeting



March 24-26, 2022
Outer Banks, North Carolina

2022 AFS Tidewater Chapter Meeting Sponsors

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Coastal Studies Institute
A Multi-Institutional Research Partnership

Meeting Venues

Coastal Studies Institute

Led by East Carolina University (ECU), The Coastal Studies Institute (CSI) is a multi-institutional research and educational partnership of the UNC System including North Carolina State University, UNC-Chapel Hill, UNC Wilmington, and Elizabeth City State University. The Coastal Studies Institute focuses on integrated coastal research and education programming centered around the needs, issues, and concerns of coastal North Carolinians by bringing together the various disciplines of both the natural and social sciences. CSI houses over a dozen permanent research scientists that focus on a range of topics including renewable ocean energy development, storm impacts and coastal vegetation change, social science, and ecology.

Jennette's Pier

Fishing on the banks was forever changed when the first fishing pier – Jennette's Pier – was opened in Nags Head back in 1939. At that time the pier was 754 feet long and 16 feet wide, with a 28-foot-wide "T" on the end. In 2003, the pier was sold to the North Carolina Aquarium Society so that it might be developed into an educational outpost for the Aquarium. But in September 2003, Hurricane Isabel swept the North Carolina coast, knocking down about 540 feet of Jennette's Pier and practically shutting down an Outer Banks institution. It then became time to rethink the fishing pier concept, with the Aquarium taking the lead to rebuild Jennette's as an all-concrete, 1,000-foot-long, educational ocean pier. The Coastal Studies Institute has developed a partnership with Jennette's Pier. Researchers and outreach staff regularly use Jennette's for education programs and research.

Invited Speakers

Plenary Talk

Friday 25th, 8:20am

Dr. Jeffrey A. Buckel

Professor, Department of Applied Ecology
Center for Marine Sciences and Technology
North Carolina State Technology

Research findings and life lessons learned from fish tagging experiments

Our research group has used tagging as a tool to estimate demographic rates in multiple species of fish. In this presentation, I'll provide an overview of several of these tagging experiments and sprinkle in some life lessons learned along the way. I'll also describe how our research results were used within stock assessments and management.

Guest Speaker

Saturday 26th, 9:45am

Val Kells

Marine Science Illustrator

Marine Science Illustration with Val Kells

Val is an award-winning freelance Marine Science Illustrator with over 35 years of experience. She has just completed her sixth book about fishes: *A Field Guide to Coastal Fishes of Bermuda, Bahamas, and the Caribbean Sea*. During her presentation, Val will describe her career history, and her illustrative and book production processes.

AFS Tidewater Meeting Schedule Overview

March 24-26, 2022

Thursday, March 24, 2022

Time	Event	Location
4:00 PM – 6:00 PM	Poster Set-up, On-site registration, Presentation upload	Coastal Studies Institute
6:00 PM – 9:00 PM	Poster Social, On-site registration, Presentation upload	

Friday, March 25, 2022

Time	Event	Location
7:30 AM	Registration Opens	Jennette's Pier
7:45 AM – 8:15 AM	Coffee and Light Breakfast Items	
8:15 AM	Opening Remarks *Jan McDowell & Jim Morley*	
8:20 AM – 9:00 AM	Plenary *Jeff Buckel from NCSU*	
9:00 AM – 9:30 AM	Student Lightning Talks	
9:30 AM – 10:30 AM	Student Oral Presentations	
10:30 AM – 10:45 AM	Break—coffee and snacks	
10:45 AM – 12:00 PM	Student Oral Presentations	
12:00 PM – 1:30 PM	**Student/Mentor Lunch** *On your own, off site*	See program for options
1:30 PM – 3:00 PM	Student Oral Presentations	Jennette's Pier
3:00 PM – 3:15 PM	Break—coffee and snacks	
3:15 PM – 4:30 PM	Student Oral Presentations	
4:30 PM – 5:30 PM	Business Meeting	
6:00 PM – 10:00 PM	Banquet *Dinner, Awards, Silent Auction, Raffle*	

Saturday, March 26, 2022

Time	Event	Location
7:45 AM – 8:15 AM	Coffee and Light Breakfast Items	Jennette's Pier
8:15 AM – 9:45 AM	Professional Oral Presentations	
9:45 AM – 10:15 AM	Guest Speaker *Val Kells, Marine Science Illustrator*	
10:15 AM – 10:30 AM	Break—coffee and snacks	
10:30 AM – 12:15 PM	Professional Oral Presentations	
12:15 PM	Meeting Adjourned	

Poster Presentations

Thursday, March 24, 2022

Poster	Presenter (S = Student)	Title
P1	Bartlett, B. (S)	Providing Insight into Southern Flounder (*Paralicthys lethostigma*) Spawning Locations via Lagrangian Particle Dispersal Modeling
P2	Behringer, D., Paris, M.	NC Division of Marine Fisheries' Pamlico Sound Independent Gill Net Survey
P3	Biesack, E.	Developing an eDNA tool for detection of Polydora mudworms on oyster farms
P4	Brooks, J. (S)	Annual variation in the abundance and distribution of spotted seatrout (*Cynoscion nebulosus*) in North Carolina coastal waters
P5	Burgess, M. (S)	Analyzing spatial trends and sex ratios in range shifts of Summer Flounder, *Paralichthys dentatus*
P6	Butts, C. (S)	Population Characteristics of Alewife Spawning in Lake Mattamuskeet, 2015-2016
P7	Clerkin, P. (S)	New Methods of Detecting an Old Group of Fish: Surveying Chondrichthyans Using Genetic Barcoding, eDNA, Deepwater Cameras and Artificial Intelligence
P8	Delvillar, R. (S)	Do Oyster Farms Have Enriched Soundscapes?
P9	Dillon, M.	The effect of temperature on metabolic rate and body condition of invasive Blue Catfish
P10	Dowd, S.	A comparison of coastal community vulnerability between the US and Australia in a changing climate.
P11	Fowler, A.	Field surveys and comparative parasitology of freshwater native and invasive snails in Virginia
P12	Greenberg, S. (S)	Is there a lesser of two evils? Castrating parasites of an estuarine crab host of the Chesapeake Bay along a salinity gradient
P13	Hagemeier, H. (S)	Parasite Diversity in the Invasive Asian shorecrab, *Hemigrapsus sanguineus,* on the Eastern Coast of the United States
P14	Jainarine, N. (S)	Phenological Analysis of Winter Predator-Prey Dynamics Between Ichthyoplankton and Zooplankton Abundance in Beaufort Inlet
P15	Johnson, M. (S)	Hatch dates and habitat use of juvenile sheepshead *Archosargus probatocephalus* in North Carolina estuaries.
P16	Mitchell, J. (S)	Growth and Reproduction of Southern Flounder (*Paralichthys lethostigma*) in North Carolina
P17	Murphy, T. (S)	Seagrass stable isotope composition provides seascape-scale tracking of anthropogenic nitrogen inputs in a tropical marine lagoon

Poster Presentations Cont.

Poster	Presenter (S = Student)	Title
P18	Rocco, A. (S)	A Reason to Feel Blue? Evaluating the Impacts of Environmental Stress and Bioactive Estrogen on the North Carolina Blue Crab Population using an Individual-Based Model
P19	Santos, N. (S)	Coastal hypoxia reduces trophic resource coupling and alters niche characteristics of an ecologically dominant omnivore
P20	Sherman, J. (S)	Identifying and Measuring Significant Changes in Submerged Aquatic Vegetation Biovolume using Single-beam SONAR Mapping in Turbid Low-salinity Estuaries of North Carolina
P21	Tudryn, T. (S)	Comparing Catch Per Unit Effort by Structure Type at Shallow and Deep-Water Artificial Reefs
P22	Warfel, Z. (S)	Interannual Variability in Morphometric Condition of Larval Mojarra
P23	Youtsey, L. (S)	COMPARING LOW SALINITY TRANSCRIPTOMIC PROFILES AMONG HARD CLAM *Mercenaria mercenaria* LINES

Student Lightning Presentations

Friday, March 25, 2022. 3 minutes each, 2 minutes Q&A

Time	Presenter	Title
9:00 AM	Wood, C.	Effects of Ship-Channel Dredging on Ichthyoplankton and Zooplankton Abundance and Species Composition in North Carolina Waters
9:05 AM	Easterling, E.	Quantifying the contributions of mesopelagic fishes to the biological pump in the North Pacific Subtropical Gyre using stable isotope analysis
9:10 AM	Theberge, K.	How fishing affects American lobster mating and reproduction
9:15 AM	Mathews, J.	Identifying Adult Atlantic Sturgeon Spawning Habitat and Estimating Abundance of Juvenile Atlantic Sturgeon within the Cape Fear River estuary
9:20 AM	Dixon, R.	Characterization of suitable habitat for juvenile striped bass (*Morone saxatilis*) in Chesapeake Bay

Oral Presentations

Friday, March 25, 2022 – Student Oral Presentations

Time	Presenter	Title
9:30 AM	McMains, A.	Oyster Aquaculture Installations as Habitat: An Acoustic Telemetry Study of Juvenile Sheepshead (Archosargus probatocephalus)
9:45 AM	Tharp, R.	Fine-scale movements of recreationally important reef fishes at two North Carolina artificial reefs
10:00 AM	Collins, M.	Locating Southern Flounder Winter Aggregations in the US South Atlantic using Pop-Up Satellite Tags
10:15 AM	Coleman, N.	Using Adaptive Resolution Imaging Systems (ARIS) to estimate the Fall Run Size for Atlantic Sturgeon in the Nanticoke-Marshyhope System
10:45 AM	Kohli, A.	Red Sore Disease of American eels
11:00 AM	Pochtar, D.	How to avoid becoming a zombie: Low salinity tolerance in white-fingered mud crabs as a mechanism to avoid castrating parasites
11:15 AM	Moore, C.	Parasites, not free-living taxa, indicate trophic complexity and faunal succession in restored oyster reefs
11:30 AM	Lee, T.	Macroinvertebrate Assemblages in the Invasive Alga Gracilaria vermiculophylla on the U.S. East Coast
11:45 AM	Mott, A.	Native tube-building polychaete prefers to anchor non-native alga over other macrophytes
1:30 PM	Conrad, H.	How egg production in summer flounder is affected by sex ratio
1:45 PM	Pelletier, C.	Reproductive dynamics of non-native Flathead catfish in the Cape Fear River estuary
2:00 PM	Clark, K.	The effect of density on reproductive activity in Atlantic sea scallops (Placopecten magellanicus)
2:15 PM	Schneider, A.	A comparison of blue crab spawning stocks in the 1990s and 2020s and the role of second-year spawners
2:30 PM	Woodard, N.	Borrowing ecological principles: Influence of orientation and habitat complexity on reef formation and biodiversity
2:45 PM	Smith, S.	Evaluation of habitat mosaics in a Virginia estuary and coastal lagoon
3:15 PM	Damiano, M.	Spatiotemporal population dynamics of common dolphinfish (Coryphaena hippurus) in the Western Central Atlantic
3:30 PM	Lambert, M.	Multi-decadal variation in community assemblage, spatial distribution, and phenology for juvenile fish in the Cape Fear River
3:45 PM	Nichols, Q.	Phenology in a Changing Environment: Ecological Forecasts of the Albemarle Sound/Roanoke River Striped Bass Stock Migration

Student Oral Presentations Cont.

Time	Presenter	Title
4:00 PM	O'Brien, K.	Ecological niche modeling and predicted shifts in available habitat for coastal sharks of the southeast Atlantic
4:15 PM	Schonfeld, A.	Environmental drivers of temporal trends in seasonal estuarine usage of Mid-Atlantic species

Saturday, March 26, 2022 – Professional Oral Presentations

Time	Presenter	Title
8:15 AM	Blakeslee, A.	Crabs without borders: early documentation of a range expanding species in coastal North Carolina
8:30 AM	Collar, D.	Temperature dependence of fast-start predator escape performance in mummichog Fundulus heteroclitus
8:45 AM	Gartland, J.	Coherence of Aggregate Biomass Ecosystem Indicators in the Mid-Atlantic Bight, USA
9:00 AM	Wang, V.	Ontogenetic spatial habitat consistency, extent, and constraint of U.S. Northeast fishes
9:15 AM	Aguilar, R.	Chesapeake Bay Barcode Initiative (CBBI): The first comprehensive genetic library for fish and invertebrates of the Mid-Atlantic US
9:30 AM	Luczkovich, J.	Linking Fishing Behavior and Ecosystem Dynamics Using Social and Ecological Network Models
10:30 AM	Dockendorf, K.	NC TOWER as an information source for conservation career mentorship programs
10:45 AM	Mirabilio, S.	Refinement and Testing of a Microprocessor-Based Shark Bycatch Reduction Device (M-B BRD) Using an Academic-Industry Partnership
11:00 AM	Scharf, F.	Evidence for partial and differential migration within an invasive catfish population: behavioral variation coupled with strong site fidelity
11:15 AM	Asch, R.	A MULTI-PRONGED APPROACH TO INVESTIGATE THE OFFSHORE MIGRATION OF SOUTHERN FLOUNDER FROM NORTH CAROLINA WATERS
11:30 AM	Legett, H.	River herring migrations and thermal regimes in Chesapeake Bay rivers
11:45 AM	Hager, C.	A Telemetry Index of Relative Importance for Passive Array Tracking Data.
12:00 PM	Richie, K.	Building strength within the acoustic telemetry community

Tidewater Chapter Meeting—March 2022

Directions for Presenters

Student Lightning Talks

All student lightning talks will be given consecutively on Friday, March 25. Lightning talks are given in 5-minute time slots. However, 30 seconds are reserved for changing speakers. We recommend that students plan for a 3-minute presentation, allowing for 1.5 minutes for questions. You are free to use that time however you wish. Typically, lightning talks involve one, or a few, PowerPoint slides. Lightning talks are not eligible for best student talk awards.

Oral Presentation

Student oral talks will be given on Friday, March 25 and talks from faculty and professionals will take place on Saturday. Oral presentations are given in 15-minute time slots. We recommend that speakers plan for a 12-13 minute talk, in order to allow time for questions.

Poster Presentations

Posters will be presented on Thursday, March 24 at the Coastal Studies Institute (room 262). The poster social will run from 6-9 pm, but presenters will be allowed to set up posters starting at 5pm. **We encourage that posters are made to fit a 30 x 40 inch space (or 40 x 30'')**. This size will allow you to use one of our provided poster-boards and easels. Posters that exceed 30 x 40'' can also be accommodated, but these will be hung on wall space. We will provide the necessary supplies for mounting posters with either of these options.

Uploading Presentations

Presentations can be uploaded to our system on Thursday at the Coastal Studies Institute, before or during the poster social. Please bring your presentation on a USB drive and we will have someone there to upload your talk and review your slides with you. If you are not attending the poster social, or are unable to upload your talk at that time, please email your talk to BOTH Verena Wang (wangv21@ecu.edu) and Jim Morley (morleyj19@ecu.edu) by Thursday evening. Arrive early before your session begins if you want to review your slides.

Student-Mentor Lunch Options

Friday March 25th

Sam & Omies (0.1 miles) — Sandwiches, burgers, seafood
#1 — Across the street from Jennette's Pier
https://www.samandomies.net/

The Sugar Shack Fish Market and Restaurant (0.5 miles) — Seafood, PoBoys
#2 – Nags Head causeway
https://sugarshackobx.com/seafood/

Freshfit Café (0.9 miles) — Grain or salad bowls, sandwiches, seafood, meat, vegetarian and vegan options
#3 — Nags Head causeway
https://obxfreshfitcafe.com/

Its All Gravy Italian Eatery (1.0 mile) — Italian food, hot and cold sandwiches
#4 — Nags Head, North of Jennette's Pier
https://www.facebook.com/itsallgravyobx

Grits Grill (2.5 miles) — Diner food
#5 — Nags Head, North of Jennette's Pier
http://www.gritsgrill.com/

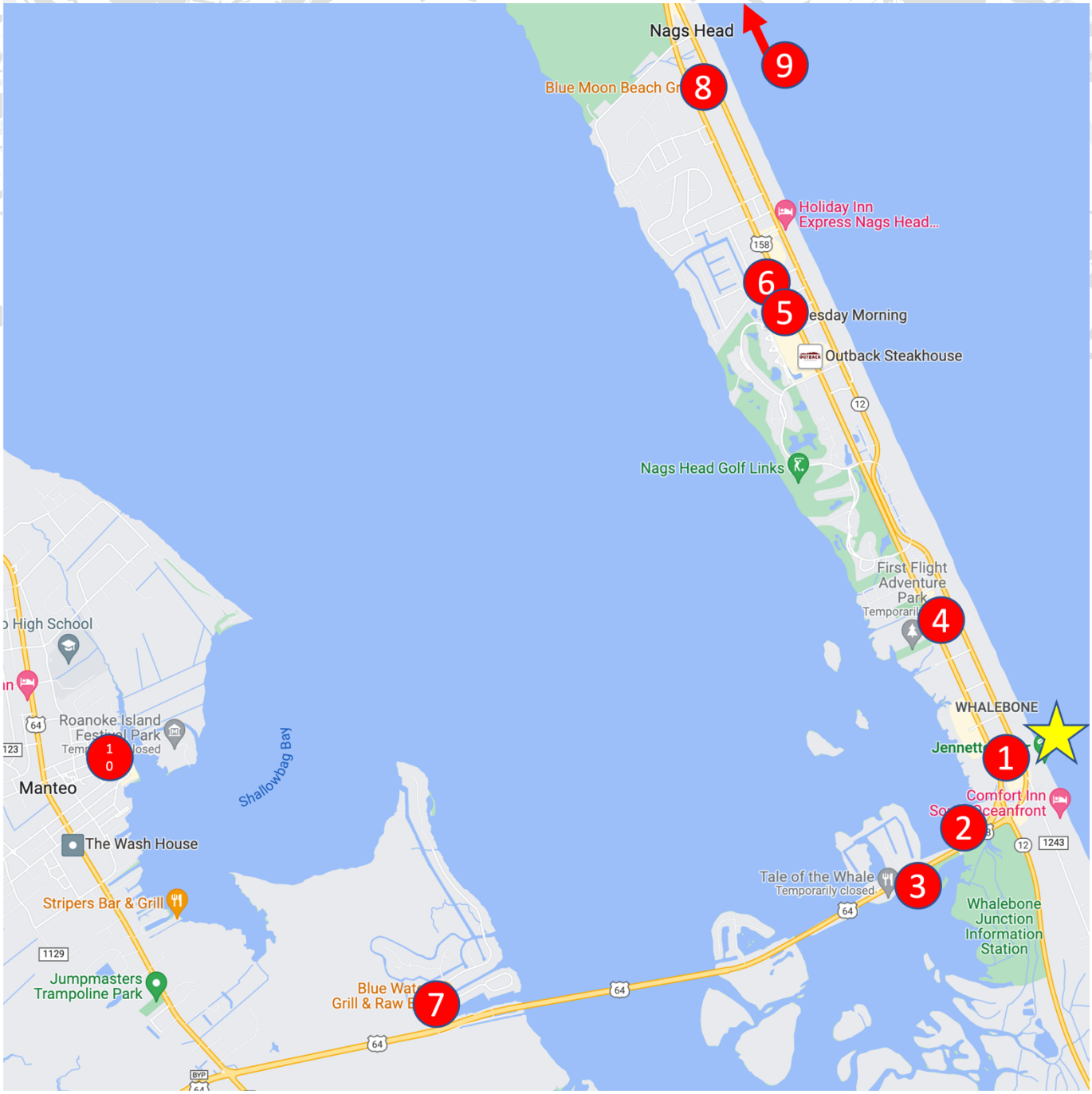
Woo Casa Kitchen (2.6 miles) – Spanish and Asian influenced cuisine
#6 – Nags Head, north of Jennette's Pier
http://woocasakitchen.com/

BlueWater Grill and Raw Bar (3.2 miles) — Seafood, burgers, soup & salad
#7 – Manteo, just over causeway bridge
https://www.bluewatergrillobx.com/

Blue Moon Beach Grill (3.7 miles) — Seafood, sandwich, burger, salad
#8 — Nags Head, north of Jennette's Pier
https://www.bluemoonbeachgrill.com/

Waveriders (5.5 miles) — Deli, Café with sandwiches & coffee
#9—Nags Head, North of Jennette's Pier
https://waveridersobx.com/

The Hungry Pelican (5.9 miles) — Deli with sandwiches
#10—Downtown Manteo
http://thehungrypelican.com/



Poster Abstracts

P1. Authors: **Brian S. Bartlett**, Rebecca G. Asch, Cheryl Harrison, Caitlin McGarigal, Naomi Jainarine

Presenter Affiliation: East Carolina University, Department of Coastal Studies

Providing Insight into Southern Flounder (*Paralicthys lethostigma*) Spawning Locations via Lagrangian Particle Dispersal Modeling

Southern Flounder (*Paralichthys lethostigma*) are an important species for commercial and recreational fisheries along the Southeast US coast. As a result of their importance, they are currently overfished and experiencing overfishing. In North Carolina, commercial landings are valued at $3-5 million annually. Spawning locations of Southern Flounder are currently unknown, making management a challenge. A particle dispersal model called the Connectivity Modeling System (CMS) was utilized to provide insight into the potential origins of Southern Flounder larvae caught off Beaufort, NC. CMS allows for simulated and backtracked larval dispersal through ocean conditions to estimate possible locations of origin. Thousands of particles representing Southern Flounder larvae were backtracked through ocean currents starting from larval capture dates in 2018 and 2019. Particles were randomly assigned ages based on an empirical age distribution from larval otolith dating. Trajectory pathways were plotted, as were probabilities of origination based on where larvae may have come from. For all release dates, dispersal showed variability due to small differences in release location and ocean turbulence. However, most dates suggested that Southern Flounder spawning occurs south of the capture site near the coast. During many weeks, hotspots of potential spawning habitat were identified in southern Onslow Bay offshore from Wilmington, NC. These findings are consistent with recent telemetry observations and may advise future research into locating Southern Flounder spawning sites. Identifying such sites may be key to successful Southern Flounder management and conservation.

P2. Authors: **David Behringer, Morgan Paris**

Presenter Affiliation: North Carolina Division of Marine Fisheries

NC Division of Marine Fisheries' Pamlico Sound Independent Gill Net Survey

Traditional methods used to monitor fish stocks have relied on catch composition and landings data from commercial and recreational fisheries. These fishery-dependent data sources are essential elements in stock assessments but have inherent biases associated with gear selectivity, non-reporting, seasonal closures, size and bag limit restrictions, and fluctuations in market value. Due to the biases associated with fishery-dependent data, it is ideal to also collect fishery-independent data to assess relative abundance of species. The North Carolina Division of Marine Fisheries' (NCDMF) Pamlico Sound Independent Gill Net Survey, which was initiated in 2001, is a stratified random gill net survey designed to provide an age-specific index of relative abundance for key estuarine species. Secondary objectives include: supplementing existing age, growth and reproductive studies, evaluating catch rates and species distributions to identify potential bycatch issues in gill nets, and characterizing habitat use. The primary benefit of this type of survey is the development of long-term indices of abundance, which

enables NCDMF and interjurisdictional partners to assess the status of fish stocks and track cohorts over time without relying solely on recreational and commercial fishery-dependent data. Data from this survey has been used in recent North Carolina southern flounder, striped mullet, and spotted seatrout stock assessments as well as Atlantic States Marine Fisheries Commission (ASMFC) bluefish, weakfish, and red drum stock assessments.

P3. Authors: **E. Biesack**, K. Hudson, R. Fisher, & J. McDowell

Presenter Affiliation: Virginia Institute of Marine Science

Developing an eDNA tool for detection of *Polydora* mudworms on oyster farms

As Virginia's shellfish aquaculture industry expands, the oyster market has become more competitive, with shell integrity and quality of the utmost importance. Shell can be negatively impacted by fouling organisms such as the mud blister worm, *Polydora websteri*, whose shell-boring behavior leads oysters to build blisters that affect their aesthetics and "shuckability". Though mitigation strategies exist, they are labor intensive and costly. A significant unknown is the optimal timing to implement mitigation efforts that minimize treatment costs while maximizing impact. Farmers often start treatments too late, when the fouling communities become visible on the product. We developed a species-specific environmental DNA (eDNA) assay that we are evaluating for use by the oyster culture industry for early detection of *P. websteri*. eDNA collections from water samples were paired with shell observations to test for the presence and prevalence of mudworms at an experimental oyster farm in the York River, VA over a period of 19 weeks. qPCR analysis demonstrates *P. websteri* eDNA in high copy numbers throughout the experimental time period compared to observations of new blisters, not observed until over a month into the experiment. Observations of *Polydora* worms and life stages were noted with microscopy. A second species of mudworm, *P. cornuta*, was also identified on the exterior of oyster shells throughout the season. Analysis of eDNA found that *P. websteri* was constantly present at a control site with no oysters, which suggests they were broadly dispersed in the water column during the sampling period.

P4. Authors: **Johnna Brooks**

Presenter Affiliation: North Carolina State University

Annual variation in the abundance and distribution of spotted seatrout (*Cynoscion nebulosus*) in North Carolina coastal waters

Characterizing the abundance of fish over both space and time is important to fisheries management, however, the spatial structure of fish stocks and seasonality are often ignored in stock assessments. The spotted seatrout (Cy*noscion nebulosus*) is a warm-temperate estuarine-dependent species throughout the U.S. South Atlantic and Gulf of Mexico. In North Carolina and Virginia, they are at the species' northern distributional extent and are therefore more susceptible to low temperature extremes in winter. Tagging studies suggested significantly higher natural mortality in winter months which was attributed to low temperature extremes. Such a strong seasonal influence has not been explicitly accounted for in the assessments. We, therefore, developed a monthly index of abundance for spotted

seatrout in North Carolina coastal waters by implementing a Vector Autoregressive Spatiotemporal model (VAST) based on a fisheries-independent survey conducted by the North Carolina Division of Marine Fisheries. The objectives of our study were to quantify the seasonal variation in the abundance and distribution of spotted seatrout within North Carolina waters and examine its relationship with the spatial extent and severity of cold stun events.

P5. Authors: **Madeline Burgess**, Hailey Conrad

Presenter Affiliation: Virginia Tech

Analyzing spatial trends and sex ratios in range shifts of Summer Flounder, *Paralichthys dentatus*

Summer flounder, Paralichthys dentatus, have been shifting their range northward over time in response to climate change. Throughout its range, summer flounder sex ratios have been shifting as well. The population has been increasingly masculinizing since the 1980s. Understanding the spatial structure and the sex structure of a stock is crucial to assessing stock resilience. It is important to identify whether there are regional differences in the changes to the sex ratio so we can assess whether the male and female populations are range shifting at the same rate. If they are range shifting at different rates, we would expect spatial differences in recruitment success and population viability. We conducted spatial analyses in ArcGIS to determine if there is spatial heterogeneity in how the sex ratio of the summer flounder population has been shifting. Fall, winter, and spring seasonal trawl data from NEFSC was used to accomplish this. We compared the changes in the sex ratio over time in the northern and southern half of the range. We also analyzed how the sex ratio has changed offshore of individual states over time. Information from this study could inform predictions about the future rate of reproduction of the stock.

P6. Authors: **Cooper S. Butts**, Roger A. Rulifson

Presenter Affiliation: East Carolina University, Biology Department

Population Characteristics of Alewife Spawning in Lake Mattamuskeet, 2015-2016

Lake Mattamuskeet, a coastal lake draining to Pamlico Sound, is situated in the federally owned Mattamuskeet National Wildlife Refuge in Hyde County, North Carolina. To prevent oceanic saltwater from entering the lake, water control structures have been placed in all four of the man-made canals. These canals allow for the movement of many aquatic species including the anadromous Alewife *Alosa pseudoharengus.* Populations of once abundant river herring have declined to all-time lows, mainly due to habitat loss and overfishing. The sudden and continued population decline along the US eastern seaboard has caused most US Atlantic coastal states to impose strict harvest limits in hopes of population recovery. The Lake Mattamuskeet Alewife population is limited by poor lake access through the water control structures to the spawning grounds during spring. There are currently two designs of flapgates being used to control water passage through the Waupoppin Canal. One design is a top-hinged

gate, while the other features a side-hinged gate. The objective of my study was to describe the length, weight, sex ratio, gonadosomatic index and condition factor of Alewife passing through the two gate designs in 2015 and 2016 and to determine whether one gate design was more efficient in Alewife passage. It was found that the side-hinged design allowed for a more efficient and varied passage of Alewife.

P7. Authors: **Paul J Clerkin**, Jan R McDowell

Presenter Affiliation: Virginia Institute of Marine Science

New Methods of Detecting an Old Group of Fish: Surveying Chondrichthyans Using Genetic Barcoding, eDNA, Deepwater Cameras and Artificial Intelligence

Chondrichthyans (sharks, rays, and chimaeras) are top predators in almost every environment they inhabit and thus are important to overall ocean health. However, about half of all known chondrichthyans have been accessed as Data Deficient by the International Union for the Conservation of Nature, making management challenging or impossible. This lack of data is largely due the costs of physical surveys, employing experts at sea, and limitations in sampling certain areas— complicated by physical structures such as wind farms, hindered access such as remote, deepwater, or MPAs and other restricted and protected areas. Currently, traditional surveys rely on physical collection of specimens and a trained taxonomist or equivalent expert to identify them and collect data. This project aims to expand upon fish-in-hand surveys and develop alternative methods for detection including environmental DNA (eDNA) and underwater cameras. We plan to expedite physical surveys by using verified pictures of chondrichthyan species to train artificial intelligence (AI) to identify specimens to species based on an image. We will then use AI to augment an information management system to aid in higher resolution data collection. This study will be conducted in conjunction with research longline surveys in the coastal mid-Atlantic and onboard a commercial deep-sea trawler in the Southwestern Indian offshore. The findings from this study will allow regional groups to better collect and organize chondrichthyan data and fill in the major gaps in our knowledge necessary to manage this important and understudied group.

P8. Authors: **Rahdiaz T. Delvillar**, James W. Morley

Presenter Affiliation: Department of Biology, Coastal Studies Institute, East Carolina University

Do Oyster Farms Have Enriched Soundscapes?

Oyster aquaculture has become increasingly popular in NC. Lease applications have increased from near-zero in 2009 to the hundreds in 2020-2021. With increasing oyster farms appearing in our waters, what soundscapes do they bring to estuaries? To determine if the presence of an oyster lease will deter or attract fish, we conducted the following research. An underwater sound recording device called a hydrophone was deployed inside of multiple oyster farms spanning from Wanchese to Hatteras. A control site was selected for each farm where the device was also deployed on the same day to serve as our control. The sound files were then uploaded into an audio software that allows for removal of any unwanted noise from waves, boats, and birds. Upon listening to the hydrophone recordings from an

oyster farm and comparing it to its corresponding control site, we were able to notice how relatively quiet the control sites were. Recordings from the inside oyster farms was able to pick up drumming fish choruses and crustaceans clicking at a much higher frequency and volume. Some species such as the oyster toadfish were heard making their famous “boat whistle” like call which is meant to attach a mate. This tells us that not only do oyster farms attract fish, but they serve as possible breeding grounds for certain species as well.

P9. Authors: Vaskar Nepal, Mary C. Fabrizio, Troy D. Tuckey, **Maggie Dillon**

Presenter Affiliation: Virginia Institute of Marine Sciences

The effect of temperature on metabolic rate and body condition of invasive Blue Catfish

Blue catfish *Ictalurus furcatus* is an invasive species in many tidal rivers of the Eastern United States. A critical impediment to predicting future distribution of blue catfish—and hence its impacts in novel estuarine environments—is the limited information on the potential effects of climate change on the vital rates of the species. We conducted a laboratory experiment to assess the effects of gradual changes in temperature on metabolic rate and body condition of wild-captured, subadult blue catfish. We exposed individuals to temperatures ranging between 7 and 37°C, and measured oxygen consumption rates using intermittent flow respirometry. Blue catfish had the highest metabolic scope at 28°C, representing an optimal temperature similar to those of other large North American catfishes. Interestingly, many fish were able to survive temperatures as high as 35°C. The relative body condition of blue catfish remained fairly constant at 32°C and lower, but declined at higher temperatures. These results suggest that blue catfish may survive exposures to gradual increases in temperatures predicted under the current climate-change scenarios.

P10. Authors: Janet Nye, **Sally Dowd**, Lisa Colburn, Ingrid E. van Putten

Presenter Affiliation: University of North Carolina at Chapel Hill

A comparison of coastal community vulnerability between the US and Australia in a changing climate

Extreme events, such as marine heatwaves, are increasing as a result of anthropogenic climate change. These climate pulses originate from interactions between atmospheric and oceanographic processes and have been shown to have overwhelmingly negative ecological and socioeconomic consequences. For communities that utilize marine resources, it is important to assess their risk, defined in the IPCC AR5 report as the potential for a system to experience climatic-induced consequences. This study compares the risk of coastal communities involved in fishing in the U.S. and Australia due to marine heatwaves and pre-existing socio-economic conditions. To do so, we

multiply the hazard (cumulative intensity of marine heatwaves) by the exposure (percentage of population involved in fishing) and vulnerability (a metric comprising various socioeconomic and demographic indicators). Though our analysis is still preliminary, the combination of these three components of risk creates definable differences with various implications for the U.S. and Australia.

P11. Authors: **Amy E. Fowler**, Grace Loonam, April MH Blakeslee

Presenter Affiliation: Department of Environmental Science & Policy, George Mason University

Field surveys and comparative parasitology of freshwater native and invasive snails in Virginia

Exotic freshwater gastropods, and their parasites, have invaded ecosystems through deliberate introductions and/or accidental transfer. We investigated whether the Japanese mystery snail, *Heterogen japonica*, experiences parasite release in introduced populations (snail species was confirmed by mitochondrial barcoding gene COI). Six locations from Richmond, Virginia to Washington, D.C. were surveyed for non-indigenous and indigenous snails in 2018 and 2019. A random subset of each species was measured, dissected, sexed, and examined for endosymbiont abundance and diversity. Brooding embryos were also counted in non-indigenous snails. They have experienced a genetic bottleneck in the introduced range. *Heterogen japonica* populations were female skewed, and brooding females were significantly the largest in size. *Heterogen japonica* were uninfected by trematode parasites at most sampled sites but had up to 34% prevalence of aspidogastreans at two sites. Female *H. japonica* infected with aspigodastreans had signficantly fewer broods. Among all snails, there was a higher diversity of trematode (digenean and aspidogastrean) parasites in indigenous snails. Trematode diversity and infection depended on site, snail sex, and snail species. The two populations of *H. japonica* that had high prevalence of aspidogastreans co-occurred with indigenous snails (*Elimia virginica)*. Genetic data found two cryptic lineages of aspidogastreans, and one was shared between *H. japonica* and *E. virginica*, suggesting host-switching has occurred. Parasites can play powerful roles in interspecific relationships, influence species interactions, and even impact ecosystem functioning. The ability of parasites to host switch could further influence community interactions in this system, particularly if *H. japonica* continues to spread.

P12. Authors: **Sarah R. Greenberg**, Amy E. Fowler

Presenter Affiliation: Department of Environmental Science and Policy, George Mason University

Is there a lesser of two evils? Castrating parasites of an estuarine crab host of the Chesapeake Bay along a salinity gradient

Estuarine organisms can move to extremes of a salinity gradient to evade competition, predation, or parasitic infection, however osmotic stress results in reduced fitness and fecundity. In the Chesapeake Bay, the white-fingered mud crab (*Rhithropanopeus harrisii* – *Rh*) is parasitized by the

rhizocephalan barnacle *Loxothylacus panopaei* (*Lp*) and isopods of the genus *Cancrion*. Both parasites are castrators, however it is unknown to what extent *Cancrion* castrates *Rh.* Both *Rh* and *Cancrion* are found in low salinities, whereas *Lp* cannot survive <10ppt. To determine if a true environmental refuge against parasitism exists for *Rh, Rh* from nine Chesapeake Bay populations were collected bi-monthly for 18 months, counted, and dissected to capture host-parasite seasonality and to calculate individual and reproductive stress. This study will (1) determine how salinity shapes the spatiotemporal distribution *Rh* and the two endoparasites, and (2) elucidate to what extent these parasites impact *Rh* reproduction. Preliminary data suggests that there will be increased *Lp* prevalence >10ppt and increased *Cancrion* sp. prevalence <10ppt, in addition to infection resulting in individual and reproductive stress to *Rh*. This unique host-parasite relationship can reveal how selective tradeoffs in dynamic environments such as estuaries can shape host distribution and ecology.

P13. Authors: **Hagemeier, H.D.**, Blakeslee, A.M.H.

Presenter Affiliation: Department of Biology, East Carolina University

Parasite Diversity in the Invasive Asian shorecrab, *Hemigrapsus sanguineus*, on the Eastern Coast of the United States

Non-indigenous species can have strong interactions in invasive ranges and may be better competitors than co-occurring native species due to enhanced physiological performance associated with lower parasite loads. However, an invasive host's release from parasites may change with time if it becomes susceptible to parasites in the invaded range the longer it is present in the system. Moreover, geography and season may influence the parasite assemblages a non-indigenous species comes in contact with in its invasive range. We evaluated the diversity, richness, and intensity of metazoan macroparasites in the Asian shorecrab, *Hemigrapsus sanguineus,* throughout the entirety of its current established invasive range along the eastern seaboard of the US. Specimens were collected seasonally in 2020 from 5 sites, ranging from the southern edge (North Carolina) of its distribution to the northern edge (mid-coast Maine) and three core sites. On average, 20 crabs per site per season were dissected and evaluated for macroparasite infection. We found three parasite taxa (nematodes, acanthocephalans and cestodes) varying in intensity throughout the range, with most occurring in northeast USA populations and later in the season. Our work identified a new parasite taxon, a cestode from a single crab, but we did not observe any trematode parasites as had been found in prior surveys. Most infections were of acanthocephalans, which were in higher loads than in past work. Finally, our work confirms past surveys (2001-2016) demonstrating a reduction in the crab's escape from parasites with time, likely due to increased interactions with native parasites over time.

P14. Authors: **Naomi Jainarine**, JP Everhart, Rebecca Asch

Presenter Affiliation: East Carolina University

Phenological Analysis of Winter Predator-Prey Dynamics Between Ichthyoplankton and Zooplankton Abundance in Beaufort Inlet

As temperatures increase over time, it is important to learn how cyclic or seasonal patterns in the marine environment are changing. This is especially true for ichthyoplankton that are expected to successfully recruit to a fishery and sustainably contribute to the spawning stock biomass of a given fishery. Under the framework of Cushing's Match-Mismatch hypothesis, the degree of match and mismatch between larval fish and their prey (zooplankton) can help explain variability in recruitment. This project aims to assess potential mismatches between predator abundance and prey availability as a response to temperature. This will be done using historical data from NOAA's Beaufort Inlet Ichthyoplankton Sampling Program (BIISP) and zooplankton samples collected by East Carolina University (ECU). We have supplemented NOAA's core sampling season with the simultaneous deployment of a zooplankton net (200-µm mesh) during ichthyoplankton sampling since 2017. Using data from 2017-2019, this analysis will look at how the abundance of adult copepods and nauplii coincide with the peak ingress time of *Leiostomus xanthurus* and *Micropogonias undulatus* larvae in the winter by calculating the degree of phenological mismatch between these two events. It is hypothesized that the degree of mismatch between the two winters will not be significantly different. This analysis will inform future methods looking at predator-prey dynamics of various fish species and prey taxa over a greater time period and in relation to multiple environmental variables. Understanding how larval abundance is influenced by changing seasonality, prey availability, and environmental drivers can help inform recruitment models in an ecosystem-based framework.

P15. Authors: **Madeline Johnson**, Andrew McMains, James Morley

Presenter Affiliation: East Carolina University

Hatch dates and habitat use of juvenile sheepshead Archosargus probatocephalus in North Carolina estuaries

Important life history information for sheepshead (Archosargus probatocephalus) is missing for populations in North Carolina and the southeastern United States. Commercially and recreationally important, sheepshead currently lack a formal stock assessment or management plan in North Carolina. Recently, potential spawning aggregations of adult sheepshead have been identified in nearshore habitats, but there is little information regarding the spatial extent of juveniles recruiting to coastal North Carolina, or how spawning periods might differ across major estuarine systems. Sheepshead are thought to prefer structured areas including biogenic habitats such as oyster reefs and seagrass beds. We placed traps in biogenic and non-biogenic habitats within three locations in Pamlico Sound to determine distribution and fine-scale habitat preferences of juveniles. Daily increments of otoliths from fish collected across the State were examined to determine hatch dates

of juvenile sheepshead. Marginal increment analysis found that hatch dates corresponded to a spring spawning season, which matches the timing of identified spawning aggregations. Our data will provide important information to fisheries managers, allowing for future efforts to protect spawning adults, examine stock structure, and to aid in understanding juvenile life history dynamics and annual abundance.

P16. Authors: **Justin Mitchell**, Rebecca Asch, Joseph Luczkovich, Roger Rulifson, Patrick Harris, Derek Aceituno

Presenter Affiliation: Department of Biology, East Carolina University

Growth and Reproduction of Southern Flounder (*Paralichthys lethostigma*) in North Carolina

Understanding the movements and reproductive behavior of fish populations will allow for a more accurate stock definition to be developed to better protect said species. Southern Flounder (Paralichthys lethostigma) is a historically valuable commercial finfish species in North Carolina and has become overfished and is experiencing overfishing, making the population vulnerable to collapse. With improved knowledge about the life history characteristics related to their growth and reproduction, management plans may be created to protect its stock and assist with its recovery. Southern Flounder were collected from Albemarle, Pamlico, and Core Sounds and offshore of Cape Fear from Fall 2020 to Fall 2021. Length (mm, TL) and weight (g) data were collected, and both sagittal otoliths and the gonadal tissue were removed. The gonads were weighed (g) to calculate the gonadosomatic index (GSI), while the right sagittal otoliths were aged whole. In total, 432 Southern Flounder were collected, with 351 females, 74 males, and seven immature individuals. Length data displayed sexual dimorphism, with males averaging 325.1 mm TL (15.9 mm S.D.) and females 395.2 mm TL (38.8 mm S.D.). The sampled Flounder had an age distribution ranging from 0-4 years, with a majority being one (n=265) and two (n=121) years of age. GSI showed a significant increase during the fall in preparation for winter spawning. The data collected will provide information on Southern Flounder life history and will be expanded upon in the future by conducting histological and otolith microchemistry analysis for greater a understanding of its movement and reproduction.

P17. Authors: **Murphy, T.E.**, J.T. Molina, D.M. Quill, P.A. Billeter, K. Mattes, and R.J. Woodland

Presenter Affiliation: University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory

Seagrass stable isotope composition provides seascape-scale tracking of anthropogenic nitrogen inputs in a tropical marine lagoon

We use the seagrass *Thalassia testudinum* as a sentinel for tracing nutrient inputs and movements in Ambergris Caye Lagoon, Belize, a region heavily dependent on ecotourism and working to expand its network of marine protected areas (MPAs). Seagrass samples were collected along a 24-km

section of the lagoon, with stations bracketing the urban center of San Pedro. Leaf tissue carbon:nitrogen (C:N) stoichiometry, stable isotope composition ($\delta^{13}C$, $\delta^{15}N$), and epiphyte load (mg cm^{-2}) were analyzed relative to location and proximate land use. Seagrass tissues showed a modal pattern in $\delta^{15}N$ composition along the north-south axis of the lagoon, with maximum average values occurring adjacent to or slightly down-current of the most urbanized areas of San Pedro. Offshore seagrasses were enriched in $\delta^{13}C$ relative to inshore areas but there was not a consistent relationship with adjacent land use. Tissue C:N and epiphyte load decreased monotonically from south to north. Impervious surface cover adjacent to lagoon sites was positively related to $\delta^{15}N$ values, but negatively related to tissue C:N and epiphyte load. Isoscapes of $\delta^{13}C$ and $\delta^{15}N$ highlighted the location and potential sources of nutrient input to the lagoon, some of which occurred within MPAs. These results support the application of seagrass tissue stable isotope composition analysis as a low-cost and time-integrated means of tracing nutrient inputs in some naturally oligotrophic ecosystems. Spatially-explicit information on nutrient inputs is vital for natural resource managers and land-use planners to identify, mitigate, and control sources of anthropogenic eutrophication in tropical coastal ecosystems.

P18. Authors: **Alex Rocco**

Presenter Affiliation: North Carolina State University

A Reason to Feel Blue? Evaluating the Impacts of Environmental Stress and Bioactive Estrogen on the North Carolina Blue Crab Population using an Individual-Based Model

Individual-based models, which build a population of individual organisms with variable characteristics such as growth rates, fecundity, and survival, are widely used in fisheries science. The variability of characteristics between individuals helps bridge the gap between small-scale ecological processes and large-scale effects. We are building an individual-based model the life history of North Carolina's blue crab stock (*Callinectes sapidus*). North Carolina's recent blue crab stock assessment found that the population is overfished and overfishing is occurring. Two of the major threats to the blue crab stock in North Carolina are climate change and input of endocrine-disrupting chemicals, mainly bioactive estrogen, into freshwater and marine ecosystems. This model will be used to predict the effect of these two threats on the future viability of North Carolina's blue crab stock. The model will be built with several submodels to add variability to individuals within the population and ensure the model is a detailed and accurate representation of the population ecology of the stock. The climate submodel has several temperature schemes which will allow for comparison between different climate scenarios. The bioactive estrogen submodel will have a concentration selection with varying physiological effects depending on estrogen concentration. These individual effects will likely affect the ecology of the model. The results of this model will provide information for management of the blue crab stock in North Carolina.

P19. Authors: Kennedy Quillen, **Nina Santos**, Jeremy M. Testa, and Ryan J. Woodland

Presenter Affiliation: Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science

Coastal hypoxia reduces trophic resource coupling and alters niche characteristics of an ecologically dominant omnivore

Energy and biomass move through a variety of trophic pathways in coastal ecosystems, with pelagic and benthic pathways often dominating food web dynamics. Consumers that couple these pathways play important structuring roles in these food webs by integrating spatially disconnected or asynchronous production pathways. The objective of this study was to quantify benthic and pelagic trophic pathway contributions to the diet of the mysid *Neomysis americana* in the Choptank and Patuxent rivers and determine if the relative contribution of these trophic pathways differs between ecosystems with different environmental, physical, and watershed features. Mysids and trophic resources were collected in each river during the summers of 2018 and 2019 and analyzed for carbon and nitrogen stable isotope composition and tissue stoichiometry (C:N). Stable-isotope based estimates of benthic trophic pathway contribution, trophic position, and isotopic niche area (proxy for trophic niche) and C:N composition of *N. americana* were compared within and between tributaries. Overall, mysids in the Patuxent River assimilated less benthic material, realized lower trophic positions, and had lower C:N ratios than Choptank River mysids. This study provides evidence that hypoxic conditions in the Patuxent reduced the strength of benthic-pelagic coupling by *N. americana* and, further, is associated with lower trophic position and a reduced stoichiometric marker of lipid storage. *N. americana* are a dominant prey taxon for many predators, underscoring the importance of this species to local food webs and the potential for bottom-up effects on the dynamics of coastal ecosystems in response to changes in their trophic ecology.

P20. Authors: **Sherman II, J.**, Luczkovich J.

Presenter Affiliation: Department of Biology, East Carolina University

Identifying and Measuring Significant Changes in Submerged Aquatic Vegetation Biovolume using Single-beam SONAR Mapping in Turbid Low-salinity Estuaries of North Carolina.

Submerged aquatic vegetation (SAV) is essential fish habitat, but we do not understand how it is varying over time, and if there are gains or losses of this critical resource for fish. Therefore, we established a monitoring program to examine how SAV has changed at sentinel sites in the low-salinity regions of the Albemarle and Neuse estuaries from 2015-2019. We mapped and analyzed SAV using two different single-beam SONAR echo sounders (BioSonics DT-X and Lowrance Elite 9 Ti). We followed the Albemarle Pamlico National Estuarine Partnership (APNEP) SAV SONAR protocol developed for sentinel sites to allow the comparison of sites over multiple years. Boat-based SONAR data of vegetation cover along 40 shore-perpendicular transects at each sentinel site were collected and analyzed using SAV detection algorithms, exported to ArcMap, interpolated with an ordinary co-kriging method to produce predicted surfaces for biovolume and percent coverage.

Changes in area covered by SAV between years were calculated by subtracting the earlier year (t1) kriging surface layer from the later year (t2) surface layer for each sentinel site. In the Neuse River, there were observed increases in the SAV areal extent cover at two sites and a decrease in vegetation coverage at another. In the Albemarle Sound, one site showed a massive loss of 35 ha from 2015 to 0 ha in 2019 and another site showed a small loss of 5 ha. Most sentinel sites showed a loss of SAV and thus a decline in essential fish habitat.

P21. Authors: **Taliana M. Tudryn**, Ryan M. Tharp, Jeffrey A. Buckel

Presenter Affiliation: Department of Forestry and Environmental Resources, North Carolina State University Center for Marine Sciences and Technology

Comparing Catch Per Unit Effort by Structure Type at Shallow and Deep-Water Artificial Reefs

Artificial reefs are often used to enhance the habitats/populations of species valuable to hard-bottom recreational fisheries. However, decision-making around the deployment of new reefs and structures is primarily driven by logistics (e.g., availability of construction debris or funds for reef balls) rather than metrics relevant to the management of recreational fisheries (e.g., fishing success). Few studies have assessed the effects of different reef materials on catch per unit effort (CPUE) of species valued by recreational fishers. In the summer of 2021, five structure types (concrete pipes, manhole sections, reef balls, sunken ships, and high-profile metal) at two reef sites east of Cape Lookout, North Carolina were fished using hook and line gear. Total and species-specific catch and effort data were grouped by reef site and each visit to a structure type (72 total visits). CPUE was calculated by dividing the number of fish caught at each visit by the number of drops at each visit. Overall, CPUE at the shallower reef was higher than the deeper site; thus, comparisons of catch by structure type were done separately within each depth. Kruskal-Wallis tests showed that there were no statistically significant differences in total or species-specific CPUE according to structure type at either reef site. While these results suggest that structure type may not have meaningful effects on CPUE, further study is required to investigate if CPUE varies significantly when artificial reef structures are grouped by other attributes (e.g., reef height).

P22. Authors: **Zachary Warfel**, Rebecca Asch

Presenter Affiliation: East Carolina University

Interannual Variability in Morphometric Condition of Larval Mojarra

While larval abundance has been surveyed in past three decades in Beaufort, NC, variations in larval abundance have not been consistently related to recruitment for many fish species, including larval Mojarra (*Eucinostomus* sp.). By studying how environmental factors affect the morphometric condition of fish larvae, we may be able to better anticipate when a high or low recruitment year occurs since condition affects fish growth and survival. This project aims to understand the relationship between morphometric condition in comparison with environmental variables [e.g.,

temperature, mesozooplankton volume, day of year (DOY)] among Mojarra from 2017-2018 to determine if there is interannual variation in how oceanic conditions affect this fish. We hypothesize that when zooplankton is abundant, there will be better body condition of larval fish. We also test if morphometric condition of Mojarra will decrease due to stress caused by summer temperatures. Lastly, we examine if Mojarra body condition reacts consistently to these environmental variables across multiple years. Principal component analysis was performed on seven indicators of morphometric conditions to create composite indices. The first three principal components (PCs) were used as independent variables in a generalized additive model (GAM) to determine if body condition was related to environmental variables. Body condition increased with food availability in PCs 1 and 2. Optimal body condition was also related to DOY in PCs 1 and 2. Temperature had a significant effect on body condition for PC 3, but not for the previous PCs, which explained a greater proportion of variation in morphometric condition. These results indicate that food availability and day of year may be more important to fish body condition than temperature in larval Mojarra.

P23. Authors: **Leslie S. Youtsey**, Jan McDowell, Kimberly Reece

Presenter Affiliation: Virginia Institute of Marine Science

COMPARING LOW SALINITY TRANSCRIPTOMIC PROFILES AMONG HARD CLAM *Mercenaria mercenaria* LINES

Assessment of how the hard clam, *Mercenaria mercenaria* (Linnaeus, 1758), responds to environmental changes, like salinity fluctuations, is an existing need. The hard clam is an important ecological and economic resource along the US Eastern Seaboard. In Virginia alone, the farm gate value of the hard clam in 2018 was $38.8 million, making it the largest aquaculture industry in Virginia. This growing industry is primarily limited to higher salinity habitats on the seaside of the Eastern Shore of Virginia or lower Chesapeake Bay. Even in areas of higher salinity, hard clams are vulnerable to extreme precipitation events, which can lead to hyposaline (low salinity) stress and threaten natural and aquacultured hard clam populations. Osmotic stress, like a drop in salinity, can lead to altered gene expression and cell cycle events. Transcriptomic analysis is a powerful tool for exploring the relationship between phenotype and genotype, enabling a better understanding of how hard clams respond to stress.

Genetically distinct hard clam populations originating from varying salinity habitats along the U.S. Eastern Seaboard have been identified and some of these populations were used to establish lines at the VIMS Eastern Shore Laboratory (ESL): Wachapreague Channel, VA (WC); Pocomoke Sound, VA (PS); Mobjack Bay, VA (MB); Great Bay, NJ (NJ); Cape Cod, MA (CC); and Bogue Sound, NC (NC). As small juveniles, clams spawned from these lines were shown to have differences in respiration performance after low salinity exposures as part of the graduate work of VIMS student Anthony Himes. In 2019, F1 generations of WC, PS, MB, NJ, and CC clams were spawned, and in 2021, F1 crosses were spawned and include WC x WC (control), WC x PS, and NC x CC. Three clams from each of the 2019 spawns were exposed to 35 ppt and 15 ppt salinities for 26 hours. After exposures, gill

tissue was sampled and placed in RNA preservative. Four replicates of 10 clams spawned in 2021 were also exposed to 35 ppt and 15 ppt salinities for 26 hours. Tissue from two groups of four clams from each replicate was pooled and placed in RNA preservative.

Whole transcriptome shotgun sequencing (WTSS), also known as RNA-Seq, will be used to explore the mRNA expression patterns of the hard clam when faced with ideal (35 ppt) and low (15 ppt) salinity conditions. Comparing mRNA expression patterns among genetically distinct clam lines that are derived from populations that experience different salinity patterns will provide important information about genes involved in response to salinity stress. RNA-seq will also be used to identify genotypic differences in the form of single nucleotide polymorphisms (SNPs). SNPs associated with specific genes that are linked with traits of interest can be powerful molecular markers. A comparative transcriptomic study is the link between the genetic and physiological variation seen among hard clam populations and could lead to SNPs for improved selection of hard clams for better low salinity tolerance by the aquaculture industry.

Student Lightning Presentation Abstracts

L1. Authors: **Ceilia Wood**, Rebecca G. Asch

Presenter Affiliation: Department of Biology, East Carolina University

Effects of Ship-Channel Dredging on Ichthyoplankton and Zooplankton Abundance and Species Composition in North Carolina Waters

Ichthyoplankton are susceptible to changes in marine environments as they enter estuaries from the sea. Sediment brought up by marine dredging can affect feeding and vision of fish larvae and is also detrimental to fish eggs. Policies in North Carolina recently changed on a trial basis to permit ship-channel maintenance dredging at any point in the year, while previously this activity was only permitted in winter months. Since little sampling of the ichthyoplankton community has been done in summer, it is unknown how this anthropogenic activity may affect fish larvae, which are important for maintaining productive stocks for fisheries. In Beaufort Inlet and Cape Fear River Inlet, inshore and offshore sampling was conducted in the summers of 2020 and 2021 to examine the effect that marine dredging could have on the abundance and diversity of ichthyoplankton and zooplankton. A before-after control-impact (BACI) study design was used. Fish larvae are being enumerated and identified to the species level to assess dredging impacts, whereas zooplankton samples are being scanned with a novel instrument called Zooscan that can identify taxa and calculate their size frequency in a semi-automated manner using a machine learning algorithm. Scanning of samples is underway but has not been fully completed. Preliminary results show there is an effect on abundance of zooplankton close to the vicinity of dredging. The anticipated results of this project could show that there are environmental windows of when dredging may have less of an impact on marine fauna.

L2. Author: **Elise Easterling**, Rebecca Asch

Presenter Affiliation: Department of Biology, East Carolina University

Quantifying the contributions of mesopelagic fishes to the biological pump in the North Pacific Subtropical Gyre using stable isotope analysis

Due to their vertical migratory mode of feeding, mesopelagic fishes are believed to be a major mechanism for transporting organic matter below the euphotic zone. After feeding at the surface at night, the fishes retreat to depths below 200 meters during the day where carbon is released through fish respiration, defecation, and mortality. My research objective is to develop a method of tissue analysis that quantifies the amount of carbon that is potentially sequestered in the water column and seafloor by measuring the carbon ingested as food and expelled as waste by mesopelagic fishes. I will utilize samples collected from Station ALOHA, located in North Pacific Subtropical Gyre. The mesopelagic fishes captured during the 2019 cruise were very small (<30 mm TL). Size limitations may hinder separating the stomach lining and gut contents. In that case, we will estimate the amount of carbon in their stomach by determining an allometric relationship between fish size/weight and the carbon biomass in the stomach lining using fish species sampled in Beaufort, NC. If consistent across species,

the allometric relationship from Beaufort samples will be used to estimate carbon content in the stomach lining of Hawaiian fishes, thus, providing a method to calculate carbon in gut contents. Stable isotope analysis will be performed on both the Hawaiian and Beaufort fishes to determine carbon content of stomach lining and gut contents. Due to their large biomass, we anticipate mesopelagic fishes play a substantial role in providing a pathway to sequestering carbon deep into the ocean.

L3. Authors: **Kaitlyn Theberge**

Presenter Affiliation: Virginia Tech

How fishing affects American lobster mating and reproduction

American lobster (*Homarus americanus*) are highly abundant in the Gulf of Maine right now, but a healthy adult population does not guarantee successful recruitment. Recently there was a decline in lobster recruitment, however the specific mechanisms that caused the decline are unknown. The question of how fishing interacts with lobster mating and reproduction is an important piece of understanding recent and future patterns in the fishery. Fishing that targets a specific size range and sex may alter the size structure of the population and skew sex ratios. I will examine how individual growth and maturation contribute to changes in lobster recruitment under various management regimes to simulate these scenarios. I will then compare findings for the American lobster with similar simulations for the European lobster (*Homarus gammarus*), whose mating systems have been studied in greater detail in the context of management protections. Future population changes are predicted to occur in the Gulf of Maine with climate change and warming waters. Previous simulation work has shown that stricter management decisions could have slowed the decline of American lobster in southern New England. Understanding the fundamental drivers of how fishing may alter recruitment success in lobsters may lead to more informed management decisions that can increase fishery resilience to future changes in temperature and climate.

L4. Authors: **Joseph Mathews**, Fred Scharf

Presenter Affiliation: University of North Carolina Wilmington

Identifying Adult Atlantic Sturgeon Spawning Habitat and Estimating Abundance of Juvenile Atlantic Sturgeon within the Cape Fear River estuary

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a long-lived species, with a range extending from Labrador, Canada to Cape Canaveral, Florida. This species was historically an important commercial fishery throughout much of its range. However, overfishing, anthropogenic factors, and changing environmental conditions, have contributed to a severe decline in population levels. Our research objectives are to identify adult Atlantic sturgeon spawning habitat through passive acoustic telemetry and to estimate abundance of juvenile (age 0-1) fish in the Cape Fear River estuary. In 2021, five adult male Atlantic sturgeon (1620-1820 mm FL) were tagged 2-4 kilometers below Lock and Dam 1 (LD1) in the mainstem of the Cape Fear River. Three of the five acoustically tagged individuals left the system shortly after being tagged, however two individuals remained directly below LD1 for ten consecutive days, consistent with spawning behavior. We tagged 48 juvenile Atlantic sturgeon (308 – 548 mm FL)

and recaptured 7 (471-550 mm FL) in 2021. Abundance estimates for juvenile Atlantic sturgeon were derived using the Schumacher-Eschmeyer mark recapture method, we estimated 186 (95% CI = 110 – 600) individuals. The prolonged presence of the two adult male Atlantic sturgeon just below LD1 and capture of juvenile, and sub adult Atlantic sturgeon in the Brunswick River at the freshwater/saltwater interface is consistent with reoccurring spawning behavior in the Cape Fear River estuary.

L5. Authors: **Rachel L. Dixon**

Presenter Affiliation: Virginia Institute of Marine Science

Characterization of suitable habitat for juvenile striped bass (*Morone saxatilis*) in Chesapeake Bay

Estuarine environments are characterized by large spatial and temporal fluctuations in hydrodynamic conditions. This variation impacts the extent of suitable nursery habitats available to fishes during early life stages in a given year. For fishes that remain in natal estuaries for the first several years of life, availability of suitable habitat may impact the survival and production of juveniles and subsequent recruitment to the adult population. Young-of-the-year (YOY) Striped Bass (*Morone saxatilis*) produced in Chesapeake Bay tributaries support coast-wide recreational and commercial fisheries by contributing a significant proportion of juvenile fish to the Atlantic coastal stock, but the mechanisms that promote strong recruitment are not fully understood. To address this question, a data-driven approach was utilized to develop space-based habitat suitability models to quantify the extent and quality of habitats used by YOY Striped Bass throughout Chesapeake Bay. An assessment of the persistence of suitable habitat conditions across nurseries and through time may inform habitat restoration and conservation efforts and provide insights into overall stock productivity under future climate and management scenarios.

Student Oral Presentation Abstracts

OS1. Authors: **Andrew McMains**, Lewis Naisbett-Jones, Jeffery A. Buckel, F. Joel Fodrie, James W. Morley

Presenter Affiliation: East Carolina University

Oyster Aquaculture Installations as Habitat: An Acoustic Telemetry Study of Juvenile Sheepshead (Archosargus probatocephalus)

Oyster aquaculture continues to expand in the eastern United States; in North Carolina alone the total area of water column leases increased 35-fold from 2011 to 2017. It is important to understand how structure-oriented species will use lease installations as habitat, as the addition of a lease converts a previously unstructured environment into a densely structured one. Sheepshead (*Archosargus probatocephalus*) are an economically important species that are known to depend on highly structured habitat throughout their life. To address the question of oyster leases serving as habitat, we installed an Innovasea (VEMCO) acoustic receiver array around a floating bag oyster lease in Cedar Island Bay, North Carolina and surgically tagged 27 juvenile sheepshead (103mm - 193mm) with acoustic transmitters in order to track their movements at the 1-2 meter spatial scale from July through November 2020. Juvenile sheepshead were detected significantly more frequently in the lease than in the surrounding embayment when the results were standardized by area. Tagged individuals frequently left the lease area to move along a mudflat or marsh edge and returned to the lease later in the same day, we expect that these movements were likely related to foraging behavior. Sheepshead showed particularly high residency during nighttime hours as they rested in and around the lease structures. These results show that juvenile sheepshead are frequently associated with oyster leases; lease habitat appears to provide refuge from predators and access to prey items associated with oyster communities. These data and analyses will provide insight into the amount of available habitat for juvenile sheepshead and the ecological benefits of oyster aquaculture.

OS2. Authors: **Ryan M. Tharp**, Jeffrey A. Buckel, Avery B. Paxton, J. Christopher Taylor, Nathan M. Bacheler, Paul J. Rudershausen

Presenter Affiliation: Department of Applied Ecology, North Carolina State University Center for Marine Sciences and Technology

Fine-scale movements of recreationally important reef fishes at two North Carolina artificial reefs

Artificial reefs can play an important role in marine fisheries management by supplementing or enhancing natural habitats. Despite their increased use, the choice of artificial materials remains largely haphazard because there have been few studies that have examined the use and selection of different artificial reef materials at the individual fish level. In summer 2021, we tagged 25 black sea bass (BSB; *Centropristis striata*), 15 gag (*Mycteroperca mircrolepis*), nine almaco jack (*Seriola rivoliana*), eight red snapper (*Lutjanus campechanus*), and eight greater amberjack (*S. dumerili*) on two different reef complexes near Cape Lookout, North Carolina. Tagged fish were tracked using a VEMCO Positioning

System (VPS) for ~100 days. Black sea bass had high site fidelity to the artificial reef material that they were captured from; distances moved in and around the materials were short and BSB rarely ventured away from the material. Gag and red snapper moved larger distances away from artificial reef materials and routinely moved between materials. Almaco jack and greater amberjack moved the largest distances from the materials and were detected at nearby natural sites. Our results suggest selection for low relief artificial reef materials such as reef balls by BSB and high relief material such as vessels by gag, red snapper, almaco jack, and greater amberjack. These results will be useful to managers charged with decisions on what types of materials to place at artificial reef sites to supplement or enhance habitat for economically important fishes.

OS3. Authors: **Mason G. Collins**, Shelby B. White, Michael S. Loeffler, Anne L. Markwith, and Frederick S. Scharf

Presenter Affiliation: University of North Carolina Wilmington

Locating Southern Flounder Winter Aggregations in the US South Atlantic using Pop-Up Satellite Tags

The Southern Flounder (*Paralichthys lethostigma*) is an economically important coastal fishery species in the U.S South Atlantic and Gulf of Mexico. A recent population assessment indicated that the US South Atlantic stock is overfished and is experiencing overfishing. Stock rebuilding and future management would benefit from more refined information on winter locations and ocean habitat use to define stock boundaries and estimate connectivity among estuaries within the basin. The goals of this study are to: 1) test a new method of tagging Southern Flounder using Pop-Up Satellite Tags (PSAT's), 2) identify offshore winter aggregation locations, and 3) estimate the degree of connectivity among Southern Flounder populations originating from different estuarine nurseries throughout the US South Atlantic. Fish are being fit with PSAT's (Wildlife Computers, Inc. models mrPAT and miniPAT) during the fall emigration period with pop-off dates set throughout winter and spring to inform winter locations and movements. During fall 2020 and fall 2021, 130 and 94 fish respectively, were tagged with mrPAT's and released in Oct and Nov, with tag pop off dates ranging between October and March. During fall 2021, eight individuals were tagged with miniPATs. Detection locations revealed a diversity of potential migratory behaviors. For fish detected over the outer continental shelf, near the Gulf Stream, most locations indicated directed pathways from their tag/release locations, with limited southward movement. Many fish were detected aggregating in mid-shelf regions that could be interpreted as pre-spawn staging or post-spawn return behavior. Collectively, the data suggest Dec/Jan peak spawning activity concentrated in outer shelf habitats, but the duration on, and pathways to/from, the spawning grounds remain uncertain.

OS4. Authors: **Coleman, N.C.**, O'Brien, M.H.P., Lankowicz, K., and Secor, D.H.

Presenter Affiliation: Chesapeake Biological Laboratory

Using Adaptive Resolution Imaging Systems (ARIS) to estimate the Fall Run Size for Atlantic Sturgeon in the Nanticoke-Marshyhope System

Currently listed as an endangered species, Atlantic sturgeon were once thought to be extirpated from the Chesapeake Bay until recent discovery of fall spawning runs in several tributaries. The Marshyhope-Nanticoke system on the eastern shore of Maryland is the United States' smallest free-run estuary that supports a spawning of run of Atlantic sturgeon. Direct sampling of this spawning run indicates a very small spawning run size <100), with high recapture rates (>75%). ARIS acoustic cameral imaging was conducted as an alternative approach to evaluate spawning run size in support of ongoing telemetry analysis. In 2019 and 2021, an ARIS camera was deployed near the mouth of the Marshyhope Creek to intercept spawning-run adults. In addition to providing a means to census adults, the ARIS deployment aimed to analyze the size distribution and identify trends in directional movement within the surveyed area. Sampling was conducted between August 26th and September 8th in 2019 and from August 19th and October 18th in 2021. Counts from the 2019 ARIS survey (N= 31 adult sturgeon) provided evidence in favor of a small run size and revealed up-estuary movement during flood tides, suggestive of tidally-aided movements. In 2021, a telemetry positioning array was deployed simultaneously with the ARIS camera. The combination of telemetry detections and ARIS observations provided an opportunity to evaluate gaps in the detection range of the ARIS camera that led to incomplete coverage of the surveyed area.

OS5. Authors: **Amanpreet Kohli**, Andrew Wargo, Wolfgang Vogelbein

Presenter Affiliation: Aquatic Health Sciences, Virginia institute of Marine Science

Red Sore Disease of American eels

American eel (*Anguilla rostrata*) is an ecologically and economically important finfish distributed along the Atlantic coast of the United States and throughout the Gulf of Mexico. American eel aquaculture in the Chesapeake Bay region is based largely on temporarily holding wild-caught eels, for variable time periods, in primitive recirculating systems lacking effective water polishing capabilities. Such aquaculture operations experience significant disease-associated mortality (10-20%) from Red Sore Disease (RSD), which is an infectious disease characterized by severe skin lesions. RSD may also be contributing to the declining wild eel stocks. Scientific knowledge about the etiology and epidemiology of RSD in American eels is currently very limited. Using standard bacteriological and molecular methods, we isolated and identified species of opportunistic bacteria *Vibrio* and *Aeromonas* from the external lesions and internal organs of diseased fish from aquaculture and the wild. Further, we injected clinically healthy eels with a field isolate of *V. vulnificus* and exposed them to different temperatures. Clinical signs of RSD and mortality were observed in fish exposed to pathogen. Mortality was also heavily influenced by temperature. Reisolation and identification of bacteria from experimentally infected fish confirmed *V. vulnificus* as a causative agent of RSD in American eels. Our next efforts are focused on further biochemical and genomic characterization of the *Vibrio* isolates associated with disease, histopathological examination of the affected tissues, and exploring environmental drivers of the disease. These results will be instrumental in effective disease mitigation and management of eel losses, both in aquaculture and the wild.

OS6. Authors: **Darby L. Pochtar**, Gregory M. Ruiz, Carolyn K. Tepolt, April M. H. Blakeslee, Amy E. Fowler

Presenter Affiliation: Department of Environmental Science and Policy, George Mason University

How to avoid becoming a zombie: Low salinity tolerance in white-fingered mud crabs as a mechanism to avoid castrating parasites

Host-parasite coevolution may influence a host's ability to use environmental refuges to escape parasitism. To test this, we used estuarine populations of hosts (white-fingered mud crabs *Rhithropanopeus harrisii* - *Rh*) and parasites (rhizocephalan barnacles *Loxothylacus panopaei* - *Lp*) from US Atlantic and Gulf coasts. Four distinct regions differed in coevolutionary history: (1) *Lp* absent, *Rh* invasive, (2) *Lp* native, *Rh* native, (3) *Lp* invasive, *Rh* native and (4) *Lp* absent, *Rh* native. Differences in *Rh* and *Lp*'s low salinity tolerance may allow lower salinities to act as a refuge against infection, and adult *Rh* salinity tolerance may be related to the coevolution history of the host-parasite interaction. We exposed 8 populations (2 from each of the 4 regions) of *Rh* to salinities (0.1, 0.25, 0.5, 1, 2, 5, 10ppt) for 4 weeks to calculate survival and non-lethal measures of stress. All *Rh* were dissected to calculate energy and reproductive storage capacity. We hypothesized that *Rh* populations with the longest coevolution with *Lp* would exhibit the highest tolerances to the lowest salinities tested. This work will provide a novel understanding of the trade-offs that exist between biotic and abiotic selective pressures in shaping host adaptation and ecology in complex coastal ecosystems.

OS7. Authors: **Moore, C.S.**, Baillie, C.J., Edmonds, E.A., Gittman, R.K., Blakeslee, A.M.H.

Presenter Affiliation: Biology Department, East Carolina University

Parasites, not free-living taxa, indicate trophic complexity and faunal succession in restored oyster reefs

Ecological restoration has emerged as a tool for testing questions related to community assembly, as practitioners often seek to restore whole ecosystems using foundation species. For example, the eastern oyster (*Crassostrea virginica*) is capable of creating complex habitat for organisms across multiple trophic levels. Historic declines in oyster abundance have prompted decades of restoration efforts. However, we still do not understand how long it takes for restored reefs to resemble the trophic complexity of natural reefs. We examined community succession in natural oyster reefs and restored reefs ranging from 5 to 22 years old in coastal North Carolina by surveying both free-living taxa and parasite communities. Trophically transmitted parasites can serve as valuable biodiversity surrogates, sometimes providing greater information about a system or question than their free-living counterparts. We found that the diversity of free-living taxa was highly variable and did not differ among New-Restored (<10 years), Old-Restored (>20 years), and Natural reefs. Conversely, parasite diversity increased with elapsed time post-restoration, and parasite communities in older restored reefs were more similar to those found in natural reefs. Our study also revealed that oyster toadfish (*Opsanus tau*) act as a key host species capable of facilitating parasite transmission and trophic ascent in oyster reefs food webs. Overall, our results suggest that trophic complexity in restored oyster reefs requires at least 10 years to resemble that found in natural reefs. This work adds to a growing body of evidence demonstrating how parasites can serve as conservation tools and cross-taxon surrogates of biodiversity.

OS8. Authors: **Timothy S. Lee**, Amy E. Fowler, Stacy A. Krueger-Hadfield, April M.H. Blakeslee

Presenter Affiliation: Department of Biology, East Carolina University

Macroinvertebrate Assemblages in the Invasive Alga *Gracilaria vermiculophylla* on the U.S. East Coast

Seaweeds can play vital roles in coastal regions as ecosystem engineers and foundational species. Many seaweeds provide valuable habitat for fish and macroinvertebrates and also protect their associated communities from thermal stress. The red seaweed *Gracilara vermiculophylla*, native to northwestern Pacific, has invaded much of the temperate estuarine ecosystems that exist around the globe. Along the U.S. East Coast, this seaweed has physically transformed soft-sediment habitats by providing novel habitat complexity, with its interstitial space providing refuge, shelter, and microhabitats for native macroinvertebrates, many of which are important prey for commercially important fisheries. We assessed the community patterns of free-living macroinvertebrates associated with *G. vermiculophylla* on a biogeographic scale. From May-August 2019, we surveyed *G. vermiculophylla* along the U.S. East Coast from sites (n = 17) ranging from Durham, NH to Charleston SC, spanning three biogeographic provinces. Five replicates (one replicate = 0.25 m^2 quadrat) of *G. vermiculophylla* were collected, along with environmental variables (e.g. seaweed biomass, depth, water temperature, salinity). All macroinvertebrates were separated from *G. vermiculophylla* through osmotic shock, preserved in 70% ethanol, and identified to the lowest possible taxonomic level. We used Generalized Linear Mixed Models to determine which sets of abiotic and biotic variables best explained the macroinvertebrate diversity patterns. Understanding macroinvertebrate abundances associated with *G. vermiculophylla* on a biogeographic scale is critical for monitoring how invertebrates and food webs that include these associated organisms are responding as this invasive seaweed physically transforms estuarine habitats along the U.S. East Coast.

OS9. Authors: **Alexander W. Mott**, Stacy A. Krueger-Hadfield, April M.H. Blakeslee, Amy E. Fowler

Presenter Affiliation: Department of Environmental Science and Policy, George Mason University

Native tube-building polychaete prefers to anchor non-native alga over other macrophytes

The establishment of non-native ecosystem engineers generates novel habitat structure and can thereby alter ecosystem dynamics, such as through the disruption of resident species interactions or through changing behaviors and forming novel symbiotic relationships. In soft-sediment marine habitats along the western Atlantic, the native decorator worm *Diopatra cuprea* anchors the non-native red alga *Gracilaria vermiculophylla* to its tube cap in a novel mutualism. To understand whether the worm's usage of *G. vermiculophylla* could represent a preference, we first surveyed the species composition of macrophytes affixed to worm tube caps at three sites in coastal Virginia, USA using transect and quadrat sampling. These unmanipulated field surveys supported previous work revealing variable, but often high frequencies (31-98%) of *D. cuprea* decoration with *G. vermiculophylla*. We next used field manipulations and controlled laboratory experiments to test the consistency of individual *D. cuprea* decoration with *G. vermiculophylla* versus three other common macrophytes (*Ulva* sp., *Agardhiella sp*., and *Spartina alterniflora*) found in our field surveys. Twenty-four hours after removing the worm's tube cap in the

field, *D. cuprea* decoration was dominated by both *G. vermiculophylla* (39.6%) and *S. alterniflora* (25.9%). When provided a choice of macrophytes in the laboratory, *D. cuprea* consistently decorated with *G. vermiculophylla* (58.7%) over the other macrophytes, showing a preference for the non-native versus the native macrophytes. Our study suggests that preference can drive strong and steadfast interactions between native and non-native organisms, rapidly developing and facilitating the persistence and spread of non-native species, changing available habitat and altering community interactions.

OS10. Authors: **Hailey Conrad**

Presenter Affiliation: Virginia Tech FWC

How egg production in summer flounder is affected by sex ratio

Since the 1980s, the overall sex ratio of the summer flounder (*Paralichthys dentatus*) population has been gradually shifting. The proportion of males has been increasing and the proportion of females has been decreasing. Sex determination in all Paralichthyid flounder is influenced by temperature, where under high temperatures, undifferentiated juveniles with female genotypes may develop as males. There are no field studies documenting how temperature effects summer flounder gonadal differentiation in wild populations, but experimental studies have found that tanks of juveniles reared at different environmentally realistic temperatures will have substantially different sex ratios. Studies have shown that warmer waters have been masculinizing the population of southern flounder (Paralichthys lethostigma), another Paralichthyid closely related to summer flounder. The changing sex ratio drove recent, sudden declines in southern flounder abundance, so it is important to identify whether the same trend could be occurring in summer flounder. So far, the shift in the sex ratio of the summer flounder population has been attributed to sex-biased fishing selectivity, but temperature-dependent sex determination could also be a contributing factor. To assess how these factors could impact population viability we created an age-, size-, and sex- structured population dynamics model of summer flounder. We then varied the sex ratio at recruitment and fishing pressure to show how the lifetime egg production of a summer flounder cohort would change. We found that when the sex ratio at recruitment is very skewed it can have a larger impact on the lifetime fecundity of an age cohort than fishing pressure. We also found that there is a clear sex ratio tipping point where the lifetime egg production of a cohort sharply drops. This tipping point would not be detected by the spawning potential ratio, the traditional biological reference point used to assess reproductive potential. New biological reference points may be needed as indicators of the reproductive potential of the summer flounder stock if current trends in the sex ratio continue.

OS11. Authors: **Claire Pelletier**, Frederick S. Scharf

Presenter Affiliation: Department of Biology and Marine Biology, University of North Carolina Wilmington

Reproductive dynamics of non-native Flathead catfish in the Cape Fear River estuary

Ranges of Flathead catfish in North Carolina were historically restricted to drainages in the western portion of the state. The 1960's marked introductions of flathead catfish to Atlantic coastal rivers and led to numerous established non-native populations. Understanding this fish's impressive rate of establishment starts with understanding their reproductive dynamics. Recent studies have proposed spawning seasons for nonnative catfish in the Cape Fear River, as well as diet analyses and trophic ecology roles. However, to date, there have been no studies outlining quantitative estimates of reproductive output. In the last decade there have been significant advances in techniques and standardization of terminology within fish reproductive biology, leading to detailed descriptions of several species' ovarian development; something that has not yet been done for flathead catfish. The next phase of catfish research in the Cape Fear will focus on creating a detailed description of flathead oocyte development, estimating fecundity, and evaluating reproductive patterns. Ovarian samples were collected, via low frequency electrofishing, for comprehensive histological analysis. In addition to categorizing structures found in oocytes, the number of eggs in each stage, the number of stages present in each ovary, and the average diameter of eggs within an ovary will also be quantified. A focus on the dates corresponding with secondary stages will better determine development schedules. Maturity readings will also be compared against fecundity and size. Understanding the reproductive patterns of nonnative catfish in the Cape Fear will ultimately lead to better management options and awareness of future population growth and establishment.

OS12. Authors: **Kaitlyn R. Clark**, Sally Roman, Roger Mann, and David B. Rudders

Presenter Affiliation: Virginia Institute of Marine Science

The effect of density on reproductive activity in Atlantic sea scallops (*Placopecten magellanicus*)

The Atlantic sea scallop fishery employs a rotational closed area strategy designed to increase yield-per-recruit and allow scallops to spawn multiple times before they are susceptible to the fishery. Though generally successful, this strategy was recently challenged by two high-density recruitment events that occurred in the Nantucket Lightship Closed Area in 2012 and the Elephant Trunk Flex Area in 2013. The scallops at these sites persisted at high densities and initially exhibited varying degrees of impacted performance. The effect of scallop density on growth, yield, and reproduction was investigated through quarterly sampling trips in 2018 and 2019 with sampling at 21 stations divided among high, medium, and low-density scallop beds. In addition to total catch and length data, 30 scallops were retained at each station to determine meat, viscera, and gonad weights along with sex and reproductive stage. Reproductive effort was quantified as the ratio of gamete production to total production to investigate how this metric differs across population density. Overall, scallop density was an important factor in predicting reproductive effort, with scallops at the extreme densities observed in the Nantucket Lightship exhibiting reduced reproductive effort compared to traditional densities found in the resource. Scallops in the high-density beds of Nantucket Lightship also exhibited less reproductive activity than other areas, with fewer scallops staged as mature or spawning. A subset of female scallop gonads collected during sampling is currently being examined using histological methods to further clarify the effects of density on reproduction in sea scallops.

OS13. Authors: **Schneider, A.K.**, Fabrizio, M.C., Lipcius, R.N.

Presenter Affiliation: Virginia Institute of Marine Science

A comparison of blue crab spawning stocks in the 1990s and 2020s and the role of second-year spawners

The blue crab (*Callinectes sapidus*) spawning stock in Chesapeake Bay has been heavily fished, particularly in the mid-1990s and early 2000s. Management actions were implemented in the mid-2000s to reduce exploitation of the spawning stock in response to a significant reduction in female abundance. For example, the winter dredge fishery, which preferentially exploited mature females in the spawning grounds, was closed in 2008. In this study, we assessed the effect of high exploitation rates on the proportions of first- and second-year spawners on the spawning grounds during winter by comparing proportions in years marked by increased fishing pressure (i.e., 1990s) with proportions observed after conservation measures were in place (i.e., after 2008). Mature females were collected from the lower Chesapeake Bay by the Blue Crab Winter Dredge Survey in 1992-1996 and 2020-2021. Females were classified as first or second-year spawners based on the presence or absence of the nemertean worm, *Carncinomertes carcinophila,* in their gill chambers. Results of generalized linear models identified individual characteristics and environmental factors that led to a higher proportion of second-year spawners and provided insight into the reproductive biology of blue crabs in Chesapeake Bay. Overall, the probability of observing second-year spawners in 2020 and 2021 was greater than in the 1990s, suggesting that the regulations implemented in the early 2000s to protect females contributed to the greater likelihood that females that spawned once survived to spawn again in the next spawning season.

OS14. Authors: **Nina Woodard**

Presenter Affiliation: East Carolina University

Borrowing ecological principles: Influence of orientation and habitat complexity on reef formation and biodiversity

Biodiversity is indicative of a healthy ecosystem. Fish and invertebrate species are key members of oyster food webs and are useful in evaluating biodiversity and restoration success. Interstitial space within reefs provides refuge for crabs and suitable substrate for spawning fish. Structural complexity also influences host-parasite interactions, with free-living and parasite diversity increasing in response to restoration. Factors like height have altered habitat availability, with high-relief reefs supporting higher crab abundances and low-relief reefs supporting higher fish abundances. However, determining if assemblages differ as a function of both relief and habitat relative to the shoreline has not been explored. Restored reefs provide coastal protection services, modifying the environmental hydrodynamics. We hypothesized that hydrodynamic stressors would differ between shallow mudflat habitats landward and seaward of restored reefs. Monthly, we quantified marine fauna richness and abundance landward and seaward of high- and low-relief restored reefs, and control (no reef) sites, along Taylors Creek (Beaufort, NC) from October 2020-2021. Across sites, host crab and fish species were collected, euthanized, and dissected for parasites. These data will help us understand relationships between shallow habitat orientation (landward/seaward of reefs), reef relief (high-and-low), and faunal biodiversity. Thus far, results suggest crustacean abundance is similar landward and seaward of reefs,

while fish abundance trends higher seaward of reefs. In response to reef presence, crustacean abundance trends higher at control sites than reef sites. Across all sites, fish abundance was similar between reliefs. These data suggest reef presence and habitat orientation relative to reefs may influence community biodiversity.

OS15. Authors: **Shannon Smith**, Mary Fabrizio, Troy Tuckey, PG Ross, Richard Snyder

Presenter Affiliation: Virginia Institute of Marine Science

Evaluation of habitat mosaics in a Virginia estuary and coastal lagoon

Juvenile fishes rely on resources in estuarine and coastal habitats to facilitate growth and survival in their first year of life. Identification and protection of habitats critical to these vital processes is becoming increasingly important as aquatic ecosystems in the Mid-Atlantic region experience habitat alteration and climate change. Habitat characterization that considers prevailing environmental conditions along with spatial complexity and connectivity of habitat patches (i.e., the seascape) may be more informative compared with characterizations based on the presence of biogenic structures alone. To identify habitats important to juvenile fish production, we examined differences in age-0 Spot *Leiostomus xanthurus* body condition across habitat types (marsh creeks, oyster reefs, seagrass beds, unstructured soft-bottom) within and between a sub-estuary and a coastal lagoon. Spot body condition was dependent on habitat type, however, habitat type-condition relationships differed depending on area. To further examine mechanistic processes that may contribute to observed differences in body condition in estuarine and coastal habitats, we calculated seascape metrics that quantified habitat patch diversity, complexity, and connectivity. Seascape metrics successfully identified habitat patch characteristics that may explain how fishes use aquatic areas. We used ordination techniques to evaluate similarity among metrics and to identify metrics for inclusion in future models relating juvenile fish body condition and recent growth to seascape metrics.

OS16. Authors: **Matt Damiano**, Jie Cao, Mandy Karnauskas

Presenter Affiliation: Center for Marine Sciences and Technology, North Carolina State University

Spatiotemporal population dynamics of common dolphinfish (*Coryphaena hippurus*) in the Western Central Atlantic

Common dolphinfish (*Coryphanea hippurus*) is a migratory coastal pelagic species that supports commercial and recreational fisheries throughout the East Coast United States, Caribbean Island nations and US territories. Mark-recapture and genetic marker studies suggest that dolphinfish caught in the Western Central Atlantic (WCA) comprise a single population, however, they are currently managed by regional fishery management organizations (RFMOs) as discrete, regional sub-stocks. Stock assessments require a reliable index of abundance to estimate changes in the population over time and are ideally derived from a fishery-independent research survey. Although no such survey exists for dolphinfish, the US pelagic longline (PLL) fishery targets dolphinfish throughout the WCA and keeps detailed logbook information. We fit Vector Autoregressive Spatiotemporal (VAST) models to PLL catch-per-unit-effort (CPUE) data during 1991-2019 to standardize a spatiotemporal index of abundance for the WCA

population. We observed seasonal dynamics in dolphinfish abundance with peak densities occurring during spring months; a declining trend in abundance overall; and potentially a northward shift in distribution. Dolphinfish are thermophilic species with a preferred range of temperatures for spawning between 27-30 ºC, therefore, we fit VAST to PLL data during May and June months, treating SST as a non-linear covariate, to further explore the potential relationship between catch information and SST. These analyses represent the first phase of a larger project to develop a spatially explicit stock assessment for common dolphinfish in the WCA and management strategy evaluation focused on the SE US.

OS17. Authors: **Melinda S. Lambert**, Troy Alphin, and Frederick S. Scharf

Presenter Affiliation: University of North Carolina Wilmington

Multi-decadal variation in community assemblage, spatial distribution, and phenology for juvenile fish in the Cape Fear River

From 1979-1989 and 1997-2007, the North Carolina Division of Marine Fisheries conducted a year-round, statewide estuarine trawl survey with the objective of estimating annual recruitment indices for economically important species and identifying primary nursery areas. Since then, the survey has only occurred during the peak recruitment period (May and June) for many fishery species. Here, we report on a comparison between the historic time series (1979-1989), the intermediate (1997-2007) and the contemporary (2010-2020) multi-habitat survey being conducted in the Cape Fear River estuary. We assessed shifts in fish community assemblages, spatial distribution within the survey area, and the recruitment timing and broad habitat shifts of key species. Comparing the historic and intermediate time series, we focused on seasonal changes in the presence and absence of multiple species to track recruitment timing as well as ontogenetic changes in broad habitat use patterns throughout the juvenile life stage. Comparing all three time series, we focused on dominant species assemblages and habitat use patterns. Dominant species assemblages remained relatively consistent despite changes in river depth, tidal inundation, and temperature between the three survey periods. The principal fish species occurring in the surveys included spot (*Leiostomus xanthurus*) and Atlantic croaker (*Micropogonias undulatus*) and peak recruitment timing was similar between the historic and intermediate sampling periods. Spatial distribution patterns indicated more extensive use of upriver habitats during the contemporary period, possibly related to further upriver penetration of salt water. Overall patterns suggest that estuarine fish communities in the lower Cape Fear River demonstrate resilience to shifting environmental gradients.

OS18. Authors: **Quentin Bratkowski Nichols**, Rebecca G. Asch, and Roger Rulifson

Presenter Affiliation: East Carolina University

Phenology in a Changing Environment: Ecological Forecasts of the Albemarle Sound/Roanoke River Striped Bass Stock Migration

Climate change and climate variability are leading to shifts in the seasonal timing of fish migration and reproduction (i.e., phenology) across many ecosystems and species, with changes especially common

among anadromous fishes, such as Striped Bass (*Morone saxatilis*). North Carolina hosts the Albemarle Sound/Roanoke River (A/R) stock, which is the southernmost major spawning population of Striped Bass. This study's objective is to create an ecological forecast of the timing of the Roanoke River spawning run, which can be used to determine the best time to protect large spawning females. The study used historical data from a Striped Bass egg survey and creel survey conducted from 1960-1993 to model spawning migration timing as a function of river and coastal temperature, regional climate indices, wind speed, river flow pulse duration timing, and Striped Bass population size structure. The forecast is split into two different models, one based on egg survey data and the other based on creel survey data due to the differences in the average dates of key phenology events. Discharge and river pulse duration timing are key variables in predicting spawning time of the A/R stock, whereas temperature was not as important for this stock. This contrasts with results from the Chesapeake Bay where temperature had a predominant influence on Striped Bass spawning phenology. Ecological forecasts explained a high amount of deviance in the phenology, but had poor predictive skill based on the anomaly correlation coefficient (ACC) and root mean square error (RMSE). The models were able to predict phenology during typical years, but unable to predict late or early spawning phenology with as much accuracy. Forecasts based on the fisheries-independent egg survey had better model fit and predictive skill than fisheries-dependent creel data.

OS19. Authors: **Kaitlyn O'Brien**, Robert Latour, Enric Cortes, Vince Saba

Presenter Affiliation: Virginia Institute of Marine Science

Ecological niche modeling and predicted shifts in available habitat for coastal sharks of the southeast Atlantic

Large coastal (LCS) and small coastal shark species (SCS) are integral to the coastal ecosystems of the Southeastern U.S. as they occupy the mid to upper trophic levels and can significantly impact ecosystem functioning and stability. Through either overfishing or shifts in distribution, alterations in the community structure can impact ecosystem diversity and response times to changing conditions. Studies have identified sharks' high potential for shifting habitat distributions in response to anthropogenic climate change, so understanding possible shifts and implications are important for management. We developed ecological niche models for a suite of LCS and SCS species using data from multiple fishery-independent surveys that span the Gulf of Mexico and the Southeastern U.S. continental shelf. These models were then coupled with high-resolution ocean models to project each species's contemporary and future available habitat. Further analysis of projected available habitat enabled the evaluation of climate change "winners" and "losers" for coastal sharks and the evaluation of changes in niche overlap between species. In general, SCS were climate change "winners" and illustrated a significant increase in available habitat both poleward and across the shelf. On the other hand, LCS tended as the "losers" with evidence of a trailing edge and decreased habitat across the shelf. Possible management outcomes in response to expected changes in sharks' suitable habitat include modifying which fishery-independent surveys are used in future assessments, re-evaluating current time-and-area closures and essential fish habitat, and redefining management boundaries.

OS20. Authors: **Adena J. Schonfeld**, James Gartland, Robert J. Latour

Presenter Affiliation: Virginia Institute of Marine Science

Environmental drivers of temporal trends in seasonal estuarine usage of Mid-Atlantic species

Climate-driven distributional shifts have been well-documented for fishery resources along the US East Coast, yet little attention has been given to adjacent estuarine systems. The Chesapeake Bay is the largest estuary in the continental US and serves as important habitat for a diversity of fishes, many of which are seasonal residents. Survey data indicate that finfish utilization of Chesapeake Bay has diminished substantially, while coastwide stock status has remained unchanged. In response to warming, seasonal estuarine residents may remain in coastal waters or enter a northerly estuary, but the extent to which changing environmental conditions may drive exchange between the coastal ocean and estuarine systems remains unresolved.

To explore changes in estuarine usage, the environmental drivers of estuarine-coastal ocean exchange, and whether fishes are utilizing an estuary north of Chesapeake Bay, data spanning 2008-2019 collected by three fisheries-independent surveys within Chesapeake Bay, Delaware Bay, and coastal waters were used. Time-series of relative habitat usage were generated for eight economically and ecologically important Mid-Atlantic species. Chesapeake Bay relative habitat usage significantly declined for most, while Delaware Bay time-series were primarily constant or increasing. Dynamic factor analysis of the resultant time-series indicated that the North Atlantic Oscillation (NAO) was an important driver of Chesapeake Bay exchange, however, average spring bottom temperature was significant for Delaware Bay. NAO is a signal of long-term warming, while average spring bottom temperature fluctuates annually. Thus, the drivers of estuarine exchange are operating on different temporal scales, highlighting spatial variation in impacts of warming within the Mid-Atlantic.

Professional Oral Presentation Abstracts

OP1. Authors: **Blakeslee, A.M.H.**, Moore, C.S., Gittman, R.K.

Presenter Affiliation: Department of Biology, East Carolina University

Crabs without borders: early documentation of a range expanding species in coastal North Carolina

Petrolisthes armatus, the green porcelain crab, is among a group of species deemed "the Caribbean creep" – species expanding their ranges northwards from tropical/subtropical waters into temperate regions along the northwest Atlantic coast with warming temperatures. In 2016, *P. armatus*' northernmost range was Wilmington, NC. However, recent biodiversity surveys (2018-2021) in oyster reefs by members of our team discovered a porcelain crab similar in morphological features to *P. armatus* at several sites off Beaufort, NC. One sampled region surveyed in August 2021 demonstrated relatively large abundances of the crab, surpassing that of native mud crabs. Moreover, we detected differences in crab abundance depending on reef associated habitat – seagrass or sandflat. Morphological and genetic barcoding revealed these porcelain crabs are indeed *P. armatus*, and that Beaufort, NC is now the northernmost record of the species. Here, we discuss the history of range expansions for this species along the northwest Atlantic coast and identified impacts at these sites, as well as future directions of research in the crab's newest invaded location (Beaufort, NC).

OP2. Authors: **David C. Collar**, Jessica S. Thompson

Presenter Affiliation: Department of Organismal and Environmental Biology, Christopher Newport University

Temperature dependence of fast-start predator escape performance in mummichog *Fundulus heteroclitus*

Estuarine fishes regularly experience fluctuations in environmental conditions driven by tidal flows, solar heating, and storm events. Although many species exhibit broad tolerances that allow them to withstand widely varying conditions without mortality, success in this habitat also requires that fish perform tasks, such as predator evasion, across environmental gradients. A full understanding of the physiological tolerance therefore requires insight into how organismal performance responds to environmental variation and whether these effects vary across size classes of fish. In a series of studies, we found that mummichogs (*Fundulus heteroclitus*), prominent residents of eastern North American estuaries, exhibit similar fast-start predator-escape performance across temperatures (24, 30, and 36 °C) when allowed to acclimate, but performance varies when fish experience acute temperature changes. Although angular and linear velocities vary directly with the temperature at which the maneuver is executed, these aspects of performance vary inversely with acclimation temperature; cool-acclimated fish exhibit faster starts across test temperatures. These temperature effects are consistent across body sizes ranging from young of the year to large adults (35–78 mm Standard Length) and varying salinities (2, 12, and 32 ppt). Altogether these results suggest that mummichogs may become

more vulnerable to predation as increasing sea temperatures combine with the short-term temperature fluctuations that occur in estuaries.

OP3. Authors: **Gartland, J**, Gaichas, S, Latour, R

Presenter Affiliation: Virginia Institute of Marine Science

Coherence of Aggregate Biomass Ecosystem Indicators in the Mid-Atlantic Bight, USA

Indicators of ecosystem status are required to establish and maintain Ecosystem Approaches to Fisheries Management (EAFM). The National Oceanic and Atmospheric Administration generates a suite of indicators for three Ecological Production Units (EPUs) in the Northeast US to support regional EAFM efforts. Information on community structure is conveyed via aggregate biomass indicators delineated by trophic guild. Species included in these guilds are restricted to taxa with extant diet data, which may jeopardize indicator consistency should climate change alter species compositions or trophic interactions in an EPU. While developing these indicators is a valuable step toward EAFM, identifying commonalities among and drivers of multiple time-series of aggregate abundance can enhance insights into ecological processes. Data collected from a coastal fisheries-independent bottom trawl survey between 2008-2019 were used to develop aggregate biomass indicators for the nearshore zone of the Mid-Atlantic Bight EPU. All species were grouped into nine ecomorphotypes (EMT), and generalized additive models were used to relate EMT-specific catch data to several covariates: year, season, a coastal position-by-season interaction, depth, and solar zenith. Predicted annual indices of relative abundance were generated for each EMT. Dynamic factor analysis revealed coherence among these indices and the influence of annualized biophysical and fishery covariates on the temporal aspects of community structure. This investigation provides a species classification framework for aggregate biomass indicator development that requires minimal auxiliary data, promoting consistency and thus comparisons across ecosystems, and employs an approach to quantify coherence among these indicators that yields ecological insights necessary to advance EAFM.

OP4. Authors: **Verena H. Wang**, Lela S. Schlenker, James W. Morley

Presenter Affiliation: Coastal Studies Institute, Department of Biology, East Carolina University

Ontogenetic spatial habitat consistency, extent, and constraint of U.S. Northeast fishes

Marine species have been demonstrated to shift geographic distributions in response to changing temperature regimes, but studies of range shifts rarely distinguish among life stages. Habitat requirements often vary with ontogeny, particularly for marine fishes that utilize distinct locales for spawning and nursery habitats. Understanding the habitat constraints of each life stage is critical for understanding the mechanisms underlying species vulnerability to climate change. To identify susceptible life stages, we applied species distribution models separately to larvae, juveniles, and adults to evaluate the spatial constraints of U.S. Northeast fishery species. We used long-term fishery-independent survey data (1977-2017) to fit distribution models focused on consistency of spatial habitat usage and extent of spatial distribution using a generalized additive model approach. Findings suggest that early life stages experience a high level of geographic constraint, which is not surprising given the

narrow range of temperature and salinity conditions often required for larval development and survival. However, the degree to which spatial constraint changed with life stage was variable among species, suggesting that life history strategy may play an important role in determining a species ability to track thermal habitat shifts. Development of a size-based ontogenetic index of spatial constraint is currently under way. Insights into the stages and life history strategies that are most vulnerable to climate change will help to inform climate adaptive fisheries management as resources continue to shift across boundaries.

OP5. Authors: **Robert Aguilar**, Matthew B. Ogburn, Amy C. Driskell, Kenneth S. MacDonald III, Lee A. Weigt, Anson H. Hines

Presenter Affiliation: Smithsonian Environmental Research Center

Chesapeake Bay Barcode Initiative (CBBI): The first comprehensive genetic library for fish and invertebrates of the Mid-Atlantic US

DNA barcoding is a powerful tool to investigate biodiversity, phylogenetic relationships, food webs, wildlife forensics, and ecosystem services. The ecological utility of reference libraries is greatly improved when they are validated, possess vouchers and detailed metadata, and are regionally based. Although the Chesapeake Bay (CB) is the largest estuary in the United States and a major focus of early fisheries research, there has been minimal genetic sequencing effort and a paucity of museum collections in the last century. We provide the first comprehensive barcode libraries for fish (*COI* and 12*S*) and invertebrates (*COI*) of the greater CB/mid-Atlantic region. Associated with each sequence are photographic, tissue, DNA, and museum vouchers and detailed metadata. All vouchers are housed in the Smithsonian National Museum of Natural History's collections and sequences and metadata will be publicly available via GenBank and BOLD. To date, we have sequenced the majority of the bay's fish fauna (>80%) and have excellent coverage (>80%) for several important invertebrate groups (e.g., decapods, bivalves). Neighbor-joining analysis based on K2P genetic distances formed non-overlapping clusters for most species, but we found evidence of divergent lineages, incomplete separation, and cryptic hybridization/introgression in a number of important species, as well as identified several non-native introductions. Additionally, these data have been used to identify digested prey remains (Sanger sequencing and metabarcoding), confirm the species validity of a soft-shelled clam, delimit an invasive shrimp species complex, verify the identity of an invasive isopod, and aid in the development of eDNA techniques for anadromous herrings (*Alosa* spp.).

OP6. Authors: **Joseph J. Luczkovich**, Jeffrey C. Johnson, Rebecca A. Deehr, Kevin J. Hart, Lisa Clough, David C. Griffith

Presenter Affiliation: Department of Biology, East Carolina University

Linking Fishing Behavior and Ecosystem Dynamics Using Social and Ecological Network Models

We can manage fisheries best when all interactions among fish, the ecosystem, and fishers and integrated in decision making, but we lack quantitative models for including these in fishery management decisions. We created an ecosystem-based model of the fisheries in Core Sound, NC

including both direct and indirect impacts on multiple species and included the behavioral responses of fishers after a simulated regulatory change (a gillnet ban). We linked fisher behavioral networks with a mass-balanced food-web ECOPATH network model for an analysis of fishing impacts after a gillnet ban on multiple species using ECOSIM. Individual fishers with common gear/species use are indicative of common fishing behavior, allowing us to identify joint gear participation and likely "gear switching" pathways. We next predicted changes in fishing effort after a gill net ban. We simulated the gill net ban in ECOSIM under two scenarios of fishing effort: Scenario 1, gill net fishing effort of 0%; Scenario 2, gill net fishing effort of 0% with increased effort in the alternative gear fisheries using the predicted switching pathways for the affiliation network. Scenario 1 predicted an increase in flounder (*Paralichthys* sp.) biomass over a decade. Under Scenario 2, fishers targeting flounders were predicted to switch from gill nets to pound nets. Scenario 2 predicted a 7% decline in flounder biomass over ten years, rather than an increase in flounders. The gillnet ban with increased effort due to switching is predicted to have the opposite effect on the conservation goal, which was to increase flounder stocks.

OP7. Authors: **Kevin J. Dockendorf**

Presenter Affiliation: North Carolina Wildlife Resources Commission, Inland Fisheries Division

NC TOWER as an information source for conservation career mentorship programs

The NCAFS *ad hoc* Mentoring Committee was formed at the 2020 NCAFS Chapter meeting. "Who is our audience?" was one of the first questions asked within the committee. Online research into this important question led to the NC TOWER database. NC TOWER is a web-based delivery system providing aggregate information on students who attended public universities and community colleges in North Carolina. These data include programs of study and degrees obtained. The numbers of graduating Natural Resources and Conservation students with a B.S. degree increased from 286 graduates in 2003 to 644 graduates in 2019 whereas the numbers of students with M.S. degree or PhD over the same time series was 77 graduates in 2003 to 99 graduates in 2019. Career professionals recognize that the natural resource field is highly competitive. However, the relatively recent boom of graduates in this field provides insight that our current audience may be more extensive than prior years. As professionals and mentors, our awareness of the increasing number of graduates as compared to the available positions in this field is important when developing mentorship programs.

OP8. Authors: **Sara E. Mirabilio**, Richard W. Brill, Peter G. Bushnell, Amanda Wilson

Presenter Affiliation: North Carolina Sea Grant, East Carolina University Outer Banks Campus

Refinement and Testing of a Microprocessor-Based Shark Bycatch Reduction Device (M-B BRD) Using an Academic-Industry Partnership

Reducing shark bycatch in U.S. pelagic longline fisheries is a NOAA Fisheries management priority as multiple coastal-pelagic species are overfished and/or experiencing overfishing. We contend shark bycatch can be reduced by taking advantage of the unique sensory biology of elasmobranch fishes, specifically their ability to perceive electric fields of less than five nanovolt per centimeter. Such signals are, however, undetectable by targeted teleost fishes which lack the electrosensory system (Ampullae

of Lorenzini) of elasmobranch fishes. A National Sea Grant Office award (NA19OAR4170413) funded development of an industry-deployable, microprocessor-based, shark bycatch reduction device (M-B BRD). We evaluated its performance using a 150-hook, three-mile, bottom longline deployed from a commercial fishing vessel operating in coastal waters from Oregon to Hatteras inlets (North Carolina). Over the course of 15 fishing days (Aug. 2 – Oct. 1, 2021), a total of 141 sharks (across nine species) were captured with all but 34 on hooks near M-B BRDs that emitted no electric pulse (controls). This ratio is significantly different from the expected 1:1 ratio ($p=0.0000000007$). Although effectiveness was species-specific, in aggregate the presence of an active M-B BRD reduced shark catch by greater than 50%. These data support the hypothesis that weak electric stimuli generated by a M-B BRD can reduce shark bycatch in longline fisheries. Further, with a M-B BRD shark bycatch could be reduced without imposition of time-area closures, significant gear modifications, or mandated hook types, and with little or no effect on catches of non-electrosensitive target teleost fishes (e.g., swordfish and tunas).

OP9. Authors: Mitch Kinz, Claire Pelletier, David Belkoski, **Fred Scharf**

Presenter Affiliation: University of North Carolina Wilmington

Evidence for partial and differential migration within an invasive catfish population: behavioral variation coupled with strong site fidelity

The Flathead Catfish; (*Pylodicitis olivaris*), is native to the Mississippi River basin but has found success at inhabiting new waterways where it has become invasive. There have been several studies conducted around their movement patterns in their native range, but very little has been studied outside of this range. We performed a 2 year-long study on the movement of the Flathead using acoustic telemetry within the lower Cape Fear River system. We surgically implanted transmitters in 25 Flathead Catfish divided between five separate release locations throughout the river system. We had an array of 34 passive receivers placed every 3-15km that recorded fish movement which was supplemented with weekly targeted active tracking. There were two fish in our study that we received no data on. We observed 12 of the Flathead Catfish engage in an upriver migration in the spring followed by a return downriver throughout the summer and into fall. In the 2nd year, only 6 of the original 12 migrants participated in migration again. None of the non-migrants the first year participated in migration the 2nd year. Their movements between the years were found to be highly individualized along with evidence of partial migration. There is a significant relationship between the size of the Flathead at tagging and the likelihood it will migrate. We observed some large-scale movements that spanned over 100km that has also been documented in studies in their native range. Most of these fish returned from their migration to the same site where they were captured, tagged, and released the previous fall showing a high site fidelity. Their movement was found to be highly variable between seasons based on their life history traits. Our research can help inform fisheries management target population reductions efforts based on their movement behavior to prevent further ecological damage and to protect native species.

OP10. Authors: **Rebecca G. Asch**, Caitlin McGarigal, Brian Bartlett, Eric Diaddorio, Patrick Harris, Joseph Luczkovich, Justin Mitchell, Tyler Peacock, Roger Rulifson, Paul Salib, Mark Sprague

Presenter Affiliation: East Carolina University, Department of Biology

A MULTI-PRONGED APPROACH TO INVESTIGATE THE OFFSHORE MIGRATION OF SOUTHERN FLOUNDER FROM NORTH CAROLINA WATERS

Southern flounder (*Paralichthys lethostigma*) historically has been the most valuable finfish fishery in North Carolina but is currently overfished. A challenge for fishery management is that the location of its offshore spawning grounds is unknown, which complicates determining whether the fishery would be best managed by the state or regionally. To address this, we are taking a multifaceted approach to investigate the species' offshore migration and spawning habitat: 1) Acoustically tagged flounder are tracked with a nearshore receiver array at seven estuary inlets, an offshore array, and a wave glider; 2) A hydrodynamic model uses data from long-term ichthyoplankton monitoring to back calculate larval dispersal to determine potential spawning habitat; 3) DNA barcoding is used to identify fish eggs collected during offshore surveys of potential spawning habitat; 4) Otolith microchemistry of adult fish from estuaries and offshore reefs is used to determine migration histories with Ba:Ca and ^{87}Sr:^{86}Sr isotopes serving as proxies for salinity. Initial results indicate that: 1) Flounder exit estuaries through diverse pathways; 2) Emigration timing was later than expected compared to previous research; 3) Fish have been detected around a hypothesized spawning area at the edge of the continental shelf but spend substantial time in coastal, oceanic waters; 4) Some adults forgo offshore migration, while others migrate southward or return to North Carolina estuaries shortly after migrating offshore; 5) Hydrodynamic modeling located a hotspot in southern Onslow Bay where many larvae potentially originated. Overall, results indicate a greater diversity of migration behavior and pathways than previously known.

OP11. Authors: **Henry D. Legett**, Anne Timm, Robert Aguilar, Keira Heggie, Kimberly D. Richie, Matthew B. Ogburn

Presenter Affiliation: Smithsonian Environmental Research Center

River herring migrations and thermal regimes in Chesapeake Bay rivers

The life-history strategies of many aquatic organisms depend on specific environmental conditions and resource levels that fluctuate with seasons. Anadromous fishes migrate between marine and freshwater ecosystems, spending their adult lives at sea and annually returning to freshwater tributaries to spawn. These spawning migrations connect aquatic ecosystems by moving valuable energy and nutrients between food webs. For many anadromous species, movements between ecosystems are driven by water temperature patterns. Climate change is causing shifts in aquatic thermal regimes which can disrupt the timing of seasonal migrations in fish populations. In this study, we examine the migration phenology of river herring, Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalis*), in the Chesapeake Bay. Using multiyear upstream counts of these species we assess how water temperature thresholds and variability drive within-season and within-day movements. We also characterize the thermal regimes of three Chesapeake Bay rivers (Choptank, Patapsco, and Rappahannock rivers) using networks of water temperature loggers distributed throughout the

mainstems and tributaries of each system. Anthropogenic influences on water temperatures in these rivers were assessed by analyzing land cover variables and using spatial-stream-network (SSN) models. We discuss our results in the context of climate adaptation and management strategies, and future research needs for river herring in the Chesapeake Bay.

OP12. Authors: **Christian Hager**

Presenter Affiliation: Chesapeake Scientific LLC

A Telemetry Index of Relative Importance for Passive Array Tracking Data

The statistical approach that derives an index of relative importance (IRI) has long been accepted in the trophic literature. We create a similar telemetry based index of relative importance (TIRI) that merges the varied statistics that are derived from passive array tracking and are based on number of subjects detected, how many detections occurred, and the frequency at which a given site was occupied into a single index. This index reduces the inherent bias of each detection based component and results in a single indices that can be used to compare receiver sites within a study or between studies over time. The % IRI takes this approach further and provides an additive index and thus provides a more meaningful comparison between sites. A single index per site also allows for development of advanced models that can examine correlations between occupancy patterns and physical and environmental variables over time and space that were not previously possible. Thus the index advances the usefulness and applicability of passive array data.

OP13. Authors: **Kimberly Richie**, Matthew B. Ogburn

Presenter Affiliation: ACT Network

Building strength within the acoustic telemetry community

Acoustic telemetry is used around the world to study marine, estuarine, and freshwater species migrations. The Atlantic Cooperative Telemetry (ACT) Network is a grass roots cooperative that facilities sharing of acoustic telemetry data among researchers in the northeast and mid-Atlantic United States. Data sharing occurs using database tools developed by the Ocean Tracking Network (OTN) and managed in collaboration with MARACOOS and the US Animal Telemetry Network. Since adopting the OTN structure in 2020, tag detections are more efficiently and accurately matched within the network and across neighboring networks like FACT and OTN. The ACT Network database, ACT_MATOS, has 112 users representing more than 70 institutions and agencies. Researchers have reported 4,520 tags in 44 different species, and 1,091 acoustic receiver stations within the region. To date, 9.3 million receiver detections have been positively matched to tagging projects. These projects focus on a range of topics including animal migration and habitat use (58% of projects), projects directly informing management for conservation (17%), and projects studying wind farm impacts (9%). Efficiently sharing tag detections at a continental scale makes for a stronger more effective animal tracking community and improved data for informing management and conservation.