THE NORTH CAROLINA COASTAL RESERVE AND NATIONAL ESTUARINE RESEARCH RESERVE'S

Research at the Reserve Symposium

Wednesday & Thursday, May 8-9, 2024
Beaufort, NC

Poster Presentation Program

Poster Presentations

Poster Reception, NC Maritime Museum, May 8th 5:30-7:30pm

Ray Danner, Althouse and Meade, Inc. & UNC Wilmington
Synthesizing Motus Data Across the NERRS For Research, Education, and Conservation

Co-Authors/Collaborators: Marae L. West, Evangelyn Buckland, Lori Davis
Abstract: Over half of the NERRs have Motus wildlife tracking stations, which provide new information on the presence and movements of animals. Given the NERRS' increasing number of Motus stations, growth of the resulting databases, and interest in these data from within and outside of the NERRs, there is an opportunity to develop a collaborative community and supporting infrastructure within the NERRS. Objectives: 1) Create a website that displays Motus data from across the NERRS, which would support research, education, and conservation. The website will show locations of towers, numbers of species detected, example species detected, and connections among sites. 2) Develop freely available educational resources related to Motus data from the NERRS. Including: i) an online dashboard intended for students in grades 6–12 that could be used individually or in a directed lesson in the classroom, ii) digital and printable resources for visitors to the NERR sites, and iii) social media content. 3) Develop in-person educational experiences at NCNERR by attaching Motus transmitters to painted buntings at reserve sites. 4) Facilitate construction of Motus systems at approximately four priority locations. 5) Promote communication and collaboration among the NERRS staff to ensure that shared values and goals are met.

Presenter Bio: Ray Danner has expertise in coastal bird ecology, including marsh and beach-nesting birds, population biology, assessments of current and future habitat availability, assessment of human disturbance, breeding biology, radio telemetry, and thermal biology. He is a Senior Research Scientist at Althouse and Meade, Inc. and an Associate Professor in the Department of Biology and Marine Biology at UNCW. He and colleagues are leading a current NERRS Science Collaborative Project with the NCNERR and other NERRs across the country that is helping build the NERRS' capacity to use the Motus radio telemetry network. His current and former students conduct research at NCNERR sites, with a current

project led by Juan Zuluaga focusing on thermal biology of birds at Bird Island, and previous projects on marsh sparrows and beach-nesting birds.

Mackenzie Douglas, UNC-Chapel Hill Outer Banks Field Site
An Analysis of Community Values and Vegetation Changes in Buxton Woods

Co-Authors/Collaborators: Lindsay Dubbs, '21 & '22 UNC-Chapel Hill Institute for the Environment
Abstract: This research poster presents findings from a study conducted in 2021 and 2022 involving stakeholders from Buxton Woods, aiming to understand shifts in the ecology and perceptions of change within the area. Through the analysis of 11 interviews, 26 key concepts were identified which were then utilized in the Conceptual Content Cognitive Mapping (3CM) method. This method, involving physical ranking and grouping of terms, yielded many insights. Notably, participants highlighted positive connections to natural systems, particularly emphasizing resource access and recreational activities like hunting and trail use. Concerns about Buxton Woods were less frequently mentioned but were highly ranked. The Carolina Vegetation Survey (CVS) method was employed to understand the natural systems in Buxton Woods. By employing the CVS method, current vegetation structure and composition were assessed and compared to a similar study conducted in 1988, revealing shifts in species variation and stem cover density. The study underscores the importance of community engagement and ongoing monitoring to ensure the resilience and sustainable management of protected ecosystems like Buxton Woods amidst natural and anthropogenic changes.

Presenter Bio: Environmental studies graduate with a bachelor's degree from UNC-Chapel Hill. With a passion for understanding and preserving natural ecosystems, Mackenzie has engaged in research projects focused on community involvement and environmental change assessment, specifically in the Buxton Woods. Currently working as a Middle School science teacher in rural Appalachia, Mackenzie seeks to drive scientific knowledge and understanding whilst encouraging student-led action for the sustainable management of ecosystems in response to evolving environmental challenges.

Joel Fodrie, UNC-Chapel Hill (on behalf of Lillian Doll, Nadya Gutierrez, and Heather Bruck)
Weathering the storm: are restored oyster reefs insensitive or vulnerable to tropical cyclones?

Abstract: Resilience to intense weather is an essential quality of successfully restored habitat, including constructed oyster reefs. Factors that drive the long-term lifespan of restored oyster reefs, including physical stressors from extreme environmental events, are unclear. We used fetch, the distance over which wind travels over open water, as a proxy for constructed oyster reef vulnerability to physical damage from storms. We measured fetch in four cardinal and four ordinal directions from reefs constructed between 1997 and 2016, and compared those values to historical (1997 - 2021) and present-day (April 2024) reef status (present or absent). Reefs present as of April 2024 had >50% lower fetch values than those that were absent. Lower fetch values likely correlate with lower physical stressors during storms (i.e., wind, current, or wave energy). The historical track of reef conditions suggests there are threshold dynamics at play, where only large storms (i.e., Florence) triggered reef loss. Though the conditions that promote resilient, long-lasting oyster reefs need further investigation, the information collected here suggests that fetch should be considered when determining reef construction locations.

Presenter Bio: Professor, Estuarine Ecology Lab, UNC-CH Institute of Marine Sciences. Our lab's activities in and around the Rachel Carson Reserve date back to 1998, and span projects related to oyster reef

restoration, living shorelines, seagrass community ecology, and nursery habitat dynamics via long-term juvenile fish surveys (2010-present, monthly)

Megan Geesin, East Carolina University
Evaluating the influence of a biodegradable oyster breakwater on local ecosystems and geomorphology

Co-Authors/Collaborators: Hannah Sirianni, Georgette Tso, Rachel Gittman
Abstract: Salt marshes are highly productive systems that provide a variety of ecosystem services including shoreline stabilization, water purification, carbon sequestration, and nursery habitat to important fisheries species and wildlife. A variety of human impacts including climate change, coastal development, and pollution threaten salt marshes. A common method of protecting salt marshes from sea level rise and storm surges involves installing fringing oyster reefs. Because oyster reefs can attenuate waves, they are able to reduce shoreline erosion and accrete sediments allowing salt marshes to expand seaward.

Presenter Bio: Ph.D. candidate, Integrated Coastal Studies, East Carolina University. Megan's research focuses on investigating the influence of different living shoreline structures on their surrounding habitats and faunal communities through the use of in situ methods and remote sensing techniques. As a member of Dr. Rachel Gittman's lab, she has assisted with data collection and processing at living shoreline sites constructed in 2020 along Taylors Creek in the Rachel Carson Reserve.

Kate Goodenough, Larid Research and Conservation, and **Lindsay Addison, Audubon NC**
GPS telemetry reveals important foraging dynamics for American Oystercatcher pairs nesting in variable habitats

Abstract: Approximately 400 pairs of American Oystercatchers (*Haematopus palliatus*) (AMOY) nest in North Carolina, with the majority nesting on natural marsh islands and barrier island beaches (36% and 45%, respectively), while others nest on dredged-material islands (19%). In some regions, these non-barrier island breeding locations have up to 17.6 times more breeding pairs per kilometer than barrier beach habitat, yet we know little about how AMOY use these landscapes. For this project, we used GPS telemetry to identify associated foraging areas for AMOY nesting in each of these landscapes. We deployed a total of 30 GPS dataloggers on nesting AMOY during the 2019 and 2021-2023 breeding seasons. Our preliminary results suggest that space use by AMOY varies spatially and temporally depending upon nesting habitat. All monitored AMOY foraged nocturnally throughout the night from dusk to dawn (2200-0400). Very little foraging overlap occurred, suggesting AMOY might have foraging territories in addition to nesting territories. Last, foraging distances were smaller for pairs with nesting territories that had adjacent foraging grounds compared to locations without, which has important implications for AMOY conservation and management.

Presenter Bios: Lindsay is a coastal biologist, Audubon North Carolina, and manages Audubon's coast islands and sanctuaries program which manages and monitors 40% of the state's nesting coastal waterbirds and collaborates on conservation-related research. She sits on the American Oystercatcher Working Group's steering committee and coordinates oystercatcher banding statewide. For over a decade, Audubon has been a partner of the Coastal Reserve System, supporting bird monitoring efforts at Masonboro Island and Rachel Carson Reserves.

Kate is a movement ecologist whose research is focused on life history strategies of coastal nesting bird species. She has been involved in shorebird management and conservation related research since 2004.

She has over 12 years of experience working with telemetry projects and over 18 years of experience working on avian movement projects.

Andrew McMains, East Carolina University
Investigating the Impacts of Dredging on Coastal Inlet Habitat Function Using Acoustic Imaging

Co-Authors/Collaborators: Chris Taylor, James Morley
Abstract: Despite the accepted importance of coastal inlets as foraging habitat and as critical movement corridors between estuaries and the littoral ocean, these areas remain understudied. Along with their ecological function, inlets play an important role in coastal economies. Deep draft shipping channels must be maintained through inlets to allow the passage of commercial shipping vessels, requiring consistent dredging. Historically, inlet dredging has been restricted to winter months to mitigate the impacts on larvae and nekton. While it would be desirable to allow the dredging of port serving inlets year-round, the ecological tradeoffs of that strategy are unknown. We utilized a Before, After, Control, Impact experimental design to investigate the impacts of inlet dredging on fish abundance and habitat utilization in Beaufort Inlet, NC in the summer and fall of 2022. Random stratified sampling was conducted using an acoustic imaging sonar to determine the relative abundances and trophic guilds of fish in the inlet area. Overall, we saw low fish densities in the inlet and large temporal variations in abundances; peak abundances in Beaufort Inlet occurred in late August. Our data will provide important information to managers regarding the impacts of dredging on inlet use by fish as well as the duration of the disturbance. Additionally, this work will provide a baseline understanding of the seasonal trends in inlet utilization and will support future work identifying the drivers of large-scale inlet ingress and egress events.

Presenter Bio: PhD student studying fisheries ecology. Specific research interests revolve around identifying range of anthropogenic impacts on fish habitat use using and array of acoustic techniques. NERRS involved research includes using split beam sonar and acoustic imaging to look at the impacts of dredging on inlet habitat use in Beaufort Inlet and the adjacent estuary.

Dan Rittschof, Duke University Marine Lab
Sympatric Speciation in Blue Crabs

Co-Authors/Collaborators: Megan Moran, Zack Darnell, Gary Dickenson
Abstract: Blue crabs release larvae at mouths of estuaries and in the coastal ocean. Larvae spend 40 to 60 days developing into the last larval stage and return to estuaries. Female crabs undergo a terminal molt to maturity and mate 1 to several times over a few days until their seminal receptacles are full. Crabs mature their ovaries and then migrate to the mouths of estuaries and coastal ocean where they release 3 to 7 clutches of embryos about 64,000,000 larvae. We provide molecular biology evidence on a mitochondrial enzyme that suggests Blue crab genotypes sort by salinity with high salinity crabs being different than low salinity crabs. Because the crab fishery removes intermediate genotypes, development of two species from one species may be accelerated.

Antonio Rodriguez, UNC-Chapel Hill
Accelerating sea-level rise promotes rapid oyster reef accretion

Co-Authors/Collaborators: Justin T. Ridge, Molly C. Bost, Naomi Nice, Eve R. Eisemann, Yasamin Sharifi, Joshua Himmelstein, and F. Joel Fodrie
Abstract: Intertidal oyster reefs are increasingly being promoted as effective natural breakwaters to protect coastal infrastructure from storm waves and as carbon burial sites to mitigate greenhouse gas emissions. Their function as carbon sinks and breakwaters is often supported by information extracted from living oyster populations and assessment over short periods; however, both services depend on accretion, which operates over decadal to century time scales. Sea-level rise is accelerating globally and a reef's provision of wave attenuation and carbon burial into the future is predicated on its growth. Here we show that the rate of sea-level rise drives oyster reef vertical accretion and carbon burial. We found that when sea-level rise began to continuously accelerate after 1800 CE to the modern rate of ~3.5 mm y-1, reef vertical accretion rates were an average of three times greater than the previous 18 centuries when sea level was rising 0.9 mm y-1. Oysters modulate carbon burial because the flux of shell to the subsurface was directly related to the flux of organic matter; however, none of the 25 reefs sampled ever functioned as net carbon sinks because CO2 is emitted during shell formation. Our results suggest that as sea-level rise continues to accelerate, oyster reef vertical growth will rapidly respond, shell production and burial will increase more than organic matter, and there will likely be ecosystem-service tradeoffs with reefs becoming even larger sources of CO2 but more effective at damping waves.

Georgette Tso, East Carolina University
Wave transformation across natural and restored oyster reefs

Co-Authors/Collaborators: Rachel Gittman, Siddharth Narayan, Hannah Sirianni, Megan Geesin
Abstract: Oyster reefs offer coastal protection benefits by reducing incoming waves and stabilizing coastal sediments. As offshore waves propagate towards coastlines, intertidal oyster reefs act to reflect and dissipate waves through depth-induced wave breaking and bottom friction, reducing wave heights before they reach the shore. Wave attenuation by oyster reefs is critical to the stabilization of coastal sediments, yet the degree of wave attenuation provided by natural and restored oyster reefs has not been quantified. Wave gauges were deployed across natural and restored oyster reefs in Middle Marsh and Back Sound to capture wave transformation processes and to quantify wave attenuation benefits.

Kalena Walker, UNC Wilmington
Characterizing inter- and intra-annual grain size trends on Masonboro Island, NC

Abstract: Barrier islands are coastal features that provide wildlife habitat, recreation opportunities, and protection from storm surge and wave action for adjacent communities. Barrier islands are also particularly dynamic and responsive to changes in the environment and require informed management practices for coastal resiliency. An important component of informed management practices is the utilization of probabilistic models, which often use a default grain size for a given barrier island system. However, studies have suggested that grain size has a significant impact on sediment dynamics that control barrier island morphology and by incorporating real-world grain size measurements, modelers can improve their accuracy and performance. There remains a need to analyze sediment grain size on barrier islands with high spatiotemporal resolution to inform the use of grain size as a model parameter. This study aims to characterize the grain size distribution of Masonboro Island, North Carolina at varied

spatio-temporal resolution to capture the range in grain size variability. In 2018, a north and south transect was established, each consisting of five surface sampling stations placed from the foreshore to backbarrier, and an aerial sediment trap array installed at the crest of the foredune. Surface and aerial sediment samples were collected seasonally as well as before and after storms, then analyzed for grain size from 2018–2024. By examining the grain size trends on Masonboro Island, I aim to elucidate the role grain size may play in the geomorphology of the island over short (i.e., days to weeks) and long (i.e., seasons to years) timespans. A better understanding of the variability in sediment grain size on a barrier island will inform coastal management and allow coastal communities to better prepare for coastal related challenges like storms, rising sea levels, and resource management.

Presenter Bio: MS Geoscience Student in Earth and Ocean Sciences at UNCW. Kalena is currently working on characterizing the grain size characteristics of surface and aeolian transported sediments on Masonboro Island over varying spatial and temporal scales.

Brett Wilson, UNC Wilmington
Diamond-backed terrapin bycatch reduction in the North Carolina commercial Blue crab fishery

Co-Authors/Collaborators: Amanda Southwood Williard, Joe Facendola (NC Division of Marine Fisheries)
Abstract: The commercial blue crab (*Callinectes sapidus*) harvest represents one of the most valuable fisheries in North Carolina and is a significant economic driver for coastal communities. The estuarine diamond-backed terrapin (*Malaclemys terrapin*) is listed as a Species of Special Concern by the North Carolina Wildlife Resources Commission, and a report submitted by the Scientific Council on Amphibians and Reptiles concluded that incidental bycatch in crab pots is the most serious threat to terrapins in North Carolina and throughout their range. Efforts to reduce bycatch by installing bycatch reduction devices (BRDs) to funnel openings on crab pots have been met with strong resistance due to perceived reductions in blue crab catch. In 2020, the North Carolina Division of Marine Fisheries (NCDMF) designated Diamond-backed Terrapin Management Areas (DTMAs) at Masonboro Island and Bald Head Island, within which the use of NCDMF-approved BRDs is required. While this regulatory measure was taken, the NCDMF acknowledged the need to explore alternative gear modifications that exclude terrapins while minimizing impacts to target species catch and therefore more accepted within the industry. The primary goal of our study was to test the efficacy of novel, industry proposed gear modifications that narrow the funnel entry without the need to install a BRD, referred to as the narrow funnel design (NFD) and reinforced funnel design (RFD), at excluding terrapins and assess impacts to blue crab catch.

Presenter Bio: Graduate student in the Comparative, Integrative, and Marine Biology Program at UNC Wilmington. Dissertation research focused around Diamond-backed terrapin bycatch reduction and management in the North Carolina commercial blue crab fishery, using a combination of fishing gear development and testing, population genetics, and spatial analysis of crab pot distribution. Actively collaborating with crabbers fishing within the Masonboro Island Reserve and Zeke's Island Reserve.