MISSISSIPPI STATE UNIVERSITY EXTENSION

Grand Bay National Estuarine Research Reserve

Bi-Annual Research Symposium Proceedings

Grand Bay Coastal Resources Center
Moss Point, Mississippi

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Prepared by Jennifer De Bose, PhD, Research Coordinator, Grand Bay NERR, Coastal Marine Extension Program, MSU

Grand Bay National Estuarine Research Reserve

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

Mississippi Department of Marine Resources

Symposium Objectives

1. Share significant research conducted in the Grand Bay National Estuarine Research Reserve
2. Provide results of research projects to researchers and natural resource managers
3. Encourage collaboration among researchers and natural resource managers conducting studies in the Grand Bay National Estuarine Research Reserve

Proceedings Contents

List of Shortened Forms

The following list has frequently used abbreviations, acronyms, and initialisms in this publication.

AU	Auburn University
DBH	diameter at breast height
EC	electrical conductivity
eDNA	environmental DNA
NERR	National Estuarine Research Reserve
LS	living shorelines
LSU	Louisiana State University
MHW	mean high water
MSU	Mississippi State University
nGOM	northern Gulf of Mexico
NIR	near infrared spectrometry
NWR	National Wildlife Refuge
Ole Miss	University of Mississippi
qPCR	quantitative polymerase chain reaction
SAV	submerged aquatic vegetation
SERNEC	Southeast Regional Network of Expertise and Collections
tNSC	total nonstructural carbohydrates
UA	University of Alabama
UAS	unmanned aircraft system
UGA	University of Georgia
UHR-MAT	Upland Habitat Restoration Management Application Team
USA	University of South Alabama
USM	University of Southern Mississippi

Symposium Organizers

Planning committee
Sandra Bilbo, Jennifer Cumbest, Jennifer De Bose, Jonathan Pitchford, and Margo Posten

Process agenda preparation
Sandra Bilbo

Catering committee
Jennifer De Bose and Margo Posten

Set up
Mike Archer, Sandra Bilbo, Jennifer Cumbest, Jennifer De Bose, Jay McIlwain, and Margo Posten

Lunch catering
Aztecas Restaurant and Catering, Gautier

Social dinner catering
Scranton's Restaurant and Catering, Pascagoula

Poster session set up
Mike Archer, Sandra Bilbo, and Jeneil Patel

Field trips led by
Emmett Carstens, Jennifer Frey, Andrew Heaton, and Janet Wright

Seminar room facilitators/support
Mike Archer, Sandra Bilbo, Nate McGregor, Dennis McGrury, Jay McIlwain, Jonathan Pitchford, Cassy Porter, and Margo Posten

Facilitated discussion
Jennifer De Bose and Ayesha Gray, with support by Sandra Bilbo

Cruise captains/crew Grand Bay vessels
Mike Archer, Jacob Goff, Jay McIlwain, and Jonathan Pitchford; MSU vessels: Jaden Akers, Nathan McGregor, Jeneil Patel, Maya Stratman, and Anthony Vedral

We are thankful to the MSU Coastal and Marine Extension Program for providing two boats and captains.

Drivers for field trips and social dinner
Jacob Goff, Dennis McGrury, and Jay McIlwain, and Jonathan Pitchford

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Sandra Bilbo, Dennis McGrury, and Jonathan Pitchford

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Agenda

07:45–09:00 Registration and coffee

08:00–08:50 (*optional*) Savanna Walk with Andrew Heaton, Emmett Carstens, and Janet Wright

09:00–09:25 Welcome, symposium purpose, introductions, and agenda overview

09:25–09:40 Ayesha Gray: The Road Map: Infrastructure revision to achieve transformational ecosystem restoration, economic prosperity, and community resilience in a Gulf Coast estuary

09:40–09:55 Eric Sparks: The potential for conservation grazing in coastal uplands of the nGOM coast

09:55–10:10 Steve Brewer: A simple model of the maintenance of high plant species diversity by fire in wet pine savannas

10:10–10:30 BREAK

10:30– 10:45 Mandy Rigsby: The response of bats and their insect prey to different coastal upland habitat management techniques

10:45–11:00 James Rigney: Phenology of Gulf Coast ticks in the wet pine savanna at Grand Bay NERR

11:00–11:15 Sofia Campuzano Vallejo: Preliminary winter bird community data for tracking pine savanna restoration in the Mississippi Gulf Coast

11:15–11:30 Emmett Carstens: The use of wildlife cameras for monitoring and inventory projects at the Grand Bay NERR

11:30–12:45 LUNCH and gopher tortoise burrow excursion with Jennifer Frey and Andrew Heaton

12:45–01:00 Anthony Vedral: Marsh vegetation loss and recovery due to the presence of marine debris

01:00–01:15 Amanda Free: Temporal and spatial variation of fecal coliform sources in the Grand Bay NERR

01:15–01:30 Jessica Woodall: Differences in nekton community composition in *R. maritima*, *H. wrightii*, and the unvegetated bottom in the Grand Bay NERR

01:30–01:45 Sarah Ramsden: Sportfish behavior and habitat selection along a protected shoreline

01:45–02:00 BREAK

02:00–02:15 Mike Archer: Fish community response to artificial reef construction in a nGOM estuary

02:15–02:30 Matt Virden: Evaluating the effectiveness of restoration approaches for nearshore habitat

02:30–02:45 Andrew Heaton: Mississippi diamondback terrapin (*Malaclemys terrapin pileata*) nest site preferences in the nGOM and implications for restoration

02:45–03:00 Iwo Gross: Examination of mating system dynamics in the Mississippi diamondback terrapin (*Malaclemys terrapin pileata*)

03:00–03:45 BREAK and Poster Session

03:45–03:55 Jennifer De Bose: Overview of Grand Bay NERR research efforts and priorities

03:55–04:30 Facilitated Discussion: Science support for ecosystem function restoration and effectiveness monitoring

04:30–04:45 Symposium wrap-up and evaluations

04:45–06:30 Sunset bayou excursion and social dinner

Poster Session

The asterisk (*) indicates the presenting author. Please contact the authors if you would like more information or view their posters.

Ocean and Human Health: Linking Water Quality to Health of Bottlenose Dolphins and the Implications for Human Health
Ania Brown, Jennifer Bloodgood, Brandi Kiel-Reese, and Ruth H. Carmichael*

Intertidal Refuge Improves Oyster Survival at Living Shoreline Breakwaters
Aaron Bland* and Ronald Baker

Molecular Microbial Source Tracking for Source-Specific Management of Water Quality on the Mississippi-Alabama Coast
Penny Demetriades,* Ania Brown, Brianna Janssen, Ruth H. Carmichael, Sinéad Ní Chadhain, and Brandi Kiel Reese

Plankton of Grand Bay NERR
Jeneil Patel,* Jennifer De Bose, Elizabeth Moore, Cassy Porter, Michael Archer, Jonathan Pitchford, and Ayesha Gray

Developing Efficient Biomass Estimation Methods Utilizing Tree Parameters and Nondestructive Sampling Methods for the Coastal Forest Ecosystems
Favour Onyido, Emma Schopen,* Jose Febles Diaz, Haomin Huang, and Zhaofei (Joseph) Fan

Seeking Advice in the Development of an Upland Habitat Restoration Management Application Team
Jonathan Pitchford*

Impact of Soil Salinity on Chinese Tallow (*Triadica sebifera*) Resprouting Vigor and Belowground Nonstructural Carbohydrate Stores in Slash and Longleaf Pine (*Pinus elliottii; P. palustris*) Flatwoods and Savannas along the Gulf of Mexico Coast
Eric BruBaker, Zhaofei (Joseph) Fan,* Heather Alexander, and Christopher Anderson

The Grand Bay NERR Herbarium
Emmett Carstens*

Living Shoreline Technical Assistance Programs
Eric Sparks,* Sara Martin, Jaden Akers, and Ashleigh Dunaway

Examining Fish Diets in Restored Seascapes: An Alternative Metric to Assess Nekton Habitat Enhancement from Restoration
Matheus de Barros,* Charles Martin, Jonathan Grabowski, and Ronald Baker

Effects of Structural Design on Oyster Survival in Artificial Reefs
Jaden Akers,* Nigel Temple, and Eric Sparks

Abstracts (alphabetized by first author)

The included abstracts are for both oral presentations and poster presentations. These are designated in parentheses at the end of each title. The asterisk (*) indicates the presenting author.

Effects of Structural Design on Oyster Survival in Artificial Reefs (poster)

Jaden Akers,* Nigel Temple, and Eric Sparks

Eastern oysters are well-known ecosystem engineers responsible for providing water filtration, habitat and refuge for numerous species, and other ecosystem services. However, natural oyster reefs are declining due to several natural and anthropogenic threats. To mitigate for the loss of natural oyster reefs, many reef restoration projects have been completed, and several more are being planned. It is known that variation in reef height, interstitial space, and slope can encourage oyster settlement, but little is known about how reefs can be designed to exclude oysters' predation by oyster drills, fish, crabs, and other predators. In this study, we seek to quantify the effectiveness of varying oyster reef designs at excluding predation. Sixteen replicates each of eight different reef designs varying in height, slope, and vertical spacing have been created from Portland cement and seeded with oysters from Auburn Shellfish Lab. These reefs have been deployed in Bayou La Batre, Alabama, in a block design with two replicates of each reef design deployed in a single block. Monthly photographs to determine oyster growth and survival in addition to predator counts will be collected and analyzed. After 8 months, 50 percent of the reef units were removed from the field and placed in a mesocosm with 8 separate blocks (1 replicate each). Daily monitoring captured the location of oyster drills on each reef unit. Results from this study can be used to inform the design of oyster reef restoration projects.

Fish Community Response to Artificial Reef Construction in a nGOM Estuary (oral)

Michael J. Archer,* Jonathan L. Pitchford, Michael Brochard, and Cher Griffin

The Grand Bay NERR is a retrograding deltaic system along the nGOM experiencing high rates of shoreline erosion, topping 2 meters per year in some locations. Total marsh extent at the Grand Bay NERR is decreasing as exposed erosional marsh edge loss is exceeding upland-marsh migration. Subtidal and intertidal artificial reefs were installed within the reserve in early 2021 with the goals of decreasing shoreline retreat by reducing wave energy and creating functional habitat. Using a before-after-control-impact experimental design, resident and transient fish assemblages were sampled pre- and post-reef construction every other month from January 2019 to March 2023 using a 750-foot gill net at one intertidal reef and control site and two subtidal reef and control sites. A total of 45 species and 8,203 fish were caught during the sampling period. The permutational analysis of variance results determined that there were differences in the fish communities pre- and post-reef construction at subtidal habitats, but not intertidal habitats. Similarity of percentage results show that an increase in speckled trout (*Cynoscion nebulosus*) and Atlantic croaker (*Micropogonias undulatus*) and a decrease in Gulf menhaden (*Brevoortia patronus*) and spot (*Leiostomus xanthurus*) drove much of the change in the fish community at subtidal reef sites. There was also a sharp decline in the number of times no fish were caught at reef sites. Artificial reefs can hopefully be a valuable tool in conserving marsh extent as well as creating functional habitat. This project will be used to inform project managers about their impact on the local fish community in an estuary.

Intertidal Refuge Improves Oyster Survival at Living Shoreline Breakwaters (poster)

Aaron Bland* and Ronald Baker

Coastal restoration projects often provide a hard substrate to be colonized by live oysters. When engineered structures develop into oyster reefs, the reefs may improve water and habitat quality and improve shoreline protection. However, many structures fail to develop into oyster reefs due to various ecological forcings. We investigated potential factors that may prevent oyster reef development on living shoreline breakwaters in Portersville Bay, Alabama. We deployed ceramic tiles at two living shoreline sites across a range of tidal elevations. Bare tiles were used to investigate rates of wild oyster settlement, and tiles seeded with live oyster spat were used to examine post settlement mortality. We observed very limited wild recruitment to date and high rates of post settlement mortality. At one site (Point aux Pins),

overall mortality was greater but decreased at increasing tidal elevations. At the other site (Coffee Island), mortality was lowest at an intermediate tidal elevation. Notably, this potentially "optimal" elevation was higher than the crests of the nearby breakwater structures. We found that oysters at living shoreline sites are likely limited by post settlement mortality, especially predation, and potentially by larval availability. Furthermore, the successful development of oysters on living shoreline structures may depend in part on the amount of intertidal refuge provided by the structure. These results may improve future oyster restoration by informing living shoreline siting and design.

A Simple Model of the Maintenance of High Plant Species Diversity by Fire in Wet Pine Savannas (oral)

Steve Brewer*

Pine savannas maintained by frequent fires contain among the most species-rich plant communities in the world. Precisely how fire maintains such high fine-scale diversity is poorly understood and not adequately explained by classical disturbance theory. I have previously shown that increases in species richness that occur in response to an increase in fire frequency can be simulated by removing surface litter and standing dead, without causing significant plant mortality. I thus created a simple patch model of fire-maintained plant species richness wherein community plant density increases with increasing fire frequency due to an increase in recruitment within litter-free patches. Increases in plant species richness are then simulated by randomly sampling individuals from a species pool. I validated the model with empirical data by determining whether observed changes in species composition that resulted from a reduction in simulated fire frequency in two wet pine savannas were different than expected by chance. They were not. The most abundant species in the annual simulated fire treatment experienced the greatest losses in terms of density and frequency in response to a reduction in simulated fire frequency, consistent with a random expectation. However, these same species also exhibited traits that could explain the greatest increases in response to increased fire frequency (e.g., fire-stimulated emergence from a seed bank) and the greatest losses in response to a reduction in fire frequency (e.g., short lifespan). The observed changes in species composition thus may indicate a narcissus effect, wherein randomly generated assemblages of species reflect non-random factors that produced differences in species abundances in the species pool (e.g., life history differences). I conclude that frequent fires maintain high plant species richness in wet pine savannas by increasing the recruitment of most species, especially short-lived species, while eliminating few if any other species.

Ocean and Human Health: Linking Water Quality to Health of Bottlenose Dolphins and the Implications for Human Health (poster)

Ania Brown, Jennifer Bloodgood, Brandi De Bose, and Ruth H. Carmichael*

Freshwater discharge conveys pollutants and pathogens to coastal waters, degrading water quality and threatening the ecosystem and human health. Bottlenose dolphins (*Tursiops truncatus*) are common residents of bay, sound, and estuarine habitats, where overlap with human activities and impacts to the marine environment are greatest. Coastal nGOM receives among the highest freshwater inputs among watersheds in the U.S. and supports resident bottlenose dolphin populations, providing a unique setting to study the effects of water quality and subsequent effects on dolphin health. In recent years (2020–2022), pathogens, including the bacteria *Erysipelothrix* and the parasite *Toxoplasma gondii*, have been documented in stranded bottlenose dolphins. In the case of *Erysipelothrix*, two dolphins died of acute sepsis following high freshwater influx. *Erysipelothrix* and *T. gondii* are "one health" pathogens of importance to animal, environmental, and human health that can be transported to aquatic environments through runoff and are associated with disease and mortality in many species. This ongoing study seeks to determine if seasonal freshwater discharge patterns and associated changes in water quality (e.g., increased contaminants, microbial indicators, pathogens) relate to metrics of health (body condition, lesions, pathogens, hormone levels) in dolphins. As long-lived, mammalian apex predators, dolphins are potentially valuable analogs to assess human health risks. Hence, understanding relationships between water quality and dolphin health will necessarily help identify potential human health risks and support critical management of waters commonly used by marine mammals and people, especially under increasing anthropogenic land use and climate changes that will continue to impact water quality.

Impact of Soil Salinity on Chinese Tallow (*Triadica sebifera*) Resprouting Vigor and Belowground Nonstructural Carbohydrate Stores in Slash and Longleaf Pine (*Pinus elliottii; P. palustris*) Flatwoods and Savannas along the Gulf of Mexico Coast (poster)

Eric BruBaker, Zhaofei (Joseph) Fan,* Heather Alexander, Christopher Anderson, and Martin Spetich

Endangered coastal pine flatwoods and savannas found in the southeastern U.S. consisting of an overstory of longleaf and slash pine (*Pinus palustris*, *P. elliottii*) are at risk of invasion from Chinese tallow (*Triadica sebifera*). This study aimed to determine what environmental factors along the Gulf of Mexico coast influence post-topkill mortality and resprouting vigor (aggregate resprout length) in those survived trees. A group of tallow trees of varying size and age classes were collected at two study sites: Grand Bay NERR, approximately 2 kilometers off the Gulf of Mexico coast, and NWR about 9 kilometers from the coast, to assess what drives tallow tree mortality and resprout vigor. Over one year, we found that initial resprouting vigor in tallow trees is driven by canopy closure and tree size, with larger trees under open canopies resprouting with the greatest aggregate length. Mortality, however, is impacted by soil EC, with trees growing at the low EC site being five times more likely to survive than those at the high EC site. In addition to top-killing mature trees, we collected a sample of 2- to 4-year-old seedlings from both study sites to assess differences in belowground nonstructural carbohydrate stores that could potentially influence mortality and resprouting vigor following top kill. As a percentage, the tNSC were similar between both sites; starch was higher at the low EC site while sugar was higher at the high EC site nearer the coast. Additionally, seedlings growing closer to the coast in high soil EC had shorter roots but greater root biomass, suggesting a limited rooting zone and nutrient-poor growing conditions that could adversely affect survival. While the scope of these findings is limited to two study sites in southern Mississippi, the apparent impact of soil EC on tallow seedling tNSC and mature tree mortality suggests that it could limit the invisibility of at-risk ecosystems nearer the coast with higher soil EC. Similarly, managing and removing invasive tallows, specifically with prescribed fire, from high EC sights could be more effective in controlling the species by preventing resprouts after top kill.

Preliminary Winter Bird Community Data for Tracking Pine Savanna Restoration in the Mississippi Gulf Coast (oral)

Sofia Campuzano,* Ray B. Iglay, Mark S. Woodrey, Jonathan Pitchford, Andrew Heaton, Emmett Carstens, and Jacob Goff

North American grassland bird populations have declined, due in part to the loss of suitable winter habitats, including the longleaf pine (*Pinus palustris*) savanna ecosystem, across the southeastern U.S. Longleaf pine savanna coverage has vastly declined across the southeast region of the U.S. from approximately 23 million hectares prior to European colonization to less than 1.2 million hectares in most recent years due to habitat conversion, but perhaps most importantly, lack of fire. Several bird species of conservation concern are found during the winter in these longleaf pine savanna ecosystems along the Gulf of Mexico coast including Henslow's sparrows (*Ammodramus henslowii*). Our objectives in this study are to 1) document changes in bird communities associated with habitat management activities (i.e., mechanical clearing, prescribed fire, etc.) and 2) determine the presence/absence and density of winter grassland birds, with a primary focus on Henslow's sparrows, in relation to pine savanna restoration efforts. Initial avian surveys conducted from December 2019 to March 2023, to establish baseline bird communities across sites to measure bird response to intensive land management actions indicate most of the restoration areas are dominated by species characteristics of shrub and forest. Preliminary data also showed a representative presence of grassland birds including sedge wren (*Cistothoris stellaris*) and swamp sparrow (*Melospiza georgiana*) and Henslow's sparrow. One particular site, a regularly managed area using prescribed fire, had a significant number of winter grassland birds including 37 Henslow's sparrows, a Species of Greatest Conservation Need.

The Use of Wildlife Cameras for Monitoring and Inventory Projects at the Grand Bay NERR (oral)

Emmett E. Carstens (presented by Jonathan Pitchford)

Grand Bay NERR has several completed and ongoing camera trapping projects. The passive nature of camera trapping limits the need for direct interaction with wildlife as necessary in live trapping. Camera trapping also eliminates the need to check traps daily, as the cameras can be left out for as long as the battery life and memory card allow. A year-long (Grand Bay NERR-wide) marsh/ecotone camera project was completed in June 2023. This project had the goal of generating a broad-scale snapshot inventory of wildlife use of coastal wetlands and required standardized camera settings and placements.

Following the conclusion of this project, two camera trapping projects began at the Grand Bay NERR with the goals of 1) inventorying mammal species at the reserve that may not be otherwise detected and 2) comparing vertebrate use of nine-banded armadillo (*Dasypus novemcinctus*) and gopher tortoise (*Gopherus polyphemus*) burrows. Initial results from pilot camera trapping as burrows were located, show similarity in species assemblages between the two burrow types, as well as notable differences in visitation frequency between the burrows. Additional factors like elevation, substrate, light intensity, microhabitat of individual burrows, and historical land use may impact activity and visitation rates at burrow sites and will be included in the study. Comparing the vertebrate assemblages at the two burrow types will help determine the ecological role or niche of both species at Grand Bay NERR and similar habitats.

The Grand Bay NERR Herbarium (poster)

Emmett E. Carstens

Grand Bay NERR herbarium currently has 711 specimen records consisting of 458 species since it was founded in early 2020. The overall goal of the Grand Bay NERR herbarium is to establish a collection of all plant species found within the reserve initially intended to serve as a tool for Grand Bay NERR researchers during vegetation surveys. The collection is made unique through additional documentation of each collected specimen using the citizen science-based app, iNaturalist. Each specimen in our collection has a corresponding georeferenced entry on the database for herbaria, SERNEC. Plants are collected passively, and seasonally as new areas of the reserve are observed and managed. When a new specimen is encountered, an iNaturalist observation is created prior to collection. Once collected, each plant undergoes pressing and fumigation before being mounted to individual sheets. Each mounted specimen receives an identification label corresponding to the iNaturalist observation and a unique barcode. The mounted plants are photographed and uploaded to SERNEC. The connectivity and accessibility of the Grand Bay NERR herbarium through iNaturalist and SERNEC provide education and outreach possibilities at a local level as well as research potential among scientists interested in the distribution or phenology of vulnerable or rare plant species. Prior collaborations include rare species mapping efforts with Georgia and Indiana Departments of Natural Resources, a PhD student in New York working on a population genetic study, and an interview with Arizona State University regarding SERNEC and biodiversity collections.

Examining Fish Diets in Restored Seascapes: An Alternative Metric to Assess Nekton Habitat Enhancement in Restoration Metrics (poster)

Matheus de Barros,* Charles Martin, Ronald Baker, and Jonathon Grabowski

Efforts to stabilize shorelines while maintaining or enhancing ecological functions have led to the development of novel restoration strategies such as LS to emerge. The enhancement of nekton habitat is one of the most mentioned co-benefits of LS. Among the mechanisms theorized to enhance habitat quality for nekton in restored seascapes is enhanced prey resources. In this study, we used Bayesian inference to compare the diet composition of juvenile pinfish (*Lagodon rhomboides*), croaker (*Micropogonias undulatus*), and silver perch (*Bairdiella chrysoura*) between restored and degraded, unrestored seascapes at the nGOM to evaluate whether coastal restoration provides enhanced prey resources. Results show that two of the three studied species had fuller guts at restored sites. Model outputs suggest substantial spatial variability in the diet composition of the three species, with prey items such as SAV, polychaetes, isopods, and tanaidaceans being more likely to be found in fish guts from restored sites. In general, this suggests that coastal restoration might increase the abundance or availability of some prey for juvenile fish, perhaps through the addition of structured habitats and increased shoreline stability. We argue that diet composition of ecologically important, generalist fish should be included as a complementary, cost-effective metric in the toolkit to evaluate the effects of restoration on nekton.

Molecular Microbial Source Tracking for Source-Specific Management of Water Quality on the Mississippi-Alabama Coast (poster)

Penny Demetriades,* Ania Brown, Brianna Janssen, Ruth H. Carmichael, Sinéad Ní Chadhain, and Brandi Kiel Reese

The urbanization of coastal areas allows for the introduction of contaminants from various terrestrial sources into aquatic systems. Pathogens can be conveyed to waterways from human (e.g., wastewater treatment plants and septic systems) and non-human (e.g., livestock, wildlife, and domesticated pets) sources. Pollution loads and sources vary within coastal

areas, and differing levels can pose human health risks through contaminated recreational waters and consumption of contaminated seafood. Water quality degradation, therefore, poses a significant threat to human health, coastal resources, and coastal economies on the Mississippi-Alabama coast. Microbial sources to Alabama waters are largely undefined, and a better understanding of these sources can inform system-scale management to improve community and ecosystem health. This study aims to identify and quantify potential fecal sources from sub-watersheds along the Mississippi-Alabama coast via microbial source tracking that will align traditional microbial indicators with eDNA and qPCR; molecular technologies that can identify human and non-human sources of contamination to aquatic systems. Genetically different groups of *Bacteroidales* bacteria will be targeted for source identification (due to their high host-specificity), and metagenetic eDNA analyses will be incorporated in tandem to provide valuable ecological context to specific field sites and refine geographic locations of contamination sources for management. Over the course of one year, a monthly sample collection will occur at each of the 13 sites identified to be key potential entry points of contamination to Alabama's coastal waters. Data will immediately support shellfish aquaculture and seafood safety, tourism, and ecosystem health across state borders.

Temporal and Spatial Variation of Fecal Coliform Sources in the Grand Bay NERR (oral)

Amanda Free, Beth Baker, Philip Lee, and Eric Sparks

Grand Bay NERR has chronically elevated fecal coliform counts; however, the source of the contamination is unknown. Due to the poor understanding of the local fecal pollution sources, this area has not been opened to shellfish harvesting since 2007. According to past sanitary surveys, there has been a history of malfunctioning residential septic systems and inadequate wastewater treatment in the upper watershed. Feral hogs and birds are also abundant in the estuary and could be a potential contributor to elevated fecal coliform levels in this area. The Grand Bay NERR is located on the nGOM coastline, which is known to receive some of the highest annual precipitation totals in the U.S. The intense rainfall can lead to a large fecal load from upland sources into the estuary. To better understand the temporal and spatial variation of fecal coliforms in the Grand Bay NERR and inform oyster reef management, monthly sampling will take place over the course of a year at six sites within the main watershed of the Grand Bay NERR and two sites upstream in the bayous. Having the two sites upstream will allow for a better understanding of how rainfall affects fecal contamination throughout the estuary. qPCR will be used for microbial source tracking to identify levels of potential fecal sources from humans, feral hogs, and birds within the estuary as well as the concentrations of *Enterococcus*, a fecal indicator bacteria.

Examination of Mating System Dynamics in the Mississippi Diamondback Terrapin (*Malaclemys terrapin pileata*) (oral)

Iwo P. Gross* and Matthew E. Wolak

In studies of sexually reproducing organisms, the paternal contribution to the population growth rate is often ignored on account of the assumption that males generally do not limit the reproductive success of female conspecifics. However, theoretical and empirical studies have shown how sexual conflict and skewed operational sex ratios can shape mating systems and ultimately influence population extinction risk. Quantification of mating system dynamics should, therefore, be a priority when assessing the viability of depleted populations. Here we propose a study design that will produce the first estimates of the rate of multiple paternity—a key characteristic of mating systems—from a diamondback terrapin (*Malaclemys terrapin pileata*) meta-population along the Alabama-Mississippi coastline. Despite the cryptic nature of terrapin mating systems, the predictable nesting habits characteristic of all turtles provide us an opportunity to collect maternal and embryonic genetic material from emerged nests and thus infer parentage. Considering high rates of terrapin nest predation, however, we describe the development and validation of a method to extract DNA from depredated terrapin eggshells and their residues. We hope this non-invasive genetic sampling approach will provide useful information regarding the mating system structure at key terrapin nesting beaches along the nGOM.

Conservation Priorities of Mississippi Diamondback Terrapins (*Malaclemys terrapin pileata*) at the Grand Bay NERR (oral)

Andrew Heaton*

In Grand Bay NERR, Mississippi diamondback terrapins (*Malaclemys terrapin pileata*) primarily nest at two locations, Point Aux Chenes and Grand Battures. The shorelines of these marsh beaches are retreating at rates of 0.50–1.99 and 2.0–6.55 meters per year, and Grand Battures has seen its available shoreline nesting habitat decrease by 38 percent from 2014 to 2021. Depredated nest-monitoring efforts over the past two decades have also found the lowest number of nests at Grand Battures to date in 2021, with increased search effort. To determine what factors drive nest site selection at the Grand Bay NERR, a survey of environmental characteristics of nesting sites occurred in 2022. Elevation and the presence of *Spartina patens*, respectively, were the two factors found to drive nest site selection the most. Nests below the MHW level are typically not successful due to inundation. The local MHW is 0.33 meters, and greater than 90 percent of all nests were found at elevations above 0.83 meters, which supports this. Most nesting beach habitat in the Grand Bay NERR is low elevation, and our monitoring has found nests to be grouped in small patches of higher elevation beach. Elevation and the plant community should be considered when determining nesting habitat quality, and we believe the information from our monitoring can inform future restoration, management, and research of this species and its habitat.

Developing Efficient Biomass Estimation Methods Utilizing Tree Parameters and Nondestructive Sampling Methods for the Coastal Forest Ecosystems (poster)

Favour Onyido, Emma Schopen,* Jose Febles Diaz, Haomin Huang, and Zhaofei (Joseph) Fan

Biomass estimation is an essential part of being able to measure carbon sequestration. However, biomass estimation is traditionally done through stem analysis, which involves physically weighing the trees, which is labor and cost intensive. Because of this, scientists are trying to find more efficient ways to estimate biomass. In this project, we are felling trees in the Grand Bay Coastal Resources Center to measure different tree parameters such as height, canopy cover, and DBH to create allometric relationships to estimate biomass as well as be able to compare it to the true biomass value. We are also focusing on more nondestructive sampling methods, such as using increment cores to calculate wood density values using NIR to be used in volume conversion captured by a terrestrial lidar scanner. Using field data, we first established a general biomass allometric equation. However, the equation uses a DBH variable, which limits it to field-acquired measurements. Following this, we established a relationship between biomass and height, and this relationship presents an opportunity to use lidar-acquired height measurements to estimate biomass. The estimated biomass can be converted to carbon sequestration using species-appropriate biomass-to-carbon conversion factors. Results from this project would include systematic methodologies for estimating biomass through field and lidar-acquired measurements and wood density measurements. Resource managers can use these methodologies to accurately estimate their forest lands' biomass content or carbon sequestration levels.

Plankton of the Grand Bay NERR (poster)

Jeneil Patel,* Jennifer De Bose, Cassy Porter, Elizabeth Moore, Michael Archer, Jonathan Pitchford, and Ayesha Gray

Plankton are essential to aquatic ecosystems but can cause concern when at abnormal concentrations. Because of its close proximity to industrial activity, the Grand Bay NERR has previously experienced drastic water quality changes, elevated nutrient levels, and algal bloom events. Therefore, it is important to provide insight into typical plankton community structure, seasonality, and spatial differences to identify instances of unusual plankton concentrations. From July 2023, monthly surface-water samples and water quality data were collected at 15 sites across the reserve. Microscopy was used for observation, identification, and Sedgewick-Rafter enumeration. Through these methods, recurrent information on plankton community structure was gathered. Combined with water quality and nutrient monitoring, the ongoing collection of this reference data will aid in detecting considerable shifts in concentrations, why they may have occurred, and what ecological and economic impacts these changes may bring to Grand Bay NERR.

Seeking Advice in the Development of an Upland Habitat Restoration Management Application Team (poster)

Jonathan Pitchford*

Pine savanna and flatwoods habitat restoration along the Gulf Coast is complex and rife with challenges. These habitats have been fire suppressed for decades resulting in heavy fuel loads and are often adjacent to the wildlife urban interface. Invasive species are often prolific and take persistent treatments to control or eliminate. Also, the weather along the Gulf Coast is varied and unpredictable and can be a huge obstacle for implementing restoration treatments. As such, there is a great need to engage with experienced practitioners as we develop restoration plans and to use creativity and innovation to overcome the many challenges that are impediments to savanna and flatwoods restoration. I am interested in forming a small group (5–10 people) willing to participate in a UHR-MAT that can lend experience and insight to restoration efforts along the Gulf Coast. I am also hoping that this group can foster the development of innovative solutions to some of the common problems we are facing that are described above. To do so will require the investment of time and energy, so one of the things I want to do is to be creative in how I engage with this group to maximize their collective knowledge but minimize the pester factor. I am hoping to get ideas from anyone who is reading this abstract/poster on 1) innovative tools for upland habitat restoration, 2) members who should be included in the UHR-MAT, and 3) creative ways for the group to interact that aren't too burdensome on the members. The more ideas, the better!

Sportfish Behavior and Habitat Selection Along a Protected Shoreline (oral)

Sarah Ramsden,* Mark A. Albins, Sean P. Powers, Ronald Baker, and Michael A. Dance

The eroding shoreline of Point aux Pins Peninsula, off the coast of Bayou la Batre, Alabama, has been the subject of two major protection and restoration efforts. Manmade reefs constructed from loose oyster shell were installed along this shoreline in 2007. These reefs have largely eroded, and in 2020, a series of concrete wave attenuation pyramids were installed farther offshore. We used fine-scale acoustic telemetry to track the movements and monitor the behavior of sportfish (red drum, speckled seatrout, and sheepshead) around these shoreline protection structures. We deployed an array of closely spaced acoustic receivers to triangulate the positions of acoustically tagged fish with an accuracy on the order of 1 to 2 meters. Tracks of fish positions were sorted into three behaviors based on the distance and turning angle between successive positions: 1) traveling, a straight path of long steps; 2) sheltering or ambushing, a tortuous path of short steps; and 3) foraging, a tortuous path of medium length steps. Surprisingly, given their highly eroded state and lack of topographic relief, the man-made oyster reefs were used for foraging by all three tracked species. These reefs had been classified as defunct, and because they do not contribute to shoreline protection or oyster recruitment, they would have been marked for removal in some coastal states. However, they are still serving as valuable habitat for economically and culturally important fish species.

Phenology of Gulf Coast Ticks in the Wet Pine Savanna at Grand Bay NERR (oral)

James Rigney* and Jerome Goddard

The Gulf Coast tick (*Amblyomma maculatum*) is the most abundant tick species in the wet pine savanna at the Grand Bay NERR. As part of a Master Naturalist project, twice-monthly tick collections were conducted to determine the seasonal phenology of adult ticks from March 2022 through February 2023. Gulf Coast ticks began to emerge in July with peak activity in mid-July through early September, when over 100 Gulf Coast ticks were collected during each tick drag. The numbers began to decrease in late September, but a few specimens were collected as late as early November. Ad hoc collections conducted in August and September 2023, after a prescribed burn in March 2023 and after an abnormally dry summer, yielded less than 15 percent of the number of ticks collected at the same times the year before, indicating the possibility of large interannual variability.

The Response of Bats and Their Insect Prey to Different Coastal Upland Habitat Management Techniques (oral)

Mandy Rigsby,* Eric Sparks, Jonathan Pitchford, and Scott Rush

Declining bat populations necessitate a need to understand how different land management techniques influence bat activity. This study assessed the influences of different coastal upland habitat management techniques, such as mulching, prescribed fire, and select cut, on forest bat activity within the Grand Bay National Wildlife Refuge and National Estuarine Research Reserve. Acoustic recorders were used to monitor bat activity, and insect and vegetation surveys were used to assess influences on bat activity across different land management techniques. Results demonstrate that overall bat activity was similar across different land management techniques. However, larger species adapted for open-space flying were shown to be less active within dense forest such as the select-cut technique areas. Findings from this study suggest that various land management techniques can influence bat activity differently.

Living Shoreline Technical Assistance Programs (poster)

Eric Sparks,* Sara Martin, Jaden Akers, and Ashleigh Dunaway

Natural shorelines provide ecosystem services that are integral to maintaining healthy and resilient coastal ecosystems and communities. However, anthropogenic and environmental stressors are reducing the extent of natural shorelines and, thus, their capacity to provide critical ecosystem services. Small-scale private property owners own an overwhelming majority of waterfront property in coastal Mississippi and Alabama. Therefore, environmentally focused management of private shorelines can provide large-scale benefits. Unfortunately, the most common shoreline management strategies for private property owners are hardened structures (e.g., bulkheads and seawalls) that are known to impair coastal ecosystems. An alternative to hardened shorelines is living shorelines, which are a collection of shoreline stabilization techniques that incorporate natural materials such as native shoreline plants. To promote living shorelines with private property owners, the Mississippi-Alabama Sea Grant Living Shorelines Program and its partners began producing guidance documents, offering technical assistance, developing cost-share programs, and conducting trainings for private property owners and contractors. In this presentation, we will discuss the status of the technical assistance programs and needs related to enhancing these programs across both states.

The Potential for Conservation Grazing in Coastal Uplands of the nGOM Coast (oral)

Eric Sparks,* Kristi Gill, Jonathan Pitchford, Keith Chenier, Amanda Free, Jacob Goff, Kim Cressman, Margo Posten, Eric Brunden, Mike Shelton, Katie Swanson, Sara Cunningham, Joan Garland, Caitlin Snyder, Meagan Lamb, and Tim Schauwecker

Along the Gulf of Mexico coast, natural resource managers struggle with managing coastal uplands due to front-end costs, prolonged maintenance, and habitat-specific ecological needs. Prescribed fire, mechanical removal of vegetation, and chemical treatments are commonly used to restore and maintain coastal uplands; however, there are challenges with the application of these tools (e.g., variable weather, urban development, etc.). A potentially less intrusive and a financially viable alternative is using livestock as a restoration and management tool. As part of a NOAA RESTORE Science Program Planning Grant, a survey was developed and distributed to natural resource managers with the goal of understanding the research needs and logistical and environmental concerns related to using livestock for habitat management. Survey results show that more than 96 percent of respondents were interested in using livestock for habitat management, but less than 10 percent were aware of any information that could be used to inform grazing practices in coastal uplands. Generally, small-sized cattle breeds (e.g., pineywoods) and goats were identified as the livestock with the most potential for environmental benefit and ease of containment. Items noted for further investigation included factors associated with implementation (e.g., which livestock type to use, grazing intensity, etc.); logistical considerations (e.g., fencing and rotational frequency); and the impacts of grazing on water quality, wildlife, vegetation, and livestock nutrition. Survey respondents overwhelmingly indicated that grazing would not be a standalone management practice and should be used in conjunction with other habitat management techniques (e.g., prescribed burns). This led the project team to develop two research objectives that need to be addressed regarding livestock grazing as a tool for coastal upland habitat management: 1) assessing the potential for livestock to spread and manage invasive and non-target species and 2) determining the frequency and duration of livestock grazing needed to meet management goals across multiple habitat management scenarios.

Marsh Vegetation Loss and Recovery Due to the Presence of Marine Debris (oral)

Anthony Vedral*

Marine debris discarded in or transported onto marshes can negatively impact vegetation and shoreline stability. Such loss of habitat is of concern to coastal areas in the nGOM due to ongoing habitat degradation and erosion as well as receding shorelines resulting from sea-level rise. This study aims to quantify the loss of vegetation due to the presence of debris for variable intervals of time as well as the recovery rates of vegetation with and without restoration efforts after removal of debris. Two common types of debris items (wire crab pots and dense plastic squares intended to mimic opaque debris) were placed on 48 plots of 0.4 square meters of black needlerush (*Juncus roemerianus*) vegetation in the Grand Bay NERR at shoreline and high marsh locations. The monitoring of vegetation density, leaf height, canopy coverage, elevation, and sediment grain size was conducted to assess changes in marsh dynamics. Following removal, half of the plots were re-planted, while the rest were left to recover without intervention. Data analysis is ongoing, but preliminary results indicate varying impacts relative to debris location, duration of exposure, and debris type. Data from this project will provide useful spatial and temporal information for making critical decisions when prioritizing wetland cleanup sites and restoration efforts from ongoing litter accumulation and sudden debris spreading disturbances such as hurricanes.

Evaluating the Effectiveness of Restoration Approaches for Nearshore Habitat (oral)

Matt Virden*

In the nGOM, oysters and marshes have been critical components of estuarine ecosystems and provide myriad ecological and economic benefits. At the Grand Bay NERR, there is a large-scale subtidal and intertidal living shoreline project that finished construction in July 2021. A suite of ecosystem functions and services are being evaluated at the intertidal and subtidal study sites, along with nearby control sites. Wave gauges are deployed on a rotational basis and replicated in front and behind reefs and at similar locations in control sites to evaluate the influence of reef placement on wave energy. To provide large-scale estimations of shoreline position and vegetation cover, quarterly UAS flights are conducted. Continuous georeferenced maps are produced of the entire study area from the UAS flights. Fine-scale field measurements using a real-time kinematic positioning for elevations and quadrat counts for fringing vegetation are being used to validate UAS maps. Oyster settlement is monitored using tile-based spat collectors deployed on both intertidal and subtidal reef areas as well as nearby controls. The impact on secondary productivity is being monitored using nekton settlement trays deployed at both reef and control sites. Evaluating the impact of restoration efforts will be accomplished using a variety of univariate and multivariate approaches across the range of metrics measured. Understanding this impact of oyster reef restoration on a wide range of ecosystem functions will better inform the planning and implementation of future restoration projects.

Differences in Nekton Community Composition in *Ruppia maritima*, *Halodule wrightii*, and Unvegetated Bottom in the Grand Bay NERR (oral)

Jessica Woodall*

Seagrass beds support high biodiversity and animal abundance, serve as feeding grounds for a variety of animals, offer shelter from predation, and act as a nursery habitat for juveniles. The species composition of seagrass beds can impact their use as habitat by animals. Two common species of seagrass in the Gulf of Mexico are *Ruppia maritima* (widgeon grass) and *Halodule wrightii* (shoal grass). The shallow coastal waters of the Grand Bay NERR support both species, but the use of each seagrass as habitat by nekton is poorly understood, which limits management decision-making. Nekton communities were sampled in May, July, September, and November 2022 in the Grand Bay NERR within *R. maritima*- and *H. wrightii*-dominated seagrass beds and unvegetated habitat. All nekton were collected, identified to species, weighed, and measured to quantify density, species richness, and species diversity within each habitat. Seagrass cores were also collected to quantify aboveground biomass, root-to-shoot ratio, and epiphyte density. Juveniles of several commercially fished nekton species including blue crabs (*Callinectes sapidus*), white shrimp (*Penaeus setiferus*), and brown shrimp (*Penaeus aztecus*) were collected, with higher densities and greater species diversity in seagrass beds compared to unvegetated bottoms. *R. maritima* and *H. wrightii* were marginally different from each other in terms of habitat use by nekton. Percent cover of both species was the most important habitat feature influencing use by nekton, with greater cover hosting more nekton. These results reinforce the importance of seagrass within the Grand Bay NERR as essential habitat and can be used to inform management and long-term planning.

Facilitated Discussion

We asked the symposium attendees to offer their top 5 research questions, to inform and visualize how well they fit under our current research priorities. If questions did not fit under a current priority, it was placed in an "other" category to be referenced prior to developing future priorities. Listed below are the questions provided, organized under general themes within the current priorities and "other" category. For more information on our Current Research Priorities, please visit our website (grandbaynerr.org/science).

Current Research Priorities

1. Restoration effectiveness monitoring
2. Physical and hydrological processes
3. Sources and impacts of contaminants
4. Vertebrate population distribution and ecology
5. Socio-economic impacts of ecosystem restoration

Discussion Questions

1. Are there research priorities that are missing from our current priorities/topics (including ones that would apply to The Road Map project)?
2. Do our research priorities, as posted, support your Grand Bay NERR research questions?

Research Question Discussion Outcomes

Restoration Effectiveness Monitoring

General Restoration

- Quick, reliable indicators of savanna restoration success.
- How can we increase the long-term monitoring of restoration (long-term success, failures)?
- When are restoration efforts of wetlands needed after disturbances?
- Consideration of following a historical baseline or modeling is based on novel/new ecosystem dynamics for restoration, especially concerning how heavily anthropogenically influenced the coast has been for hundreds of years (i.e., the artificial beach from Pass Christian, Biloxi).
- Dredge sources/effectiveness.
- Microbe dynamics with different types of restoration materials.
- Offshore oil infrastructure as an artificial reef. Also designing less terrible oil infrastructure.

Invasive Species

- Invasive species management/effective management of cogongrass.
- What native plant would be a viable ground cover to replace nearly an entire island of torpedo grass and through what process would be best to make the transition without losing the island?
- Invasibility of coastal wet pine flatwoods and savannas to invasive plant species.
- Invasive species pathway identification and management.

Prescribed Burning

- Animal responses to prescribed burning in savannas using BACI (before-after, control-impact) experiment.
- Prescribed fires and long-term impacts on coastal pine ecosystems.
- How does (the above) impact available bat habitat as population threats increase in the north (coast as possible refugia)?
- Burning in the marsh.

Conservation Grazing

- Combined effects of grazing and fire on pine savanna restoration.
- Can livestock be used effectively for habitat management?
- Soil impacts of using grazers for management?
- How does pasture rotation impact conservation grazing?

Seed Banks

- Are there seagrass seed hotspots in Grand Bay? If so, where are they located?
- Evaluation of pine savanna restoration potential (seed and bud banks).

Living Shorelines

- Prioritizing marsh restoration vs. facilitating marsh retreat.
- Impact of restoration/living shorelines on marsh carbon accumulation rates.
- Efficiency of erosion control/barrier island restoration.
- Relative effectiveness of various living shoreline and breakwater designs/materials.
- Comparing living shorelines projects between "closed/protected" estuaries and "open" estuaries (e.g., Little Lagoon in Gulf Shores, AL, vs. Point aux Chenes Bay).
- Updating methods of marsh shoreline delineation.
- Breakwater effects on benthic infauna.

Estuarine Zone, Including Seagrasses

- Restoration effects on fish production or aggregation.
- Would seagrass restoration efforts increase water quality and habitat value to animals?
- SAV surveys and monitoring.
- Ongoing structural integrity of restored oyster reefs?
- Performance of oysters on various breakwater structures.
- *Juncus*!

Physical and Hydrological Processes

Restoration Impacts

- Effects of pine savanna restoration on hydrology?
- Hydrology restoration?

Sea-Level Rise

- Resilient management for projected sea-level-rise scenarios?
- Impacts of saltwater intrusion on habitat?
- Groundwater salinity and flow.

Nutrient Transport/Sequestration

- Nutrient transport in seawater (drift); remote sensing in sea environment.
- Nutrient flux between land and sea?
- Land cover impact on coastal water quality; fecal runoff.
- How do changes in rainfall impact seagrass and local animal communities?
- Soil carbon sequestration from remote sensing?
- Dissolution pattern in karst region due to increase of soil carbon?
- Coastal carbon loss (erosion, veg transitions)

Sources and Impacts of Contaminants

General Contaminants

- Movement of emerging contaminants and their concentrations on the reserve?
- Effects of contaminants on marine life (e.g., marine mammals, etc.)?
- Bioindicators of human influences; metals, microbes, alternative and new indicator development?
- How will climate related changes in rainfall patterns impact contaminants?

Fecal/Microbial Contamination

- What effect do feral hogs have on water quality?
- How can we naturally lower fecal coliforms if they are from wildlife?
- Wastewater influences under different flow/ hydrology regimes.
- Identifying and quantifying sources of fecal contamination.

Marine Debris

- How does marine debris impact wetlands?
- What are the main sources of marine debris in Grand Bay?
- What coastal environments lead to the greatest levels of plastic degradation?

Microplastics

- Microplastics (sources/reduction).
- What quantities of microplastics are present on a special scale in the Grand Bay NERR?
- Microplastics and microbial population dynamics.

Vertebrate Population Distribution and Ecology

General Ecology

- Microbiome as indicator of organism health.
- Species range shifts due to erosion/climate change/water quality? Which species can adapt, which have to move?

Aquatic/Estuarine Organisms (Other than Terrapins)

- Modeling/simulation approaches to inform restoration; effects of restoration on nekton and nursery habitat; alternative metrics to inform restoration outcomes.
- Ichthyoplankton community composition and seasonal recruitment patterns.
- Across-creek surveys to determine fishing pressure in different areas of the reserve?
- Salamanders? How are they doing?
- Southern flounder nursery habitat.

Terrapins

- Terrapin-driven energy/nutrient flow across a water-shore interface.
- Efficacy of terrapin head-starting.
- Genetic variation of temperature sex-determination in terrapins (climate resilience).
- Impacts of SLR on terrapins.
- Terrapin population connectivity/gene flow along north Gulf Coast.
- Development of stakeholder support for crab-pot turtle excluder device regulations.
- Removal of invasive beach vegetation; restoration of existing terp nesting beaches.

Mammals

- Marine mammal health and status (distribution range/ response to climate change).
- Monitoring river otters as an indicator species for the health of watersheds.
- Which bat species utilize the coastal pine savanna and forests and barrier islands (tree-dwelling bats)?

Socioeconomic Impacts of Ecosystem Restoration

- Advancing equitable restoration to address environmental justice issues.
- Impacts on underserved communities.
- Human perception of the socio-economic impacts of ecosystem restorations.
- How can we incorporate citizens and landowners into restoration projects? What kind of ecological incentives matter to them?

Sustainable human development in eroding habitats

- Is there any effort in post-construction changes made to human-used systems to create wildlife bridges or tunnels?
- Timber harvest impacts/potential (equipment rutting, market potential).

Other

Human Behavior and Community

- Native community involvement? Indigenous/traditional methods of nature tending? Western science and non-western science used in conjunction.

Community Science Programs

- What are the main drivers that influence behavior toward environmental stewardship?
- Is there a push from anyone or any organization to incorporate citizen scientists/volunteers or wildlife rehab facilities, with proper training/guidance to gather data?
- One health applications and networks.
- Understanding how marsh models are being used by natural resource managers and/or coastal decision-makers.
- How can native peoples be included in these projects? How can we as scientists incorporate Indigenous knowledge while working with these communities, centering their voices?

Biology/Ecology

- Proper identification of uncertainty in ecological metrics.
- Monitoring ecological/biological processes across varying spatial and temporal scales.
- What does the overall bacteria community look like in the estuary?
- Where do oyster drills actually live?
- Spatial and temporal variation in oyster predators.
- How can we make terrestrial lidar scanning for biomass estimation?
- How can we make wood-density values more accurate?

Climate Change and Resilience Measures

- Resilience of wet pine flatwoods under climate change: mechanisms and implications for resource management.
- Developing climate-smart monitoring framework and indices for resource conservation and restoration.

Scaling Research

- Scaling research up or down to be applicable at different spatial levels.

Images (Seminar Room and Field Trips)

All photos by Dennis McGrury.

Figure 1. The symposium was held in the large classroom of the Grand Bay Coastal Resources Center building.

Figure 2. Andrew Heaton led a field excursion to a gopher tortoise burrow.

Figure 3. Symposium participants listen to a naturalist during the gopher tortoise burrow excursion.

Figure 4. Jennifer Frey uses a burrow-probe camera to peek inside the gopher tortoise burrow.

Figure 5. Jennifer Frey explains how she uses a burrow-probe camera to peek inside the gopher tortoise burrow.

Images (Poster Session, Bayou Excursion, and Sunset Dinner)

Unless otherwise noted, all photos by Sandra Bilbo.

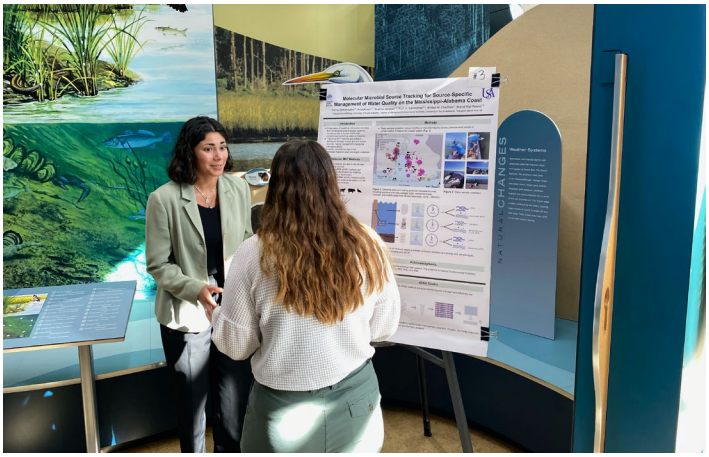

Figure 6. Poster presentations were held in the visitor's center at the Grand Bay Coastal Resources Center.

Figure 7. Jeneil Patel presents his plankton research.

Figure 8. Wake of the boat in the bayou during the sunset cruise after the symposium presentations. Photo by Jonathan Pitchford.

Figure 9. Sunset cruise after the symposium presentations.

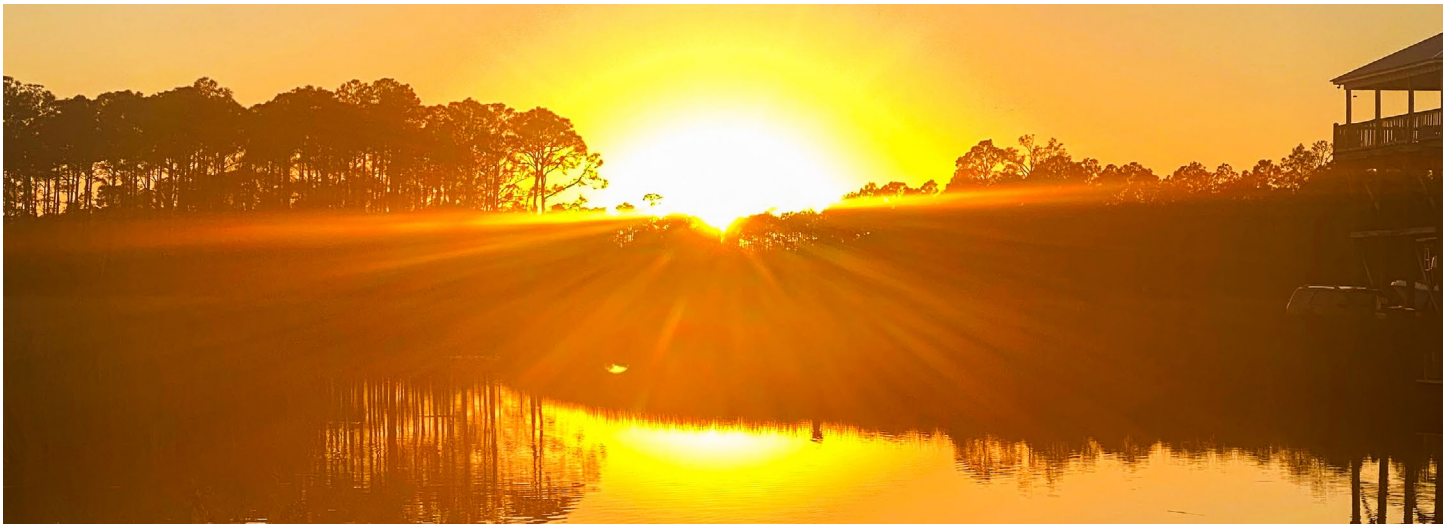

Figure 10. Sunset in the bayou, during the sunset social after the symposium presentations.

Evaluations

How would you best characterize your profession or organizational affiliation? (Check the most appropriate box.)

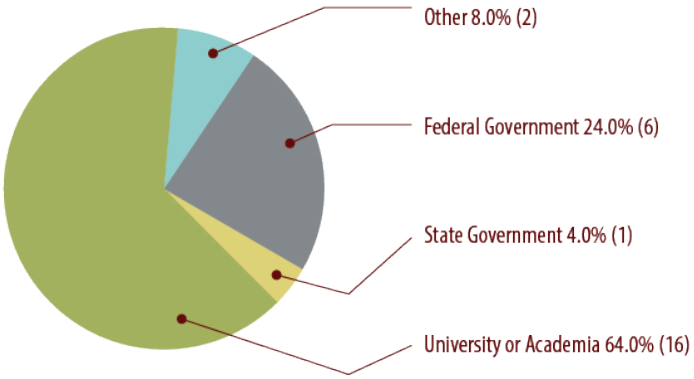

Figure 11. Of the attendees at the symposium, the majority represent the university/academic profession.

How much did the symposium increase your knowledge about the projects and collaboration going on at Grand Bay NERR? (Select the one that best reflects your opinion.)

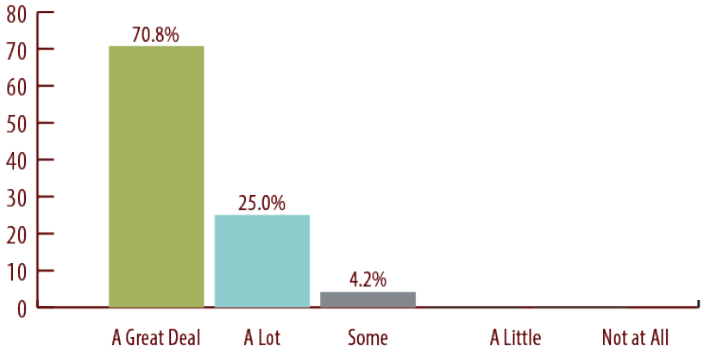

Figure 13. By attending the symposium, all respondents felt that their knowledge of the projects and collaborations occurring at Grand Bay NERR was increased.

Participating in this symposium was a good use of your time? (Select the one that best reflects your opinion.)

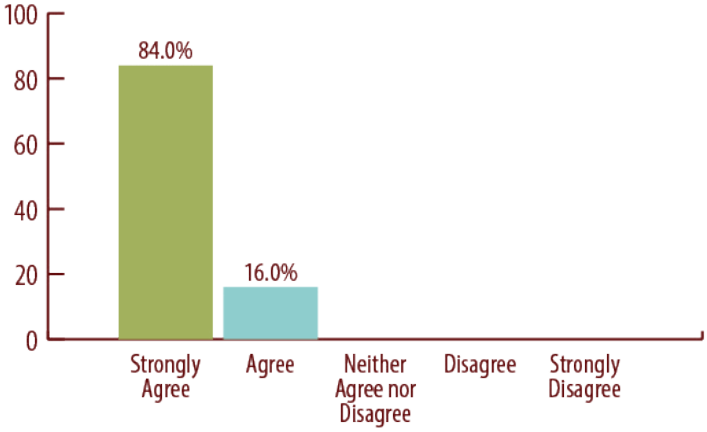

Figure 12. All respondents agree that the bi-annual, one-day symposium was a good use of their time.

Did you learn something that you will incorporate into future decisions about your work?

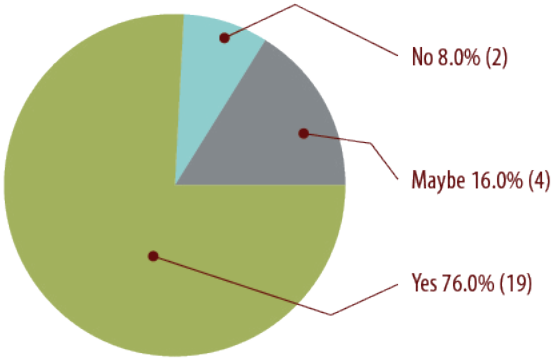

Figure 14. Of the respondents, 76 percent learned something that they would incorporate into future decisions in their work/research.

Tell us what activities you participated in. (Choose all that apply.)

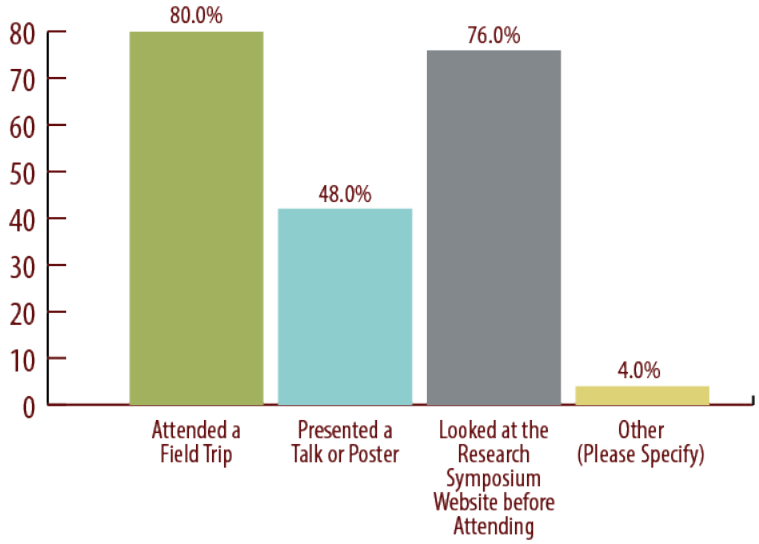

Figure 15. Of the respondents, 80 percent participated in the field trips and almost 50 percent presented a talk or poster.

Notes

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By **Jennifer De Bose**, PhD, Senior Extension Associate, Coastal and Marine Extension Program, Coastal Research and Extension Center.

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