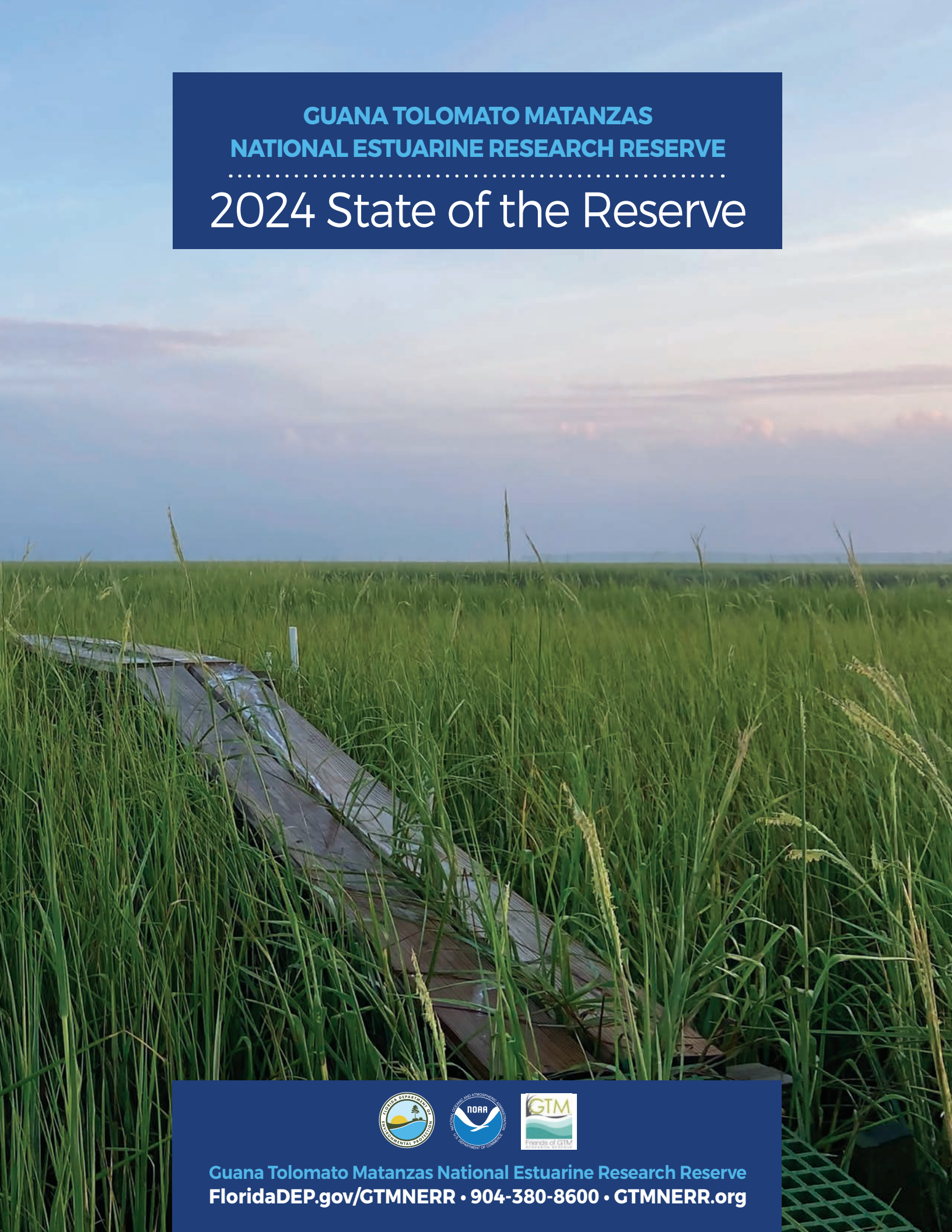

GUANA TOLOMATO MATANZAS NATIONAL ESTUARINE RESEARCH RESERVE

2024 State of the Reserve

Guana Tolomato Matanzas National Estuarine Research Reserve
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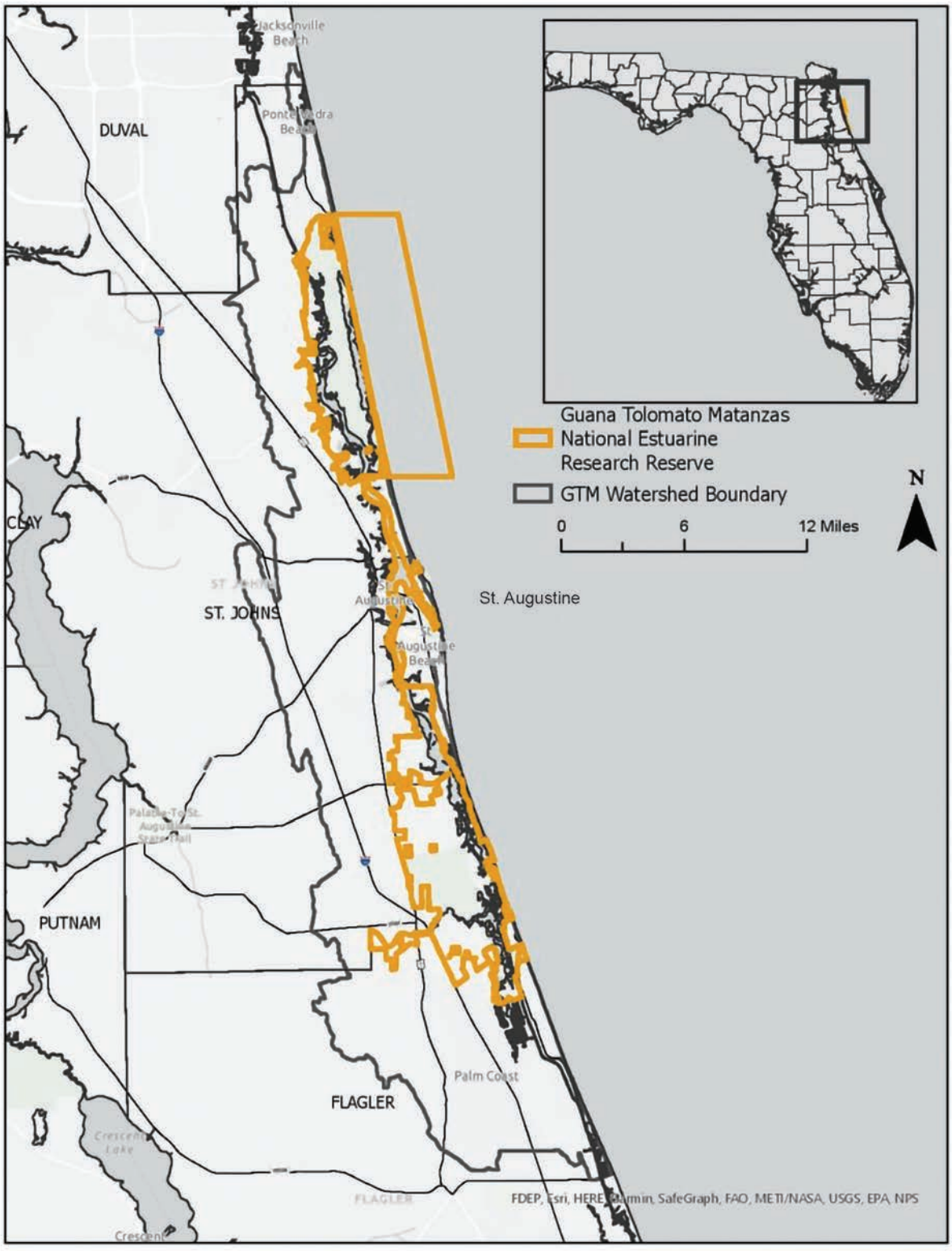

The Guana Tolomato Matanzas (GTM) National Estuarine Research Reserve was established in 1999 by the National Oceanic and Atmospheric Administration and is one of 30 national estuarine research reserves. This document includes information representing select current and long-term research projects taking place within the Guana Tolomato Matanzas National Estuarine Research Reserve boundaries.

Spartina, **Spartina alterniflora,** *and black needlerush,* **Juncus roemerianus,** *at Faver-Dykes State Park, within the boundaries of the GTM Research Reserve. Photo by Debbie Perez.*

2024 State of the Reserve

GUANA TOLOMATO MATANZAS NATIONAL ESTUARINE RESEARCH RESERVE

Presentations and Program Summary Feb. 15, 2024

The Guana Tolomato Matanzas National Estuarine Research Reserve (GTM Research Reserve) is managed by the Florida Department of Environmental Protection's (DEP) Office of Resilience and Coastal Protection in cooperation with the National Oceanic and Atmospheric Administration (NOAA).

The reserve covers 76,760 acres of coastal lands in Northeast Florida from Ponte Vedra Beach to Palm Coast. It is composed of a network of public lands managed by the GTM Research Reserve, Florida Fish & Wildlife Conservation Commission, City of St. Augustine, Flagler County, St. Johns River Water Management District, Florida State Parks, the Florida Forest Service and the National Park Service.

Elizabeth Terwillinger collects surface water quality data using a YSI ProDSS instrument. Photo by Emily Hill.

A MESSAGE FROM THE RESERVE MANAGER

It is with great enthusiasm and pride that we celebrate the collaborative efforts and achievements in research conducted at the GTM Research Reserve. Our team and partners continue to diligently delve into a diverse array of research initiatives, striving to uncover deeper understandings of the unique ecological dynamics within our reserve. Our studies have spanned various critical areas within the reserve, emphasizing the delicate balance of the estuarine ecosystem and its interconnections with the surrounding environment.

Understanding the resilience of our coastal environment against environmental stressors has been a pivotal aspect of our studies. Our research into water quality monitoring and habitat change has revealed compelling insights into the resilience and vulnerabilities of our estuarine system. These findings will contribute significantly to our ongoing efforts to enhance coastal resilience and adaptation strategies.

I extend my deepest gratitude to each agency, academic institution, non-profit and community stakeholder for their unwavering dedication, collaborative spirit and commitment to advancing ecological research. The synergy among our teams has been the cornerstone of our success, and I look forward to nurturing and expanding these partnerships for continued advancements. I eagerly anticipate the exchange of ideas and insights at the 14th annual State of the Reserve symposium where we can collectively contribute to the broader discourse on estuarine ecology.

Sincerely,

Lia Sansom
Manager
GTM Research Reserve

The Friends of the GTM Reserve

The Friends of the GTM Reserve is the 501(c)(3) support organization for the Guana Tolomato Matanzas National Estuarine Research Reserve, also known as the GTM Research Reserve. The Friends give their time, treasure, and talents to help the Reserve staff achieve their mission.

Be a Friend.

Support the GTM Research Reserve and be a champion for the estuaries and precious coastal ecosystems in North Florida.

Scan the QR code or use:
https://gtmnerr.org/support/

Save the Date

Under the Light of the Moon - Evening at the Estuary

Friends of the GTM Annual Fundraiser

Saturday April 20, 2024

Ponte Vedra Beach, Florida

A MESSAGE FROM THE FRIENDS OF THE GTM RESERVE

It gives me great pleasure to welcome you to the State of the Reserve, sponsored by the Friends of Guana Tolomato Matanzas (GTM) Reserve, which includes our dedicated members and board of directors.

We firmly believe that informed citizens foster healthy practices that contribute to prepared and resilient communities. It is our conviction that a well-informed community is better equipped to nurture the health of our estuaries. The mission of the Friends of GTM Reserve revolves around the practices of clean water, sound environmental practices, knowledgeable citizenry and prepared communities.

The reserve stands as a unique pillar of research, education and collaboration. Through its collaborative endeavors, the GTM Research Reserve has emerged as a leader for uniting diverse stakeholders and sharing vital scientific insights crucial for the decision-makers responsible for the well-being of the Guana estuary. Events such as the State of the Reserve serve as a testament to our enduring commitment to foster partnerships that enhance our science-based educational initiatives and stewardship programs.

We are grateful to our steadfast members, whose generous support year after year continues to fund research and programs like “Roots and Rakes” led by Dr. Samantha Chapman, sea turtle monitoring patrol, the University of North Florida Fellowship and the upcoming “Under the Light of the Moon- Evening at the Estuary” on April 20, 2024. If you would like to learn more about how you can support the reserve go to Gtmnerr.org.

I trust that your time at this year’s science symposium will be both enjoyable and enlightening, leaving you with a profound appreciation for the pivotal role of science and data in our lives. The urgency of research in crafting meaningful and immersive estuarine science and conservation education cannot be overstated, as it seeks to impact not only our present but future generations.

I encourage you to become an advocate for the reserve, for together, we have the power to amplify our influence and bring about enduring, positive change in the world.

DaleAnn Viger
Executive Director
Friends of GTM Reserve

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State of the Reserve 2024 Coordinators

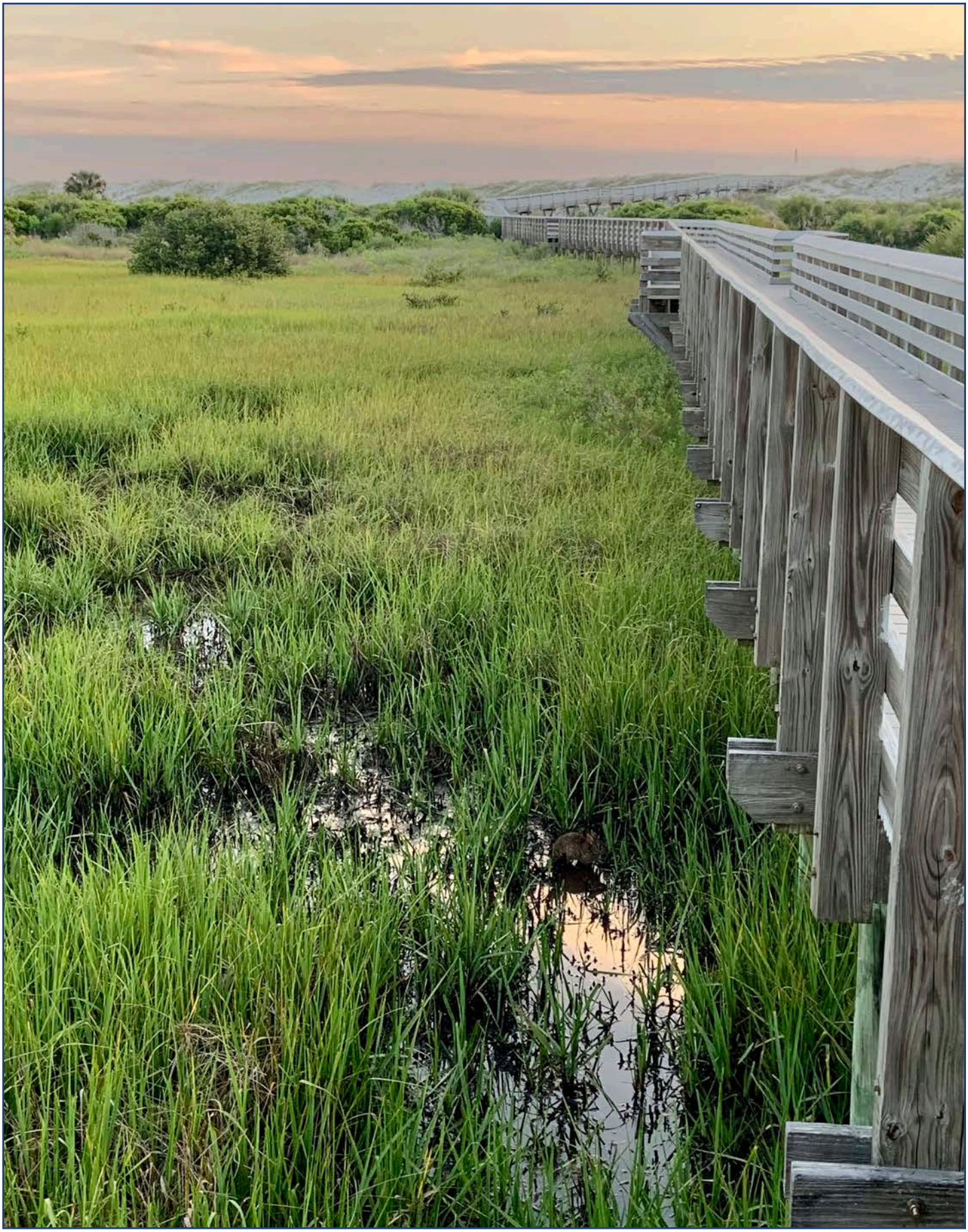
Event Facilitator: **Kaitlyn Dietz**, Collaboration Coordinator

Chief Program Editor: **Kirstin Thompson**, Collaboration Specialist

Program Editor: **Patrician Price**, Communications Coordinator

Cover and back cover photo by Shannon Dunnigan.
Vegetation monitoring platforms at Hat Island.

UNF students and GTM Research Reserve volunteers dipnetting fish from liftnets. (Pictured: Ethan Fuhrmeister, Valerie Granger, Maria Alvarez, Megan Howkins, and Gabbie Nelson). Photo by Hunter Mathews.



Spartina, **Spartina alterniflora**, *and black mangroves,* **Avicennia germinans**, *in the distance with marsh rabbit,* **Sylvilagus palustris**, *foraging during low tide. Photo by Nikki Dix.*

GTM'S TECHNICAL ADVISORY GROUP

Establishing Collaborative Spaces to Investigate Knowledge and Data Gaps

In 2023, the GTM Research Reserve began hosting quarterly Technical Advisory Group (TAG) meetings, providing collaborative opportunities with subject-matter experts to understand the knowledge and data gaps important to the health of the GTM Research Reserve's estuaries. One of the goals of the meetings is to address questions related to oysters, water quality, coastal wetlands, fish and people, along with the role they play in the ecosystem. The inclusivity of the topics discussed, and the expert presentations, make for interesting, engaging and thorough meetings that benefit not only the reserve, but also stakeholders including federal, state and local agencies, researchers, non-governmental organizations and residents. The following summaries are from the 2023 TAG meetings.

Guana dam.

A ladyfish from GTM Research Reserve.

A puffer fish from GTM Research Reserve.

An osprey catching a fish in the GTM Research Reserve

Diving In: Uncovering Questions and Management Needs Relating to Fish

Through discussions with subject-matter experts and stakeholders, knowledge and data gaps about fish within the GTM Research Reserve watersheds were identified and prioritized as management/research needs. The collective needs listed below can be used by the GTM Research Reserve and colleagues to seek funding opportunities and support collaborative efforts.

- **Status and trends** - More quantitative fisheries data is needed. This information is vital to understanding the health and function of our estuary; therefore, we need a standardized fisheries assessment program that operates on a regular temporal interval.
- **Habitat associations** - Healthy fisheries depend on healthy habitats, but habitats are changing due to various drivers and there is no comprehensive dataset connecting habitat types, conditions and biodiversity; therefore, we need a collaborative approach for habitat assessments and data sharing to inform management actions.

Brown pelicans collecting near fisherman at the GTM Research Reserve. Photo by Craig O'Neal.

- **Water quality** - Many regulatory agencies oversee water quality within the Guana estuary, but collaboration, communication and data sharing are incomplete; therefore, there is a need to foster collaboration to potential emerging contaminants and their impact on fisheries within and upstream of the watershed.
- **Indicator species** - We have historic datasets of fish communities in the area from entities including the U.S. Geological Survey, Flagler College, the University of North Florida and the GTM Research Reserve. We know specific requirements for specific life stages of species that can serve as indicators, but we need to build the ability to identify status and trends; therefore, we need to do large-scale sampling like identifying hot spot areas.
- **Human health** - The GTM estuary is an important local research and recreational resource. We are currently studying the impact of water quality and nutrient dynamics on local species, but we do not understand the level or presence of contaminants; therefore, baseline contaminant data is needed across the estuary, including contaminant bioaccumulation and its effect on trophic dynamics, which can be used to look at human health impacts.
- **History/stories** - Fish nurtured, fed and provided income historically to humans. We need to protect the resource to continue this into the future, but we are lacking oral and cultural histories about fish in the region; therefore, we propose a series of partnerships to capture these histories that translates into civic tourism, ecosystem knowledge and cultural and economic value of the region.
- **Education/outreach**- GTM Research Reserve has data, and we know this information impacts fisheries, but we do not yet have targeted communication and outreach programs in place for the fishing stakeholders; therefore, we need to create education and outreach programs that are targeted based on the audience and begin building relationships.
- **Drivers of change** - We know that eutrophication can negatively impact fish populations and that land use/cover contributes to negative human impacts to estuaries, but we do not know how this impacts fish within the reserve; therefore, we need to study and analyze how land use, water quality and fish populations have changed over time.

The discussions and needs from the meeting will inform management and research questions moving forward as stakeholders and GTM Research Reserve staff work to address these data and knowledge gaps.

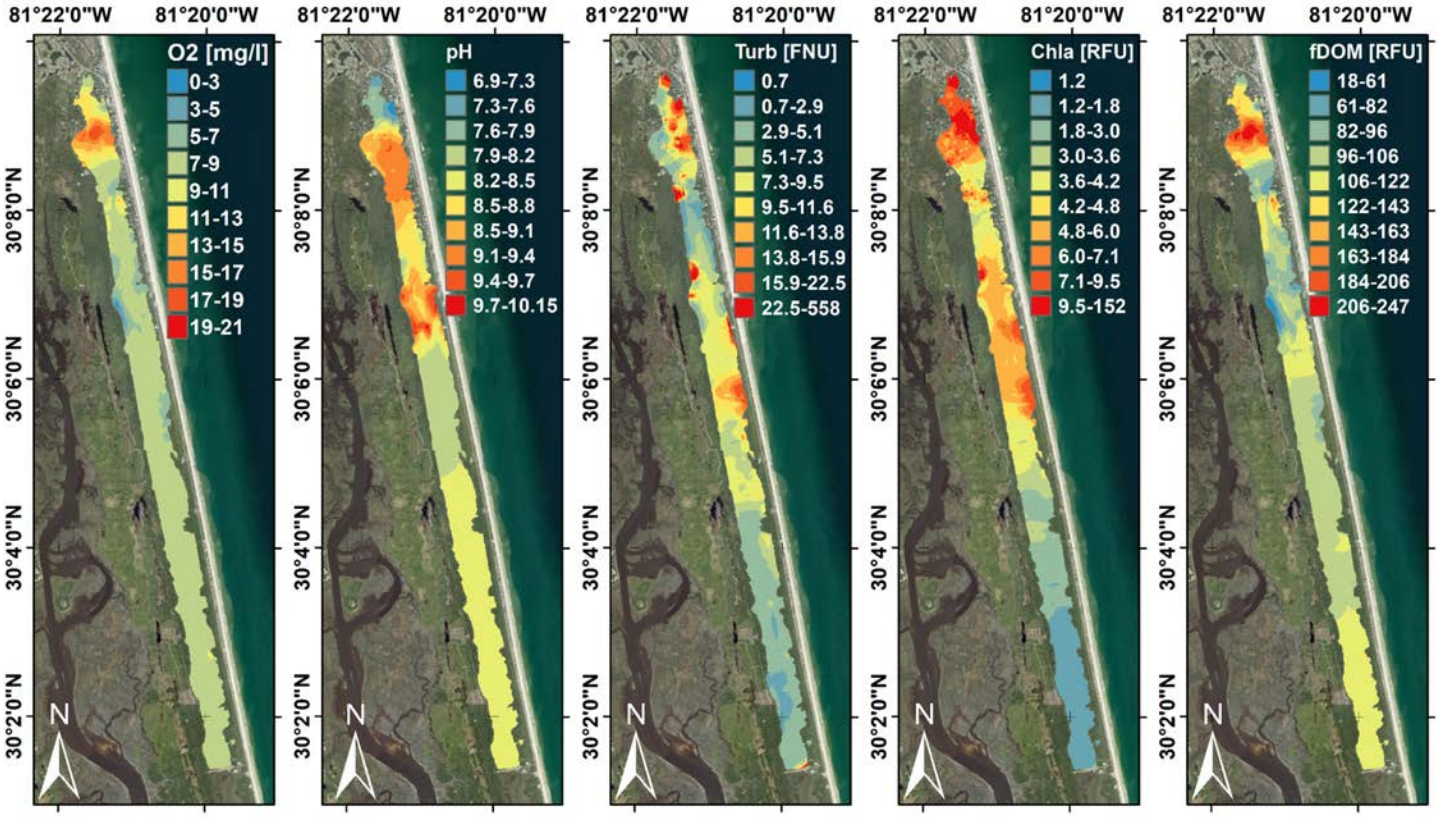
The Guana Estuary

The Guana estuary was the focal point of a TAG meeting where subject-matter experts and stakeholders gathered to share research and monitoring efforts and solicit feedback on specific projects in the Guana estuary.

Ashley Smyth, Ph.D., University of Florida, is leading the "Guana Nutrients: Budgets and Bivalves" project, which is designed to meet two GTM Research Reserve management needs: 1) to understand the ecosystem benefits and tradeoffs of different management options and 2) to design a mesocosm approach to understanding the impact of watershed actions on water quality, harmful algal blooms and biodiversity in the Guana estuary. The project approach includes identifying nitrogen sources in Guana Lake and understanding how nitrogen moves through the system from Guana Lake to Guana River. To understand the role shellfish play in water quality dynamics, the project also aims to develop an understanding of how oysters and mussels impact water quality and how water quality can affect shellfish health.

To address challenges of nutrient inputs from urban land use, the project team is working to develop a framework for water quality management in the Guana estuary by determining where reductions in pollution are needed and developing water quality restoration recommendations. The project team introduced a set of potential Best Management Practices (BMPs) to the TAG and sought feedback on feasibility and other considerations. In the context of this project, BMPs are behaviors or technologies that serve to protect, improve and conserve water quality with the target of reducing pollutant export. They can be structural, such as engineering solutions, or non-structural, such as education or behavioral changes. Through discussions of values and perceived threats within Guana estuary, stakeholders and subject-matter experts recommended management opportunities, including: shellfish harvesting, shellfish restoration, vegetation harvesting, establishing treatment wetlands, reduction of impervious surfaces, septic to sewer conversions and education. The identified locally relevant projects will be considered in scenario testing and restoration recommendations. For more information about the project, visit Nerrssciencecollaborative.org/project/Smyth20.

Alberto Canestrelli, Ph.D., **Daniele Pinton, Ph.D.** and a team from the University of Florida are working with staff from the GTM Research Reserve and FWC's Guana River Wildlife Management Area to quantify water flows and water quality in the Guana estuary by using a combination of monitoring and numerical modeling. The objective of this project is to "promote a sustainable estuarine ecosystem that can withstand urban inputs while supporting biodiversity, recreation, education and the shellfish industry." The project team is working to provide resource managers of the Guana estuary



Water quality parameters (Oxygen, pH, Turbidity, Chlorophyll-a, and Dissolved Organic Matter) in Guana Lake. Measurements taken by Dr. Canestrelli, Dr. Pinton, and team in April and May of 2023. Figure courtesy of Daniele Pinton.

with information on how hydrodynamics, such as Mickler's Weir and Guana dam operations, affect water quality conditions. In monthly surveys, the team is deploying a YSI HYCAT, an Autonomous Surface Vehicle, to collect data on water quality, water velocity and water depth in Guana Lake. The HYCAT is new technology, so a secondary objective of the project is to assess the HYCAT's utility for potential water quality studies around the state. Future data and modeling outputs from this project will help foster interdisciplinary research and inform water quality initiatives, management or investigations within the GTM Research Reserve.

A second project within the Guana estuary led by Dr. Canestrelli and Dr. Pinton seeks to provide resource managers of the Matanzas estuary with information on the relative contribution of human fecal pollution related to septic systems under various development, water level and precipitation scenarios. The project team will be quantifying the flux of fecal indicator bacteria (FIB) and human fecal indicators from septic tanks into ground water and adjacent surface water using an ArcGIS numerical model. The project team is investigating the dispersal of FIB in the estuary and nearshore region coupling a hydrodynamic and particle tracking numerical model (Delft3D) to determine how FIB concentrations vary. Maps with fecal pollution indices, which assess the extent to which an area is affected by fecal pollution, will be created for local stakeholders.

Geraldine Klarenberg, Ph.D., University of Florida, is leading the project "Using Open Science Tools to Improve Engagement with the Ecology of the Guana River Estuary". The team is developing a web-based, interactive data dashboard that can be easily updated by researchers to provide access to Guana estuary datasets, give users the ability to visualize data and engage the community with the reserve and its ecology. With stakeholder and subject-matter expert discussion, the project team is working to equip the dashboard with streamlined and engaging data, providing data interpretation and making sure to update with well-maintained, current data. For more information about the project, visit Nerrssciencecollaborative.org/project/Klarenberg22.

TERMS DEFINED

- **Bioaccumulation** - the accumulation over time of a substance, especially a contaminant such as a pesticide or heavy metal, in a living organism. (Merriam Webster)
- **Trophic dynamics** - the basic process of transference of energy from one trophic level to the next in an ecosystem. (https://link.springer.com/referenceworkentry/10.1007/978-94-017-8801-4_267)
- **Eutrophication** - the process by which a body of water becomes enriched in dissolved nutrients that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen. (Merriam Webster)
- **Mesocosm** - a controlled outdoor experimental environment or ecosystem, as opposed to one in a laboratory. (dictionary.com)
- **Impervious surfaces** - surfaces that allow little or no stormwater infiltration into the ground. Everything that falls on an impervious surface (pollution, trash, animal waste, chemicals, oils, sediment, etc.) washes off those surfaces during rain events, often on a direct path to local streams or water bodies. (https://stormwater.allianceforthebay.org/glossary-of-terms/impervious)
- **Hydrodynamics** - a branch of physics that deals with the motion of fluids and the forces acting on solid bodies immersed in fluids. In the context of ecosystems, hydrodynamics covers the movement of water in ecological systems. (Merriam Webster)
- **Ecotone** - areas of steep transition between ecological communities, ecosystems, or ecological regions along an environmental gradient. (https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/ecotones)
- **Oyster rakes** - an accumulation of dead oyster shells along shorelines.
- **Biomass** - the total quantity or weight of organisms in a given area or volume. (Oxford Languages)
- **Biometrics** - the application of statistical analysis to biological data. (Oxford Languages)
- **Sedimentation** - the action or process of forming or depositing sediment. (Merriam Webster)
- **Biogenic accretion** - the gradual accumulation of matter due to the capacity of wetlands to trap sediments and to incorporate dead leaves, branches, stems and roots into the soil. (https://hess.copernicus.org/articles/25/769/2021/)
- **Carbon sequestration** - the long-term storage of carbon in plants, soils, geologic formations, and the ocean. (Britannica)

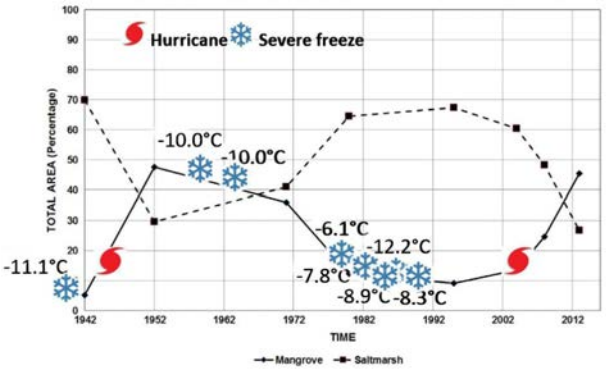
Understanding Coastal Wetlands and Coastal Habitat Shifts

With the GTM Research Reserve being an ecotone of transition from *Spartina alterniflora* dominated saltmarshes to mangrove dominated coastal wetlands, researchers around the country are gathering to investigate wetland migration and elevation change in relation to sea level rise, mangrove migration as a response to nutrients and temperature changes, the impact of oyster rakes and hydrology on coastal wetland condition and other related topics.

Scott Jones, Ph.D., University of North Florida, is identifying where and when salinity is going to impact the Guana peninsula with sea level rise and how freshwater wetland plants will respond. As water rises and plants migrate upslope, upland habitats are converted into coastal wetlands. Plants that migrate upstream convert tidal freshwater forests to low-salinity marsh, and low-salinity marsh to more saline coastal wetlands. Interdune swales and depression marshes, which are coastal freshwater wetlands connected to a shallow fresh groundwater lens, are often surrounded entirely by salt water. With sea level rise, saltwater is encroaching on that freshwater lens. The reserve's long-term monitoring data of surface water shows that freshwater wetlands along the west side of the Guana peninsula have experienced intrusion of saline surface water during storm events.

The mangrove-marsh ecotone range of northern Florida.

Candy Feller, Ph.D., Smithsonian Institution, leads research on the role of temperature and nutrients as drivers of mangrove migration. Mangroves are normally limited in range by their low tolerance for freeze events; however, climate change and fewer hard freezes near their northern range limit allow mangroves to establish and survive in northeast Florida. A 300-year historical timeline of mangroves along the coast of Florida at their range edge, compiled by Dr. Feller, suggests that mangrove ranges have expanded and contracted in the temperate-tropical ecotone multiple times in the past. Severe freeze events kill mangroves and allow saltmarsh to dominate, but hurricanes facilitate mangrove range expansion by increasing dispersal of seeds. To further understand the factors that contribute to mangrove survival during freeze events, Dr. Feller has initiated a nutrient fertilization experiment in the mangrove-saltmarsh ecotone on Anastasia Island in St. Johns County. The experiment revealed that nitrogen addition enhanced the growth of mangroves and caused them to expand into the salt marsh while increasing their freeze resistance. Due to the freeze, the mangrove leaves died, fell to the ground, and self-fertilized, aiding recovery.



Mangrove expansion versus contraction, 1942 – 2014, just North of Matanzas Inlet. Map and graph figures courtesy of Candy Feller.

Lisa Chambers, Ph.D., University of Central Florida, is part of a Friends of the GTM Reserve funded project, "Roots and Rakes", led by Samantha Chapman, Ph.D., Villanova University. The "Roots and Rakes" project is collecting data to understand the role of nutrients and altered hydrology in sustaining the coastal wetlands of northeast Florida. Local observations reveal some areas of saltmarsh adjacent to oyster rakes are deteriorating, while other areas appear to be thriving despite the presence of oyster rakes. Water appears to be flowing through oyster rakes and hydrology is not being completely impeded by their presence. As water moves through the rake, it might act as a sieve, preventing coarse sand particles from depositing on the marsh, resulting in silty soil. When assessing the difference between the stable versus unstable sites, the project team found that unstable plots had about 35% less biomass than the stable sites. Ongoing work includes soil characterization via a full biogeochemical work-up and soil particle size distribution. The project team is assessing nitrogen sources and sinks, studying plant biometrics above and below ground and looking at methane fluxes. For more information about the project, visit Wetfeetproject.com/roots-and-rakes.

Top: A stable marsh near an oyster rake, assessed by the Roots and Rakes team.

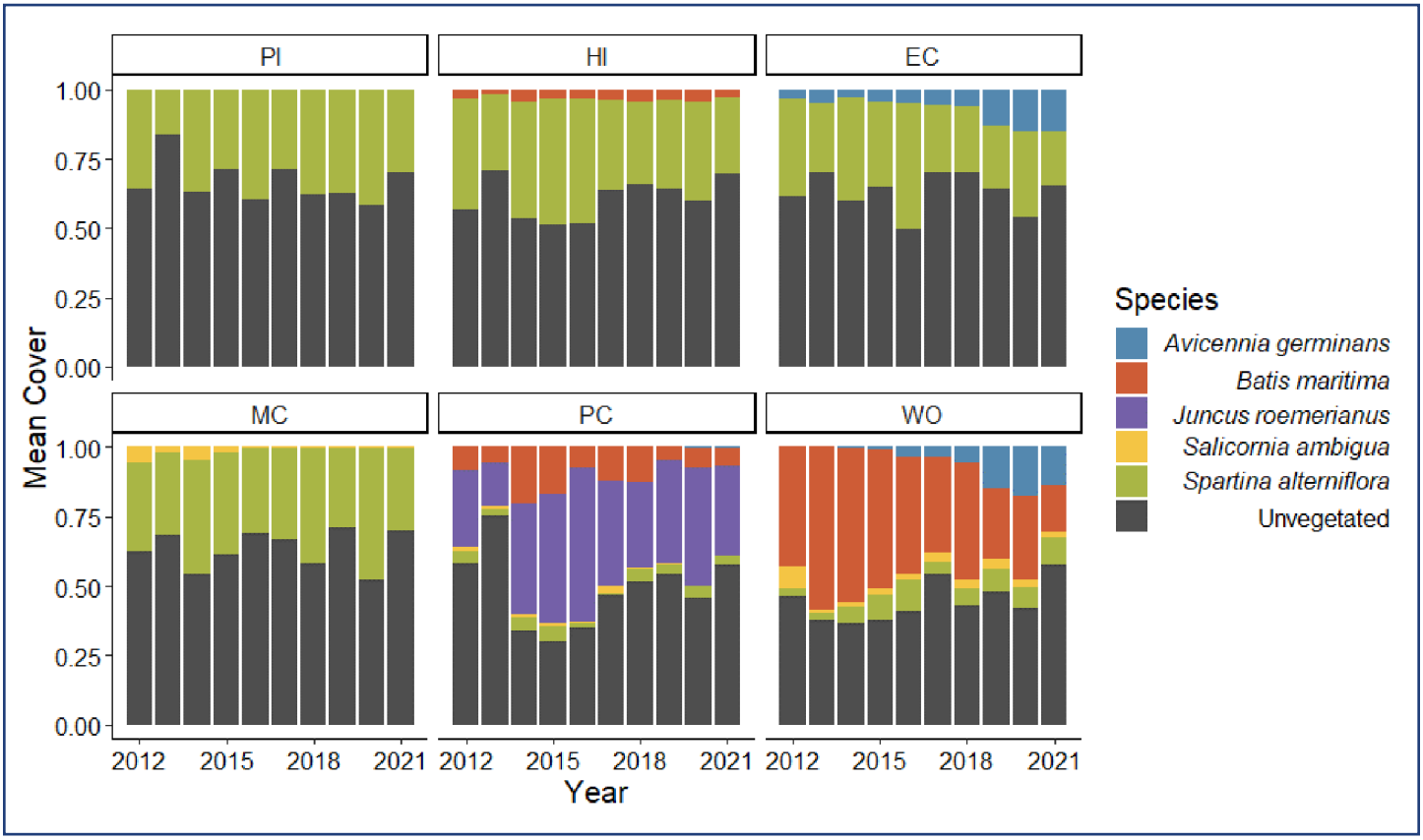
Bottom: An unstable marsh near an oyster rake, assessed by the Roots and Rakes team.

William C. Vervaeke of the National Park Service's Southeast Coast Inventory and Monitoring Network (SECN) is monitoring wetland elevation change, which can be caused by sedimentation, biogenic accretion, erosion, compaction by weight and decomposition. William measures elevation changes using the Rod Surface Elevation Table (RSET), which can take very accurate and precise measurements of sediment elevation of intertidal and subtidal wetlands over long periods of time. Utilizing the RSET Network, researchers and resource managers can determine the effects of storm events on elevation changes within the SECN coastal wetlands and the ability of these wetlands to keep pace with sea level rise, as well as inform management decisions for marsh upkeep and restoration in responding to climate change. Data has shown that some SET sites within this network are keeping up with sea level rise, while others are not. An additional tool, the Coastal Wetlands Equilibrium Model (an extension of the Marsh Equilibrium Model), computes carbon sequestration and marsh response to sea level rise by combining estimates of sedimentation and elevation change with multiple sea level rise scenarios to predict habitat change.

Nikki Dix, Ph.D., GTM Research Reserve, is working with reserve staff to measure estuary scale changes over time, marsh scale changes with sea level rise, and mangrove dynamics throughout the reserve. Since 2013, the GTM Research Reserve staff has been collecting data from vegetation monitoring plots and RSETs. The sites monitored include Pellicer Creek, mainly consisting of black needlerush (*Juncus roemerianus*); Washington Oaks, mainly consisting of saltwort (*Batis maritima*); and Pine Island, Hat Island, East Creek and Moses Creek, which are dominated by marsh cordgrass (*Spartina alterniflora*). Of these monitored sites, some are keeping up with sea level rise through surface elevation gain, but there are a few that are not.

As the GTM Research Reserve continues to host the TAG meetings, the reserve can expect continued collaboration and expert communication of ideas and research that inform current and future projects. For more information about the TAG, contact Kaitlyn.Dietz@FloridaDEP.gov.

Site characterizations with mean cover of common plant species



Site characterizations with mean cover of common plant species for PI (Pine Island), HI (Hat Island), EC (East Creek), MC (Moses Creek), PC (Pellicer Creek), WO (Washington Oaks). Figure courtesy of Nikki Dix.

WATER QUALITY IN THE GTM RESEARCH RESERVE: FROM MONITORING TO MANAGEMENT

The GTM Research Reserve is one of 30 in the National Estuarine Research Reserve System (NERRS) across the U.S., specializing in water quality monitoring and research to inform coastal management. The NERRS System-Wide Monitoring Program (SWMP) is designed to track short-term variability and long-term change in our nation's estuaries. Standard protocols, regular training, rigorous quality assurance and quality control measures, and public data access, all contribute to the program's success. Analysis of 20 years of chlorophyll-*a* data collected by the GTM Research Reserve SWMP team revealed that most of the estuary does not experience regular algal blooms and is relatively resistant to impacts from excess nutrients. Chlorophyll-*a* concentrations, above state standards at some stations and increasing trends at other stations, are indications that eutrophication may be stressing the system, making timely preventative measures imperative.

At a local scale, GTM Research Reserve uses principles and techniques of the SWMP to share data with decision-makers and monitor waterbodies where data gaps exist. Water samples are collected according to Florida Department of Environmental Protection protocols and results are entered into the Watershed Information Network database so that the data can be used in the statewide assessment process. These efforts have resulted in the Guana estuary being listed as impaired for nutrients in 2022, which began the regulatory process of restoration. The detection of degraded water quality in the Guana estuary has also spurred three collaborative science projects with the University of Florida aimed at developing remediation strategies, illustrating a repeatable process for other estuarine resource managers in the state to utilize for filling data gaps and informing management decisions.

PRESENTER: Nikki Dix, Ph.D., Research Director, GTM Research Reserve

Dr. Nikki Dix has served as research director at the GTM Research Reserve since 2013. Her research interests involve understanding how estuaries respond to natural and anthropogenic change with the intent of informing natural resource management. Dr. Dix has a Ph.D. from the University of Florida where she was supported by a NERR fellowship to study responses of plankton and oysters to eutrophication in the GTM estuary. As research director, she establishes research priorities and oversees long-term monitoring in the context of regional, state and national objectives. Dr. Dix also facilitates activities of visiting researchers and works to develop collaborations between scientists, managers, educators and the public.

PROJECT CO-AUTHORS: Shannon Dunnigan, GTM Research Reserve; Katie Petrinec, GTM Research Reserve.

Katie Petrinec and Nikki Dix collecting water from an automatic sampler in Pellicer Creek. Photo courtesy of GTM Research Reserve.

Olivia Roorbach collecting water on Guana Lake. Photo courtesy of GTM Research Reserve.

Filtering water on the research boat. Photo courtesy of GTM Research Reserve.

IDENTIFYING NITROGEN MANAGEMENT STRATEGIES IN THE GUANA ESTUARY USING NUTRIENT BUDGETS AND BIVALVES

Eutrophication caused by excess nitrogen impacts estuaries worldwide. To prevent eutrophication, management agencies develop plans to reduce nitrogen loads. Yet, mandated nitrogen reductions alone are often insufficient to improve water quality and protect downstream ecosystem health. In reality, management plans that account for the quantity, sources and fates of nutrients throughout the watershed are needed to develop remediation strategies. The Guana Estuary is a system that suffers from excess nutrients, has occasional algal blooms and a clear gradient of human influence from north to south. These conditions make it an ideal living laboratory to explore whether coastal water quality can be improved by managing nitrogen sources on land and restoring or conservating habitats that provide nitrogen removal services in water. The "Guana Nutrients: Budgets and Bivalves" research team has been working to 1) identify sources of nutrients to the Guana Estuary and determine how changes in the landscape impact nutrient loads, 2) map the current distribution of shellfish communities, 3) quantify filtration and nitrogen removal by shellfish and 4) assess how water quality affects shellfish health and how shellfish affect water quality in the estuary. This new knowledge about how the Guana Estuary functions will aid in developing science-based management recommendations for protecting and improving water quality. This presentation will share current research findings about how the Guana Estuary might respond to changes in nutrient availability, potential strategies to reduce nitrogen inputs and the role that shellfish have in water quality restoration. There are plans to combine this data with stakeholder input to identify feasible and effective nutrient management strategies. Ultimately, this research can help improve water quality models, quantify ecosystem services and aid in developing water quality restoration plans for the urbanizing Guana Estuary.

PRESENTER: Ashley Smyth, Ph.D., Assistant Professor, University of Florida

Dr. Ashley Smyth is an assistant professor at the University of Florida in the Soil, Water and Ecosystem Sciences Department located at the Tropical Research and Education Center. Dr. Smyth has a Ph.D. in marine science from the University of North Carolina at Chapel Hill and was a David H. Smith Conservation Research postdoctoral fellow at the Virginia Institute of Marine Science. Dr. Smyth's research combines aspects of marine science, microbial ecology and chemistry to understand how human activities impact the biogeochemical cycling of nutrients in coastal and aquatic ecosystems. She is the principal investigator on the "Guana Nutrients: Budgets and Bivalves" NERRS Science Collaborative project, which is focused on how nutrient pollution affects coastal ecosystem functions and the use of shellfish as a water quality restoration tool.

PROJECT CO-AUTHORS: AJ Reisinger, Ph.D., University of Florida; Shirley Baker, Ph.D., University of Florida; Christine Angelini, Ph.D., University of Florida; Peter Ifju, Ph.D., University of Florida; Justina Dacey, University of Florida; Hallie Fischman, University of Florida; Kristie Perez, University of Florida; Jenna Reimer, University of Florida; Nikki Dix, Ph.D., GTM Research Reserve; Kaitlyn Dietz, GTM Research Reserve.

Dr. Smyth collecting sediment samples from oyster reefs in the Guana River. Photo by Tyler Jones, IFAS Communication.

ROOTS AND RAKES: EXPLORING THE ROLES OF ALTERED HYDROLOGY AND NUTRIENT REGIMES IN SUSTAINING THE COASTAL WETLANDS OF THE GTM RESEARCH RESERVE

Shoreline erosion and wetland instability in the GTM Research Reserve elicits the need to understand how excess nutrients and barriers to water exchange contribute to salt marsh stress. Oyster rakes along the Intercoastal Waterway (ICW) alter tidal water flow and sediment transport. In addition to hydrological disruptions, excess nutrients can trigger wetland collapse, but may also result from it. The research team aims to improve the understanding of the role these two stressors may play in the GTM Research Reserve to aid management in prioritizing sites for conservation and restoration. At three focal marsh sites along the ICW, the project team has identified stable and unstable marsh plots. At each of these plots, researchers are sampling salt marsh growth with a focus on roots, which are integral to maintaining soil elevation. The team has also been examining soil structure, sulfide and nutrient pools, and greenhouse gas fluxes from both plants and soils. Preliminary data indicate that marsh grasses have a lower cumulative height and soil biogeochemical conditions may differ at unstable sites. The continuation of this research will contribute to a regionally explicit understanding of nutrient and hydrological links to coastal vulnerability.

PRESENTER: Samantha Chapman, Ph.D., Professor, Villanova University

Dr. Samantha Chapman is a professor and scientist at Villanova University. She is the co-director of the Center for Biodiversity and Ecosystem Stewardship and leads the "Warming Ecosystem Temperatures in a Florida Ecotone Experiencing Transition" (WETFEET) project. Dr. Chapman received her Ph.D. from Northern Arizona University and did a postdoctoral fellowship at the Smithsonian Environmental Research Center. She is an ecosystem ecologist who is interested in how climate change and altered biodiversity change the services that ecosystems provide. She has received grants from NASA, the U.S. National Science Foundation, NOAA, the U.S. Forest Service and the U.S. Department of Agriculture to conduct her research. She is a subject matter editor at the journal "Ecology". Dr. Chapman and her team collaborate to understand how climate change and rising sea levels alter coastal ecosystems and work with land managers to plan climate adaptation strategies.

PROJECT CO-AUTHORS: Tess Adgie, Villanova University; Lisa Chambers, Ph.D., University of Central Florida; Nikki Dix, Ph.D., GTM Research Reserve; Kaitlyn Dietz, GTM Research Reserve; Shannon Dunnigan, GTM Research Reserve; Adam Langley, Ph.D., Villanova University; Pamela Marcum, GTM Research Reserve; Lia Sansom, GTM Research Reserve.

An oyster rake that is progressing over a salt marsh where we the Roots and Rakes project team is studying hydrological restriction and nutrient cycling. Photo by the Roots and Rakes team.

SHARKS OF THE GTM RESEARCH RESERVE: UPDATED RESULTS FROM 14 YEARS OF SHARK ABUNDANCE SURVEYS CONDUCTED IN THE TOLOMATO RIVER

Because of their shallow and productive nature, estuaries often serve as critical habitat for young individuals of many ecologically, commercially and recreationally important shark species. Thus, it is important to characterize shark habitat use in suspected "shark nurseries" so that these habitats and the benefits they provide to overall shark populations can be protected. As part of a larger, long-term study on shark population trends and nursery ground use in northeast Florida and southeast Georgia estuaries, the University of North Florida's Shark Biology Program has examined shark habitat use in the Tolomato River (a component of the GTM Research Reserve) since 2010, using bottom longline fishing and drumline fishing. The results of this 14-year survey indicate that a minimum of ten shark species inhabit waters of the GTM Research Reserve, five of which comprise >95% of catch: the scalloped hammerhead (*Sphyrna lewini)*, Atlantic sharpnose shark (*Rhizoprionodon terranovae*), finetooth shark (*Carcharhinus isodon*), blacktip shark (*Carcharhinus limbatus*) and sandbar shark (*Carcharhinus plumbeus*). Over 98% of individuals captured in the Tolomato River were juveniles, illustrating the importance of this site as a juvenile refuge. The identification of this site as a nursery for neonate scalloped hammerheads is a novel finding, since past studies have reported preferential use of nearshore coastal areas as nursery habitat for this species rather than inshore areas. Shark habitat use in the GTM Research Reserve is seasonal, with abundance peaking in summer months. However, some species such as *C. plumbeus* may occur in the river as early as late winter, early spring. Catch rates have remained relatively stable over the duration of the survey. However, catch of *C. plumbeus* has increased in recent years, presumably reflecting an improving trend in abundance for this species.

UNF Undergraduate Brianna Traill releases a tagged juvenile shark in a northeast Florida estuary.
Photo courtesy of James Gelsleichter.

PRESENTER: James Gelsleichter, Ph.D., Professor, University of North Florida

Dr. James Gelsleichter is a professor at the University of North Florida (UNF) and Director of the UNF Coastal and Marine Biology Flagship Program. His research program, the UNF Shark Biology Program, conducts research on the population ecology, reproduction and ecotoxicology of sharks and rays, with special focus on populations residing in northeast Florida and southeast Georgia. Prior to his time with UNF, Dr. Gelsleichter was a staff scientist at Mote Marine Laboratory's Center for Shark Research for a decade. He completed his doctoral research working with the Virginia Institute of Marine Science's Shark Ecology Program. Overall, he has over 30 years of experience working with sharks and their relatives and is internationally recognized for his work on the reproductive endocrinology and toxicology of these fishes.

STATE OF THE RESERVE POSTER PRESENTATIONS

$\delta^{15}N$ AND $\delta^{13}C$ OF EASTERN OYSTERS AS A PROXY FOR ANTHROPOGENIC INFLUENCE AND INTERVENTION THROUGH TIME IN THE GUANA RIVER

Anthropogenic nutrient input is linked to declining water quality within estuaries. With human intervention and management, these anthropogenic effects can be mitigated. In the Guana River Marsh Aquatic Preserve (GRMAP) there is particular interest in how nutrient input and water quality have changed between the establishment of the preserve and present day. However, water quality monitoring in the GRMAP before 2014 is sparse and inconsistent. Individually radiocarbon-dated eastern oyster (*Crassostrea virginica*) shells from reef cores in the Guana River present an opportunity to assess the viability of nitrogen ($\delta^{15}N$) and carbon ($\delta^{13}C$) stable isotopes in reconstructing past watershed health and nutrient variability in the GRMAP during which historic water quality data is limited. Oysters are an especially useful repository of environmental data as they record isotopic variation in the watershed through the mineralization of their shells. $\delta^{15}N$ and $\delta^{13}C$ are paired with historic fecal coliform data (1979-2017) in the nearby Tolomato River. Preliminary results show that oyster shell $\delta^{15}N$ values decrease through time from 8.4 parts per thousand to 7.1 parts per thousand in tandem with decreasing fecal coliform concentrations in the Tolomato River. Results suggest that regulations preventing sewage from entering the estuary have decreased the amount of sewage derived nutrients entering the estuary.

PRESENTER: Heather Gunn, Ph.D. Student, Syracuse University

Heather Gunn studies paleoclimatology using stable isotope biogeochemistry at Syracuse University in the Department of Earth and Environmental Sciences. Her research utilizes stable isotopes to study variations in nitrogen and carbon cycling in differing aquatic systems that have occurred over the last 6,000 years. At the GTM Research Reserve, Heather utilizes oyster nitrogen and carbon isotopes to study changes in nutrient cycling through time in the Guana River, a proxy for overall ecosystem health. She is particularly interested in how anthropogenic activities alter aquatic ecosystems and seeks to quantify the success of mitigation efforts within these systems.

PROJECT CO-AUTHORS: Jaleigh Pier, Cornell University; Hallie Fischman, University of Florida; Gregory Dietl, Ph.D., Cornell University; Christopher Junium, Ph.D., Syracuse University.

AN OPTIMIZED DNA METABARCODING TOOLKIT FOR MONITORING PLANKTON COMMUNITIES IN THE GTM RESEARCH RESERVE

Ecological monitoring of estuaries is crucial for informed management decisions. Plankton communities are valuable bioindicators that respond rapidly to environmental change. Plankton data is traditionally obtained through microscopy, which is time-consuming and requires taxonomic expertise. One solution is DNA metabarcoding, a molecular technique that identifies multiple species within a single sample. In this project, an optimized metabarcoding "toolkit" is used for monitoring plankton within the GTM Research Reserve. The project team compared the performance of seven DNA extraction kits using water samples from two contrasting locations within the reserve. Metabarcoding was used to compare community assessments between kits and microscopy. The results indicate that kits differ in DNA concentration yield and polymerase chain reaction inhibitor removal, especially in turbid waters, but perform similarly to one another in terms of community composition. Taxonomic coverage differed between metabarcoding and microscopy. Metabarcoding resolved a greater number of taxa, including some potentially harmful plankton groups. However, not all taxa found via microscopy were detected by metabarcoding. These differences may be attributed to limited reference database coverage. This toolkit will be used in future studies to investigate the relationships between environmental parameters and plankton community composition within the GTM Research Reserve.

PRESENTER: Ashley Reaume, Ph.D. Student, University of Central Florida

Ashley Reaume is a former NOAA Margaret A. Davidson Fellow. Her research focus is plankton monitoring and water quality management needs within the GTM Research Reserve. She is currently a Ph.D. candidate at the University of Central Florida in Dr. Michelle Gaither's lab. Ashley previously attended Central Michigan University where she completed her bachelor's degree in biology and environmental studies. This research will create an efficient and cost-effective "bioassessment toolkit" to help evaluate the impact of water quality on plankton communities. Furthermore, it will contribute to a greater understanding of ecosystem functioning within the reserve.

PROJECT CO-AUTHORS: Nikki Dix, Ph.D., GTM Research Reserve; Gabby Canas, GTM Research Reserve; Michelle Gaither, Ph.D., University of Central Florida.

ASSESSING UNOCCUPIED AIRCRAFT SYSTEMS METHODS FOR LONG-TERM MONITORING OF INTERTIDAL OYSTER REEFS

Due to the numerous benefits oysters provide both ecologically and economically, oyster monitoring and management is critical to maintaining healthy oyster reefs. Current oyster monitoring programs use ground-based metrics for field surveys, but these methods tend to be time consuming, costly and may be damaging to the reef itself. To improve long-term monitoring of oyster reefs, scientists have explored other methods, including unoccupied aircraft systems (UAS), commonly known as drones. Drones provide advantages to oyster monitoring that include allowing researchers to access areas otherwise inaccessible, capturing data from vast areas in a short amount of time, providing the ability to look at the reef, serving as an efficient means for data collection and contributing minimal disturbance of the natural habitat. The goal of this project is to improve restoration and conservation efforts for intertidal oysters and the reefs they build by developing reliable long-term monitoring protocols, employing both UAS and field-based methods. In the summer of 2023, the research team conducted both *in situ* and UAS surveys of oyster reefs in the GTM Research Reserve at three sites. The reefs selected for surveying included an array of different reef forms and disturbances. The research team expects that certain traditional metrics will not be feasible with the UAS and certain UAS metrics would not be feasible with *in situ* sampling. Both methods will most likely successfully detect changes in oyster reef condition over space and time.

PRESENTER: Alyah Bennett, Master's Student, University of North Florida

Alyah Bennett is a master's student at the University of North Florida in the coastal biology program with a bachelor's degree in marine biology from Florida Southern College. She is currently working as a research assistant at the University of North Florida for GTM Research Reserve with Dr. Nikki Dix. Her project assesses the use of new and upcoming technology for monitoring at the GTM Research Reserve and additional national estuarine research reserves.

PROJECT CO-AUTHOR: Nikki Dix, Ph.D., GTM Research Reserve.

BAITED REMOTE UNDERWATER VIDEO CAN BE USED TO CHARACTERIZE SHARK NURSERY HABITAT USE IN LOW-VISIBILITY ESTUARINE SYSTEMS

There has been an increase in the use of baited remote underwater video (BRUV) surveys for assessing the species composition and relative abundance of shark populations in marine ecosystems. This approach provides a non-destructive, non-extractive and cost-effective alternative to traditional fishing-based methods. However, most studies using BRUVs have focused on their use in high-visibility ecosystems, such as tropical reefs. Furthermore, few studies have compared results from BRUV surveys with those obtained using traditional methods to evaluate the efficacy of this approach. Therefore, the goal of this study is to evaluate the effectiveness of using BRUV surveys to assess shark populations in low-visibility ecosystems. This study is addressing the goal by comparing shark presence and abundance surveys conducted using BRUVs and bottom longline fishing in the Tolomato River, a portion of the Guana estuary that serves as a communal nursery habitat for juveniles from multiple coastal shark species, including the sandbar (*Carcharhinus plumbeus*) and the scalloped hammerhead (*Sphyrna lewini*).

PRESENTER: Sarah Worthington, Master's Student, University of North Florida

Sarah Worthington is a master's student at the University of North Florida, where she received her bachelor's degree in biology. She is currently working as a graduate assistant, teaching biology labs to undergraduate students. Sarah's thesis project on using BRUVs to characterize shark nursery habitat use in the Tolomato River may provide support for the use of a non-extractive method for surveying shark populations in a system that is usually confined to traditional extractive methods.

PROJECT CO-AUTHOR: Jim Gelsleichter, Ph.D., University of North Florida.

BENTHIC AND PELAGIC RESPONSES TO NITROGEN INPUTS IN AN URBANIZING ESTUARY

Urbanization increases nitrogen (N) inputs, threatening the balance of estuarine N budgets. Estuaries regulate N fluxes by moderating benthic-pelagic coupling and the interactions and feedback between water column and sedimentary processes. In this study, researchers conducted nutrient limitation bioassays (NLB) using urea (NO_3^-), and phosphorus (P) alone and in combination. The team also measured nutrient fluxes (nitrogen oxides [NO_x], ammonium [NH_4^+] and phosphate [PO_4^{3-}]) at four sites during three seasons. NLBs were coupled with sediment-water nutrient fluxes and dissolved gases for two seasons. The degree of phytoplankton nutrient limitation differed between sites, with phytoplankton exhibiting large responses to organic N inputs. Preliminary data suggests N limitation occurred at all sites, while P was rarely limiting by itself but became limited in the presence of N. Co-limitation of urea + P was present along the salinity gradient, suggesting differences in site characteristics that could be driving varying nutrient limitation. Three of the sites exhibited NO_x uptake with elevated water column NO_3^-, indicating the system is poised to respond to N additions through both benthic and pelagic processes. These paired sediment flux and phytoplankton nutrient limitation studies provide a better understanding of the coupled benthic-pelagic processes and their variability, informing the potential sensitivity to anthropogenic pressures.

PRESENTER: Justina Dacey, Ph.D. Student, University of Florida

Justina Dacey is a Ph.D. student in the Soil, Water and Ecosystem Sciences Department at the University of Florida. She earned a master's degree in marine science from Jacksonville University and a bachelor's degree in biology from Florida State University. Justina focuses on how anthropogenic nutrient inputs influence benthic-pelagic coupling and ecosystem functions as part of the "Guana Nutrients: Budgets & Bivalves," NERR Science Collaborative Project. Understanding N pollution and drivers of biogeochemical N cycling rates is critical for considering how estuaries are responding to human development.

PROJECT CO-AUTHORS: A.J. Reisinger, Ph.D., University of Florida; Nikki Dix, Ph.D., GTM Research Reserve; Kaitlyn Dietz, GTM Research Reserve; Jessica Lee, GTM Research Reserve; Ashley Smyth, Ph.D., University of Florida.

COMBINING HIGH RESOLUTION SURVEYS AND NUMERICAL MODELING TO OPTIMIZE WATER LEVEL MANAGEMENT AND CONTAIN NUTRIENT LEVELS IN GUANA LAKE

Eutrophication is impacting estuaries worldwide. In most of the Guana estuary, high tidal flushing favors dilution and nutrient export, and water quality standards are met. An exception is Guana Lake, an impounded estuary that receives water from a highly urbanized watershed. Two water control structures separate the upstream river and the natural portion of Guana estuary from the impounded Guana Lake, where tidal flushing is reduced, causing nutrient accumulation. An autonomous boat (HYCAT) was deployed monthly to collect water quality parameters (Fluorescent Dissolved Organic Matter (FDOM), oxygen, nitrogen, salinity and temperature) and hydrodynamic parameters (water level and water velocity) across the lake. The same water quality parameters were collected at a ten-minute sampling rate in proximity to the two dams, which provides the boundary conditions. A Delft3D water quality-hydrodynamic numerical model was developed and will be forced by the measured boundary conditions and calibrated with data collected by the HYCAT. The model will enable better water management decisions and remediation strategies to reduce nutrient accumulation and improve water quality in the lake. This project aims to promote a sustainable estuarine ecosystem that can withstand urban inputs while supporting biodiversity, recreation, educational opportunities and a sustainable shellfish industry.

PRESENTER: Stefano Biondi, Ph.D. Student, University of Florida

Stefano Biondi joined Dr. Alberto Canestrelli's lab at the University of Florida in 2023 after completing a bachelor's and master's degree at Univesita' degli studi Padova (Italy). He spent nine months in Gainesville, Florida, for his master's thesis on wave energy dissipation by slotted wave screen. Stefano is currently cooperating with GTM Research Reserve on a water quality project at Guana Lake, where he is collecting data to perform numerical simulations that will provide guidance for the operational use of the dam. This research will inform management on how to prevent eutrophication in the northern portion of the lake and maintain an acceptable level of nutrients.

PROJECT CO-AUTHORS: Daniele Pinton, Ph.D., University of Florida; Alberto Canestrelli, Ph.D., University of Florida; Chu Chia-Chu, University of Florida; Nikki Dix, Ph.D., GTM Research Reserve.

DEVELOPING AN ECOLOGICAL BASELINE TO UNDERSTAND COASTAL FRESHWATER WETLAND RESILIENCE TO SALTWATER INTRUSION ON THE GUANA PENINSULA

Coastal freshwater wetlands contain high species diversity and provide significant ecological services in northeast Florida, but are impacted by sea-level rise, saltwater intrusion and severe storms. To successfully manage these coastal resources in the face of climate change, resource agencies need spatially explicit information on individual wetland vulnerability and resilience. This study quantifies baseline ecological conditions of coastal depression wetlands at the GTM Research Reserve. The project team analyzed surface water quality, soil porewater salinity and plant community diversity along transects in nine distinct wetlands along a salt-to-freshwater gradient. Surface water and soil salinity varied predictably and increased as wetlands were closer to salt marsh ecotones; water pH was a potentially sensitive marker for saltwater intrusion to differentiate from acidic freshwater and more basic saltwater. Plant diversity and composition was highly variable among wetlands, with soil salinity and hydrology only partially explaining current plant distributions. Spatially explicit baseline ecological information for the GTM Research Reserve coastal depression wetlands will support upcoming collaborative research projects.

PRESENTER: Emily Hill, Research Technician, University of North Florida

Emily Hill is a research technician at the University of North Florida's (UNF) WE~ECO Lab under the guidance of Dr. Scott Jones. She earned a bachelor's degree in biology with a concentration in coastal environmental science from UNF in 2022. Her current role involves monitoring coastal wetlands susceptible to climate change, specifically sea level rise and saltwater intrusion. Collaborating with the GTM Research Reserve, WE~ECO Lab's project supplies essential data on water quality, soil salinity and plant community structure within coastal depression wetlands. This data is crucial for formulating effective strategies to manage coastal wetland resilience and preserve ecologically important areas.

PROJECT CO-AUTHORS: Megan Howkins, GTM Research Reserve; Elizabeth Terwilliger, University of North Florida; Savanna Mathis, GTM Research Reserve; Allix North, GTM Research Reserve; Scott Jones, Ph.D., University of North Florida.

DIFFERENCES IN GREENHOUSE GAS EMISSIONS IN SALT MARSHES BEHIND EXTENSIVE SHORELINE OYSTER SHELL FORMATIONS

Salt marshes are widely recognized as natural carbon (C) and greenhouse gas sinks, effectively offsetting natural methane (CH_4) and carbon dioxide (CO_2) emissions. However, modifications to tidal flow in salt marshes can lead to higher greenhouse gas emissions, reduced C storage and threatened ecosystem stability. Within the GTM Research Reserve, there is uncertainty surrounding whether oyster rakes—accumulations of shells along the edges of salt marshes that rise well above mean sea level—function as tidal barriers, potentially affecting wetland stability and greenhouse gas dynamics. In this project, researchers assessed plant and soil characteristics in salt marshes behind oyster rakes in both stable and unstable areas, defined by soil consolidation, along the intracoastal waterway in the GTM Research Reserve. Additionally, the team quantified *in situ* CH_4 and CO_2 emissions from soils with plants and soils without plants. In soil + plant measurements, CH_4 emissions were greater in stable sites, likely due to increased plant biomass venting soil CH_4. In soil-only measurements, unstable sites yielded 3-13 times greater CH_4 emissions and 6-11 times greater CO_2 emissions than sites with stable soils. Oyster rakes may drive hydrological changes that alter soil consolidation and biogeochemistry of salt marshes. The project team is currently assessing pore water chemistry and turnover rates to elucidate the impact of oyster rakes on greenhouse gas emissions and overall wetland stability.

PRESENTER: Cathilyn McIntosh, Master's Student, Villanova University

Cathilyn McIntosh completed her bachelor's degree at Georgetown University where she began her research in salt marsh ecology. She is currently completing her master's degree at Villanova University under the guidance of Dr. Samantha Chapman and Dr. Adam Langley. Cathilyn's work primarily focuses on how oyster rakes within the intercostal waterways of the GTM Research Reserve may be impacting tidal flow and greenhouse gas emissions in salt marsh ecosystems. Understanding how oyster rakes impact salt marsh ecosystem services will provide insightful information to help guide conservation efforts and restoration management plans within the reserve.

PROJECT CO-AUTHORS: Scott Jones, Ph.D., University of North Florida; Lisa Chambers, Ph.D., University of Central Florida; Therese Adgie, Villanova University; Samantha Chapman, Ph.D., Villanova University; Adam Langley, Ph.D., Villanova University.

DNA BARCODING ADVENTURES IN DUNE PLANTS AND GOPHER TORTOISE SCAT COLLECTED FROM GUANA NORTH BEACH, GTM RESEARCH RESERVE

Genetic signatures have become the gold standard for species identification and confirmation of species presence within a particular ecosystem. In animals, correct identification depends on the mitochondrial gene cytochrome c oxidase 1 (CO1) and DNA database sequence matching. For animal species, the system is quite standard and robust, but when the CO1 gene in plants is too conserved it is useless in identifying plant species. Many other genetic sites have been proposed to serve as the plant barcode, namely those found in the chloroplast DNA, such as maturase K gene (matK). The current system of published reference sequences for plants is a mixed bag, with different, multiple, universal and more robust DNA reference regions still being proposed today. The matK sequence has been shown to work well with angiosperms but is less effective in gymnosperms and even less effective in cryptogams. With little consensus on the best genetic regions to use for a dune plant study, researchers began a journey to find polymerase chain reaction primers that could provide genetic signatures from samples. The project team first had to successfully extract intact DNA molecules from digested, degraded, sandy and sun-scorched material within the collected tortoise scat.

PRESENTER: Terri Seron, Ph.D., Associate Professor, Flagler College

Dr. Terri Seron received her bachelor's degree in biology at the University of Connecticut and her Ph.D. from the University of Florida working in the Whitney Laboratory. After studying reef-building corals as a postdoctoral researcher for a couple years and then teaching at the University of Florida, Dr. Seron started teaching and constructing curriculum at Flagler College. She uses her expertise in molecular biology and marine science to mentor students on community projects that ask ecological questions and seek genetic answers.

PROJECT CO-AUTHORS: Izzi Lindon, Flagler College; Caroline Blaha, Flagler College; Alexa Friszolowski, Flagler College; Christina Mark, Flagler College; Leah Yarish, Flagler College; Barbara Blonder, Flagler College; Lee Newsom, Ph.D., Flagler College.

FLOWCAM: EVALUATING APPLICATIONS OF FLOW IMAGING MICROSCOPY IN THE GUANA ESTUARY

Phytoplankton constitute the basis of aquatic food-webs by transferring light and nutrients as energy to higher trophic levels. Phytoplankton respond quickly to environmental changes and can threaten environmental and public health by producing harmful blooms. Because of phytoplankton's ecosystem-level importance, monitoring phytoplankton community composition is an invaluable tool in coastal management. Traditional microscopy methods are well-established; however, they are very time-consuming and require years of training. To address these challenges, new methods have been developed in recent years to offer quicker and more quantitative means of monitoring phytoplankton communities. One such method is flow-imaging microscopy (FIM). FIM methods involve the use of a camera microscope aimed at a flow cell through which water samples (live or preserved) are pumped. Research staff at the GTM Research Reserve have begun utilizing a FlowCam 8100 FIM instrument to generate a robust phytoplankton community monitoring program. Workflows and repeatable procedures are being evaluated with the help of technical experts around the country. The goal of this program is to provide system-wide, real-time and actionable data that is not currently available due to limitations of current monitoring techniques. The development of these methods could offer a template for other estuarine monitoring programs.

PRESENTER: Nathaniel Schirmer, Bachelor's Student, University of North Florida

Nathaniel Schirmer is currently finishing his bachelor's degree in biology at Edward Waters University. He has been pursuing a career in estuarine research and monitoring since participating in the University of North Florida's Research Experience for Undergraduates program. Nathaniel's experience at the GTM Research Reserve began as an intern with the System-Wide Monitoring Program (SWMP). In the past year, he has worked on several projects at the reserve including the development of a standard operating procedure for the FlowCam 8100 instrument.

PROJECT CO-AUTHORS: Hans Prevost, GTM Research Reserve; Jacob Berna, GTM Research Reserve; Nikki Dix, Ph.D., GTM Research Reserve.

GUANA NUTRIENTS: BUDGETS AND BIVALVES

An aspect of the "Guana Nutrients: Budgets and Bivalves" project includes laboratory experiments with local bivalves to understand the range of rates of various ecosystem services, including filtration and ammonium excretion rates. Experiments to date reflect a high degree of variability in these rates for the ribbed mussel, *Geukensia demissa*, with greater consistency shown for the eastern oyster (*Crassostrea virginica*) population. This body of work will incorporate analysis of sediment biodeposition and nutrient assimilation rates as well as determine ways to improve water clarity and decrease high nutrient concentrations via these processes. To add ecological relevance and further the understanding of bivalve ecosystems services, this project includes the *in situ* study of bivalve filtration rates, exploring interactions based on seston composition and phytoplankton constituency. Lab and field studies will be joined using flow cytometry to calibrate the results and draw comparisons.

PRESENTER: Kristie Perez, Ph.D. Student, University of Florida

Kristie Perez's background in stakeholder engagement and her passion for coastal science led to a career transition from project manager to interdisciplinary ecologist. Her interests in invertebrate health and conservation behavior change have brought her to the intersection of ecology and social science. Kristie plans to continue conducting research to better understand the need for water quality preservation and management and how best to communicate these needs to coastal communities to improve resilience and protect ocean resources.

PROJECT CO-AUTHOR: Shirley Baker, Ph.D., University of Florida.

IDENTIFYING CONTROL POINTS FOR NUTRIENT MANAGEMENT IN THE GUANA ESTUARY USING STABLE ISOTOPES

Population growth and urbanization have increased nutrient loads to coastal ecosystems. Variable timing, magnitude and spatial variations of anthropogenic nitrogen (N) inputs hinder pinpointing N sources. In excess, N is considered a pollutant and can cause eutrophication. Estuaries have the potential to reduce eutrophication by removing bioavailable nutrients through assimilation into plant biomass and mineralization. To manage the fate and delivery of anthropogenic N downstream, it is crucial to locate ecosystem control points where N is being removed. Isotope signatures in plants and sediment can be used to identify control points of anthropogenic N storage, since anthropogenic N has a distinct isotopic signature. In this project, sediment and plant samples were collected quarterly across a salinity gradient in the Guana estuary to identify control points where management strategies may be most effective at mitigating anthropogenic N inputs. The project team predicts the most enriched isotope signatures, which indicate more anthropogenic influence, will be at Mickler's Weir where water from the urbanized headwaters enters the Guana estuary. If true, vegetation and sediment at Mickler's Weir can serve as control points to store nutrients and mitigate N loading in the Guana estuary.

PRESENTER: Jenna Reimer, Ph.D. Student, University of Florida

Jenna Reimer is a University of Florida Ph.D. student co-advised by Dr. Ashley Smyth and Dr. AJ Reisinger. Jenna studies estuarine biogeochemistry at the GTM Research Reserve. She received her bachelor's degree in geology, with honors, from the University of Maryland in 2019. Jenna's project will help elucidate the transport and fate of nutrients to and through the Guana Estuary.

PROJECT CO-AUTHORS: AJ Reisinger, Ph.D., University of Florida; Ashley Smyth, Ph.D., University of Florida.

INVESTIGATING SOIL PROPERTIES ASSOCIATED WITH COASTAL WETLAND STABILITY IN THE TOLOMATO RIVER ESTUARY

Anthropogenic impacts have contributed to coastal wetland degradation worldwide. Coastal wetlands perform essential ecosystem functions, but these functions can be significantly reduced when wetlands deteriorate. The Tolomato River estuary, part of the GTM Research Reserve, is bordered by vast coastal wetlands dominated by *Spartina alterniflora* and oyster rakes (linear piles of dead oyster shells) that have formed at the boundary of wetlands in some areas. The effect of oyster rakes on the health of the wetlands behind them is unknown. While some areas of wetlands appear healthy with well consolidated soil (i.e., "stable"), others appear to have reduced plant vigor and loose, unconsolidated soils (i.e., "unstable"). The project team hypothesized that unstable sites have a larger proportion of fine sediments, sulfides, ammonium, organic matter content and active carbon than stable sites, as well as less nitrate. This study sampled 25 soil cores in stable and unstable marsh plots and conducted soil biogeochemical analyses. Preliminary data suggests in stable soil nitrate is higher and ammonium is lower. Findings like these can provide information for the GTM Research Reserve to perform best management practices in protecting and restoring wetlands.

PRESENTER: Jennifer Volk, Master's Student, University of Central Florida

Jennifer Volk received an associate degree from Eastern Florida State College, then graduated from the University of Central Florida with a bachelor's degree in general biology. Jennifer is currently a master's degree student at the University of Central Florida in the Aquatic Biogeochemistry Laboratory. Her project highlights the differences between stable and unstable soils in the GTM Research Reserve and will inform best management practices in restoring and preserving wetlands.

PROJECT CO-AUTHORS: Samantha Chapman, Ph.D., Villanova University; Adam Langley, Ph.D., Villanova University; Lisa Chambers, Ph.D., University of Central Florida.

LONG-TERM MONITORING OF SALT MARSH VEGETATION: A TWELVE-YEAR SUMMARY

Salt marshes are ecologically and economically important components of estuarine environments. The GTM Research Reserve conducts long-term monitoring of salt marsh vegetation to document ecological characteristics and discern the impacts of local and global environmental changes. Vegetation monitoring occurs at six sites throughout the reserve, with each site containing three platforms with five vegetation monitoring plots each. Monitoring plots were established 0, 6 and 10 meters from tidal creek edges as a representation of salt marsh habitat available for fish and other fauna seeking refuge and food. Percent cover, canopy height and stem density were measured in plots twice per year from 2012 to 2023. Since 2012, the biggest change has been an increase in *Avicennia germinans* (black mangrove) cover and height. Cover and height of *Spartina alterniflora* (smooth cordgrass), *Juncus roemerianus* (black needle rush), *Salicornia ambigua* (perennial glasswort), and *Batis maritima* (saltwort) have stayed relatively stable or slightly declined. In 2023, given the relative stability of vegetation characteristics, monitoring was reduced to once per year. Research has shown that the expansion and growth of *A. germinans* throughout the reserve is linked to less extreme freeze events. As temperatures continue to warm, this shift in foundational species from grasses to trees may alter the estuarine ecosystem.

PRESENTER: Hans Prevost, Biological Scientist, GTM Research Reserve

Hans Prevost attended the University of Louisiana at Lafayette where he completed both a bachelor's and master's degree in biology. He is now a biological scientist at the GTM Research Reserve, where he coordinates the long-term monitoring of oysters, plankton and salt marsh vegetation within the reserve. This work documents the ecological characteristics of salt marshes in the reserve and discerns the impacts of local and global environmental changes on the estuarine system.

PROJECT CO-AUTHORS: Jacob Berna, GTM Research Reserve; Pamela Marcum, GTM Research Reserve; Nikki Dix, Ph.D., GTM Research Reserve.

NITROGEN ENRICHMENT IMPLICATIONS FOR MINERAL-ASSOCIATED ORGANIC MATTER FORMATION IN THE MANGROVE-SALTMARSH ECOTONE ON THE NORTHEAST COAST OF FLORIDA

Coastal wetlands mitigate climate change effects by sequestering carbon (C), storing 20–30% of the total C as soil organic matter (SOM). The concentration of carbon dioxide (CO_2) in the atmosphere is increasing, making it essential to understand the mechanisms that preserve C within the SOM. Mineral-associated organic matter (MAOM) is considered the most stable and persistent form of SOM. However, anthropogenic nutrient enrichment and the interaction of climate change resulting in the northward migration of mangroves in Florida may have implications for MAOM formation in coastal wetlands. This preliminary study in the GTM Research Reserve investigates soil biogeochemical properties and MAOM abundance in marsh and mangrove plots with and without five years of artificial nitrogen (N) enrichment. One pilot soil core (0-30 cm) was collected in each of the four plot types (control mangrove, control marsh, enriched mangrove, enriched marsh), and MAOM was quantified using standard physical and density fractionation methods. The project team hypothesized that MAOM formation will be higher in N-enriched marsh plots because of greater mineral sediment and labile litter availability. This preliminary analysis will inform additional research about the impact of N enrichment and mangrove encroachment on MAOM formation to better understand coastal wetland C and N storage.

PRESENTER: Mercedes Pinzon Delgado, Ph.D. Student, University of Central Florida

Mercedes Pinzon Delgado completed her bachelor's degree in coastal environmental sciences from Louisiana State University and obtained a master's degree in oceanography. She has begun her Ph.D. in integrative and conservation biology at the University of Central Florida. Mercedes is currently investigating the individual and interactive drivers of environmental change, such as N enrichment and sea level rise, on mangrove and salt marsh ecotones. This research helps to better understand the northward migration of mangroves and the formation of MAOM that supports coastal wetlands in the GTM Research Reserve.

PROJECT CO-AUTHORS: Samantha Chapman, Ph.D., Villanova University; Adam Langley, Ph.D., Villanova University; Lisa Chambers, Ph.D., University of Central Florida.

PRELIMINARY ANALYSES OF MERCURY CONCENTRATIONS IN FISH SPECIES OF THE TOLOMATO RIVER

Mercury is a widespread marine pollutant that often accumulates in fish through the food web and poses health risks to both fish and human seafood consumers. There have been extensive efforts to quantify mercury concentrations across the United States and to identify the adverse effects of consuming seafood laced in mercury. The Tolomato River is a popular location for recreational anglers within the GTM Research Reserve and is home to several recreationally important fish species. The objective of this project is to quantify mercury concentrations within all levels of the Tolomato River food chain to better understand risks to the local fish species and to anglers. This project will provide preliminary analyses of the mercury concentrations present within fish species found in the Tolomato River.

PRESENTER: Morgan Lattomus, Master's Student, University of North Florida

Morgan Lattomus is currently a master's degree student at the University of North Florida, where she is studying the quantification of mercury in local fish populations. She completed her bachelor's degree at the College of Charleston, where her research focused on microplastic ingestion in young-of-year sharks within nursery habitats along the South Carolina coast. Morgan's current work aims to fill gaps in literature regarding the concentration of mercury across the complete food web present in the Tolomato River, which acts as a popular fishing spot for local saltwater anglers.

PROJECT CO-AUTHOR: James Gelsleichter, Ph.D., University of North Florida.

PRIORITIZING CONSERVATION OPPORTUNITIES FOR PROTECTING FLORIDA'S AQUATIC PRESERVES

This multi-year project will develop methodology for prioritizing conservation opportunities for Aquatic Preserves. The project has four primary tasks targeted toward the goal of improving resilience and connectivity for aquatic ecosystems. Tasks include delineating watersheds, applying coastal connectivity modeling, developing the Landscape Development Intensity Index and assisting with development and review of conservation restoration proposals. Understanding the ecology, connectivity and current development within which these ecosystems exist brings scientific support to the conservation activities intended to support them. Goals include understanding where in the watershed to prioritize conservation, improving resilience and connectivity, creating management relationships, ensuring equity and inclusion and creating methodology for future projects. Pathways to conservation might include projects and programs such as the "Florida Forever" project, the Rural and Family Lands Protection Program and the "Wetland Reserve Easements" component of the Agricultural Conservation Easement Program. The University of Florida Center for Landscape Conservation Planning has been involved in landscape scale conservation assessment for decades.

PRESENTER: Tricia Kyzar, Ph.D., Researcher/Spatial Analyst, University of Florida

Dr. Tricia Kyzar focuses on water quality issues including spatial analysis of septic systems and their vulnerability to failure driven by climate change factors. Her work includes local and regional analysis and provides stakeholder information that immediately identifies problem areas and informs capital planning. In addition, her work includes prioritization of conservation opportunities for both water quality and storage and multi-decadal analysis of land cover and population change across the southeastern United States. Dr. Kyzar works with a variety of stakeholders including local, regional, state and federal agencies, and her analysis results are used to inform planning and policy decisions.

PROJECT CO-AUTHORS: Tom Hoctor, Ph.D., Center for Landscape Conservation Planning; Mike Volk, Center for Landscape Conservation Planning; Reed Noss, Ph.D., Center for Landscape Conservation Planning; Eve Bohnett, Ph.D., Center for Landscape Conservation Planning; Mike O'Brien, Center for Landscape Conservation Planning; Mike Spontak, Center for Landscape Conservation Planning.

PROVISION OF OYSTER REEF HABITAT IN ENERGETIC SYSTEMS BY THE PERVIOUS OYSTER SHELL HABITAT

Many oyster reef restoration projects have been developed to restore oyster populations, which in turn benefit the many fish and crustaceans that use oyster reef as habitat. The Pervious Oyster Shell Habitat, or POSH, is a novel oyster restoration and living shoreline device created to be an environmentally friendly and effective alternative in energetic systems. The purpose of this study was to assess POSH's ability to restore oyster reef habitat by assessing the density and communities of fish and crustaceans utilizing structures with two m^2 bottomless lift nets. POSH structures were compared over the course of one year to Reef Innovations' "Oyster Ball" and a natural oyster reef control along two energetic shorelines in northeast Florida. Fish densities were low and variable across treatments. Crustacean densities were generally greatest on the oyster reef, followed by the POSH. Community diversity indices for fish and crustaceans were similar between all treatments and sites. POSH created optimal habitat for benthic crustaceans, primarily the Atlantic mud crab (*Panopeus herbstii*), and some demersal resident fish like blennies and gobies. POSH's increased complexity has shown to provide optimal habitat for restoration of a benthic oyster reef community.

PRESENTER: Hunter Mathews, Graduate Student, University of North Florida

Hunter Mathews received his bachelor's degree in environmental science from Florida State University and is currently a graduate student and research assistant at the University of North Florida. His thesis work in Dr. Kelly Smith's lab is focused on the pilot assessment of several oyster reef restoration success criteria for the novel POSH artificial reef structure. POSH combines oyster shell and cement to reduce the use of plastic and the carbon footprint of production, while increasing structural complexity and durability in high-energy systems.

PROJECT CO-AUTHOR: Kelly Smith, Ph.D., University of North Florida.

RECONSTRUCTING GUANA RIVER OYSTER FILTRATION CAPACITY OF THE RECENT PAST THROUGH GEOHISTORICAL RECORDS

The Guana River is an impaired water body in the GTM Research Reserve and the focus of several research and management initiatives. Improving water quality through filtration is one of many ecosystem services provided by the eastern oyster, *Crassostrea virginica*. In 2014, GTM Research Reserve began a comprehensive oyster monitoring program to establish population baselines, including oyster body size and density, which is required to calculate oyster filtration capacity. The NERR Science Collaborative "Guana Nutrients: Budgets and Bivalves" project is currently working to quantify filtration provided by oysters within Guana River to inform water quality restoration needs. However, extended baselines are needed to understand how filtration has changed over time. The goal of this project is to extend oyster size and density baselines further into the past to see how oyster filtration may have changed since the Guana River Marsh Aquatic Preserve was established in 1985. The project team has conducted two field seasons (2022-2023) to collect over 30 five-to-ten-foot cores from 11 reefs in Guana River using a vibracore method to access preserved oysters buried within the reefs. Preliminary geochronology (carbon-14) results reveal that the deepest oyster layers in Guana River reefs range from several decades to over a century old.

PRESENTER: Jaleigh Pier, Ph.D. Student, Cornell University

Jaleigh Pier is a Ph.D. candidate from the Earth & Atmospheric Sciences Department at Cornell University. She studies conservation paleobiology, a field that applies paleontology towards modern conservation issues. Her thesis work aims to reconstruct oyster population metrics from the recent past, prior to GTM Research Reserve oyster monitoring efforts, to extend the baseline of oyster information further into the past. Jaleigh has strong interests in science communication and crafting effective conservation messages for diverse audiences.

PROJECT CO-AUTHOR: Gregory Dietl, Ph.D., Cornell University.

SEARCHING FOR THE SOURCE: TRACING THE FOOTPRINTS OF BACTERIA IN WEST AUGUSTINE

The San Sebastian River receives significant freshwater input from numerous stormwater outfalls and is experiencing rapid urban development along its shoreline. Results from a three-year monthly water quality monitoring effort in the San Sebastian River highlights increased dissolved inorganic nitrogen concentrations and periodic increases in fecal indicator bacteria (fecal coliform and *Enterococcus*) concentrations in relatively close proximity to the West Augustine neighborhood, an area with a high density of onsite septic tank systems. Surface water grab samples were collected from a drainage ditch system in West Augustine and Oyster Creek, a drainage basin system and catchment that receives freshwater runoff from West Augustine and flows into the San Sebastian River. Results indicate elevated *Enterococcus* levels (>5000 MPN/100 ml sample) at sites associated with high septic tank density as compared with areas associated with a higher sewer system density. Results reveal a positive correlation between *Enterococcus* levels and rainfall. Additionally, results from a mixing experiment of high-salinity, low bacteria, low nutrient estuary water compared with low salinity, high bacteria, high nutrient West Augustine water, showed a relatively rapid removal of *Enterococcus* with exposure to sunlight. The study also included a microbial source tracking effort using genetic analysis of preserved filters of bacteria to determine a potential human origin. The broader purpose of this work is to identify negative water quality issues in the San Sebastian River and to communicate these findings to relevant state agencies.

PRESENTER: Carly Shaw, Bachelor's Student, Flagler College

Carly Shaw is a bachelor's student at Flagler College pursuing a bachelor's degree in coastal environmental science with minors in sustainability studies and biology. Over the past two years, Carly has worked as a research assistant under the mentorship of Dr. Matthew Brown. Her research focuses on water quality in the San Sebastian River and analysis of fecal indicator bacteria from neighborhoods with septic and sewer systems in West Augustine. Carly has interned for The Wetlands Institute in New Jersey and the New Jersey Department of Fish and Wildlife, both involving coastal salt marsh ecology and conservation.

PROJECT CO-AUTHORS: Monica Maldonado, GTM Research Reserve; Matthew Brown, Ph.D., Flagler College.

SIZE MATTERS: THE ROLE OF SMALLER OYSTERS ON FILTRATION SERVICES IN THE GUANA ESTUARY

Oysters play a vital role in estuarine ecosystems by filtering water and removing pollutants. This study, centered in the Guana estuary, evaluates the influence of oyster size on water filtration. Through a numerical removal experiment spanning oyster size classes from 0 to 240 mm, the project team observed that filtration is only marginally affected if all oysters larger than 75 mm are removed from the estuary when simulating overharvesting. Conversely, the removal of oysters ranging from 0 to 75 mm markedly diminishes overall filtration in the estuary, highlighting the pivotal role of smaller oysters (0-75 mm) with filtration in the Guana estuary. This behavior is due to the different filtration rates of small and large oysters. While individual small oysters filter less water than their larger counterparts, their higher numbers result in a more significant overall contribution to water filtration. To safeguard and continue filtration in the estuary, conservation endeavors should concentrate on protecting oysters within the 0-75 mm range. Understanding the relationship between oyster size and filtration capacity can inform sustainable management strategies for estuarine ecosystems, facilitating the protection and restoration of oyster populations to preserve their vital ecological services.

PRESENTER: Daniele Pinton, Ph.D., Postdoctoral Researcher, University of Florida

Dr. Daniele Pinton completed his Ph.D. in civil and coastal engineering from the University of Florida in December 2022, after his graduation from the University of Padova, Italy. Daniele is a postdoctoral researcher in Dr. Alberto Canestrelli's lab, which focuses on enhancing the understanding of hydrodynamic and eco-morphodynamic processes in coastal, estuarine and riverine environments. His research combines machine-learning and remote sensing for small-scale wetland feature description and includes modeling of estuarine hydrodynamics and particulate matter to assess bivalve filtration and studying the dispersion of bacteria and pollutants in these environments. This project aims to provide information that helps create sustainable management strategies for coastal ecosystems.

PROJECT CO-AUTHOR: Alberto Canestrelli, Ph.D., University of Florida.

STRATEGIC PLANTING AND NUTRIENT AMENDMENTS TO ACCELERATE THE REVEGETATION OF RAPIDLY RETREATING COASTAL DUNES

The increasing frequency and severity of disturbances to coastal dune ecosystems necessitates the development of restoration strategies that rapidly accelerate reestablishment of vegetation, enhance dune accretion and preserve dune ecosystem services. To assess how to rapidly reestablish vegetation to counter ecosystem losses, researchers conducted a manipulative field experiment on a created dune in northeast Florida to determine what combinations of planting density, outplant species composition and nutrient addition maximizes dune revegetation rate. After three months, the project team found that increased planting densities combined with nutrient addition elevated aboveground plant biomass by 868-2,961%, while growth in sparsely planted and unfertilized treatments was negligible or negative. These thickly revegetated, high density + nutrient addition plots accreted one to five cm more sediment, demonstrating that this planting method can rapidly kickstart dune-building processes. Additionally, densely planted, fertilized plots containing *Panicum amarum* (bitter panicgrass) produced 1.7 times more biomass and accreted 1.5 times more sediment than plots containing *Uniola paniculata* (sea oats), suggesting that this species and planting scheme may be most effective for rapid dune building. These findings reveal that coupling nutrient addition with dense planting can trigger self-sustaining plant growth and dune-building feedbacks within months, likely warranting the cost of additional transplants by enhancing the long-term restoration success.

PRESENTER: Joe Morton, Ph.D., Postdoctoral Researcher, University of Florida

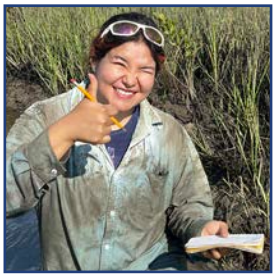
Joe Morton is currently a postdoctoral researcher at the University of Florida Center for Coastal Solutions where he works with local, state and federal stakeholders to develop more effective approaches to coastal dune ecosystem restoration that incorporate species interactions and ecological theory. Joe received a master's degree in marine science from the University of North Carolina at Chapel Hill and a Ph.D. in marine science and conservation from Duke University. He is broadly interested in teasing out the community- and ecosystem-level influence of parasites, predators and mutualists on ecosystem structure, functioning and stability by using manipulative field experiments, observational studies and laboratory assays.

PROJECT CO-AUTHORS: Hallie Fischman, University of Florida; Orlando Cordero, University of Florida; Jonathan Crabill, University of Florida; Morgen Anthony, University of Florida; Mary Schneider, University of Florida; Peter Adams, Ph.D., University of Florida; Christine Angelini, Ph.D., University of Florida.

UNDERSTANDING THE EFFECTS OF EUTROPHICATION ON THE FATE OF NITROGEN IN THE GTM RESEARCH RESERVE MARSH-MANGROVE ECOTONE

Nitrogen (N) runoff drives eutrophication in estuaries in the GTM Research Reserve in northeast Florida, but coastal wetlands can help mitigate this pollution by transforming or sequestering N from the estuary. Due to the declining frequency of freeze events, *Avicennia germinans* (black mangrove) has increased in abundance at the northern end of its range, resulting in the transition of marsh to mangrove-dominated ecosystems. In March 2022, the project team fertilized ten marsh and ten mangrove plots along the creek edge and marsh interior. In September of 2022, the project team added nitrogen-15 (15N) urea to the 20 fertilized and 20 unfertilized plots to determine the fate of N. Label recovery was greater in mangrove leaves along the creek edge (0.87%) compared to interior plots (< 0.5%) after three months. Though not significant, recovery of the label in vegetation across treatments was higher in creek edge plots compared to the interior. Surprisingly, mangrove-dominated plots tended to retain less of the 15N label, despite accumulating greater total N mass; N addition also greatly decreased recovery. These early recovery findings suggest that, despite having greater N demand, mangrove-dominated ecosystems may have a more open N cycle (greater fluxes of N in and out). Continued tracking of the label will afford a refined estimate of N cycling in these rapidly transitioning ecosystems

PRESENTER: Jocelyn Bravo, Master's Student, Villanova University



Jocelyn Bravo is a master's student at Villanova University and a research assistant on the "Warming Ecosystem Temperatures in a Florida Ecotone Experiencing Transition" (WETFEET) project with Dr. Samantha Chapman and Dr. Adam Langley. Jocelyn received her bachelor's degree in biology and mathematics at Bryn Mawr College. Her project is essential to understanding how global change drivers and mangrove migration into salt marshes impacts the ecosystem. The results and information gained from this project can be used by collaborators and stakeholders to assess ecosystem vulnerability at the GTM Research Reserve.

PROJECT CO-AUTHORS: Lisa Chambers, Ph.D., University of Central Florida; Tess Adgie, Villanova University; Samantha Chapman, Ph.D., Villanova University; Adam Langley, Ph.D., Villanova University.

UNDERSTANDING THE NORTHWARD EXPANSION OF FISH COMMUNITIES AND PREDICTIVE MANAGEMENT STRATEGIES IN A DYNAMIC FLORIDA ESTUARY

Historically, water temperatures have restricted marine fish ranges. However, current rising sea temperatures are pushing some species poleward, potentially affecting coastal fish and fisheries. To address this, multi-decadal fisheries and environmental data are analyzed to explore latitudinal range shifts and potential drivers over time from the Indian River Lagoon (IRL) to Jacksonville. Initial analyses indicate latitudinal range shifts of several sport and forage fish species from relatively low to high latitude waters. The impact of these changes on estuarine ecosystems in the area between the IRL and Jacksonville, particularly in the GTM Research Reserve, remains poorly understood. Due to the relative lack of knowledge on fish communities inhabiting northeast Florida, this project addresses historical and current community composition, differences in composition across GTM Research Reserve sites, environmental and habitat factors shaping fish composition and the influence of environmental factors on species over time. This research will increase our fundamental understanding of the impacts of local and regional pressures on the ecosystem structure and function, while generating actionable science that can be used to develop a predictive framework for increasing the ability to better manage natural resources in the reserve.

PRESENTER: Meredith Pratt, Ph.D. Student, University of Central Florida

Meredith Pratt is an integrative and conservation biology Ph.D. student at the University of Central Florida. She received her bachelor's degree in marine biology from Nova Southeastern University with minors in international law and honors transdisciplinary studies. Using multi-decadal fisheries and environmental data, her study will examine the latitudinal range shifts of fish species and investigate the potential drivers behind these shifts over time. The findings from this research will have practical implications, informing the design of conservation and management strategies that promote the sustainability of coastal ecosystems and increasing our understanding of the effects of climate change on coastal fish communities.

PROJECT CO-AUTHOR: Geoffrey Cook, Ph.D., University of Central Florida.

USE OF UNDERWATER BAITED CAMERAS TO ASSESS FISH COMMUNITIES IN NEIGHBORING SALT MARSH AND MANGROVE HABITATS IN ST. AUGUSTINE

Vegetation monitoring documents a shift in northeast Florida's coastal wetland vegetation species from a salt marsh dominated system to regions of mangrove dominance. How these shifts impact fish are of interest to recreational anglers as well as ecologists. A baited remote underwater video (BRUV) has often been used for rapid fish community assessments, providing data relevant to species richness, diversity and population structure. Using BRUVs to study fish nursery habitats would leave a minimal ecological footprint, unlike more intrusive methods such as fyke nets. This study aims to determine the impact of mangrove encroachment on local fish habitat utilizing BRUVs to compare species richness between mangrove and saltmarsh ecosystems in the intracoastal waterway near Vilano Beach in St. Augustine, Florida. Preliminary results may indicate that species diversity between saltmarsh and mangrove habitats are roughly equal, with some species demonstrating a preference for one or the other. The preliminary results indicate low species richness with the majority of the encounters being from two specific species.

PRESENTER: Ethan Fuhrmeister, Bachelor's Student, University of North Florida

Ethan Fuhrmeister is a bachelor's student at the University of North Florida studying coastal biology. He has helped with a variety of projects related to coastal fisheries and is interested in the study of anthropogenic effects on coastal fisheries species.

PROJECT CO-AUTHOR: Kelly Smith, Ph.D., University of North Florida.

The range of red mangroves, **Rhizophora mangle,** *is expanding northward like the black mangroves. This red mangrove was documented in the Matanzas River along Shore Drive. Photo by Lynne Blow.*

AVAILABLE RESOURCES

The GTM Research Reserve can provide and/or coordinate many resources for visiting researchers and collaborators.

1 LONG-TERM DATA

The reserve has been collecting water quality, meteorological, and nutrient data since 2002, salt marsh vegetation data since 2012 and oyster data since 2014.

2 BIODIVERSITY DATA

The reserve has habitat maps and monitoring data for sea turtles, butterflies, gopher tortoises, plankton, migratory birds and nekton.

3 BOATS & CAPTAIN SUPPORT

There are several vessels and certified boating captains that can be made available.

Photo by Patrician Price

4 TRAIL VEHICLES

The reserve has over 15 miles of trails on the Guana Peninsula that transect several habitats. Trail vehicles can be made available.

5 HOUSING & FACILITIES

Accommodations are available at the Princess Place Preserve. There is also facility space for meetings, including an auditorium, classroom and lab space.

6 OUTREACH & K-16 EDUCATION

Regular programming is available for K-16 classes that visit the reserve. There also are opportunities for reserve staff and volunteers to participate in festivals, programs and outreach events throughout the community.

7 COMMUNITY ENGAGEMENT

The reserve engages with the Northeast Florida community though public events, professional training and collaboration, quarterly newsletters, social media, the Friends of the GTM Reserve and our over 250 volunteers.

8 INTERAGENCY COLLABORATION

There are many opportunities to work with other organizations through the Management Advisory Group (MAG), Technical Advisory Group (TAG), the Friends of GTM Reserve and other professional workgroups.

9 PROFESSIONAL DEVELOPMENT

The reserve provides opportunities to all staff, interns, volunteers and visiting investigators for professional training as requested.

CONNECTION

Stay connected with collaboration opportunities through the *Coastal Connect* newsletter and by visiting researcher coffee chats. Make your connection by clicking the QR code beside this message and filling out the form.

For more information, please contact GTM Research Reserve Research Coordinator Dr. Nikki Dix at Nikki.Dix@FloridaDEP.gov.

ACKNOWLEDGEMENTS

Along with GTM Research Reserve staff, the following groups aided in providing information, education and recreation to the public and stakeholders.

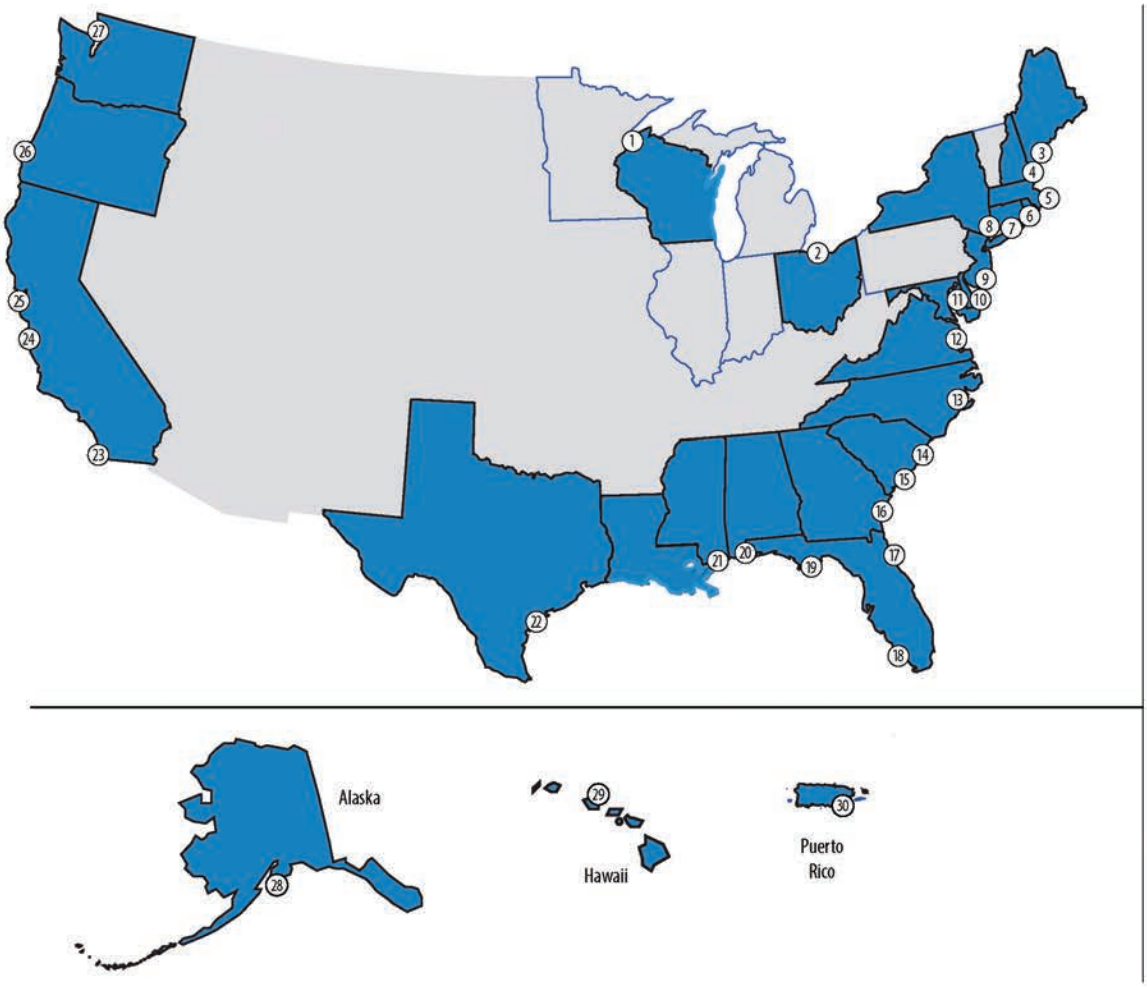
The GTM Research Reserve Management Advisory Group is composed of representatives from agencies affiliated with the reserve, landowners within the reserve and members of the public. The group meets quarterly to advise, report and review activities within the reserve. The current management advisory group members and their affiliations are:

Commissioner Barbara Blonder, City of St. Augustine
The Honorable Carl Blow, Florida Inland Navigation District
Wade Brenner and Tessa Ricker, Florida Fish and Wildlife Conservation Commission
Commissioner Matt Brown, St. Augustine Port, Waterway and Beach District
Steve Brown, Ph.D., Flagler County Citizen Appointee
Jeffrey Darr, Florida Forest Service
Commissioner Henry Dean and Ashley Raybould,
St. Johns County Board of County Commissioners
Chris Farrell, St. Johns County Citizen Appointee
Commissioner Greg Hansen, Flagler County Board of County Commissioners
Scott Johns and Heather Rohrer, Florida Department of Transportation
Carolyn Kovacs, Florida Sea Grant
Kelly Rankin Legault, Ph.D., and Darren Pecora, U.S. Army Corps of Engineers
Jen Lomberk, St. Johns County Citizen Appointee
Todd Osborne, Ph.D., Flagler County Citizen Appointee
Renee Paolini, Florida Department of Environmental Protection, Division of Recreation and Parks
Eric Smith, Ph.D., St. Johns County Citizen Appointee
Kelly Smith, Ph.D., Duval County Citizen Appointee
Steve Swann, Duval County Citizen Appointee
Frank Usina, St. Johns County Citizen Appointee
DaleAnn Viger, Friends of the GTM Reserve
Gordon Wilson and Kurt Foote, National Park Service
Eric Ziecheck, St. Johns County Citizen Appointee

The Friends of GTM Reserve is a nonprofit citizen support organization established to support and enhance environmental education, stewardship of natural and coastal resources, and scientific research of GTM Research Reserve through volunteer initiatives, public involvement and community partnership. The current board members are:

Steve Swann, President
Yash Deo, Vice President
Robert Steele, Treasurer
Peter Bailet
Bill Feeney
Mary Finnan
Undine George
Stephanie Hezel
Linda Krepp
Joanne Masingill
Chuck Snavely
Tatum Theodore
Mark Wood
DaleAnn Viger, Executive Director
Jessica Cantin, Administrative Assistant

NATIONAL ESTUARINE RESEARCH RESERVES



Great Lakes
1. Lake Superior, Wisconsin
2. Old Woman Creek, Ohio

Northeast
3. Wells, Maine
4. Great Bay, New Hampshire
5. Waquoit Bay, Massachusetts
6. Narragansett Bay, Rhode Island
7. Connecticut

Mid-Atlantic
8. Hudson River, New York
9. Jacques Cousteau, New Jersey
10. Delaware
11. Chesapeake Bay, Maryland
12. Chesapeake Bay, Virginia

Southeast
13. North Carolina
14. North Inlet-Winyah Bay, South Carolina
15. ACE Basin, South Carolina
16. Sapelo Island, Georgia
17. Guana Tolomato Matanzas, Florida

Gulf of Mexico
18. Rookery Bay, Florida
19. Apalachicola, Florida
20. Weeks Bay, Alabama
21. Grand Bay, Mississippi
22. Mission-Aransas, Texas

West
23. Tijuana River, California
24. Elkhorn Slough, California
25. San Francisco Bay, California
26. South Slough, Oregon
27. Padilla Bay, Washington
28. Kachemak Bay, Alaska

Pacific
29. He'eia, Hawai'i

Caribbean
30. Jobos Bay, Puerto Rico

PROPOSED
Bay of Green Bay, Wisconsin
Atchafalaya, Louisiana

The National Estuarine Research Reserve System is a network of 30 coastal sites designated to protect and study estuarine systems. Established through the Coastal Zone Management Act, the reserves represent a partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. NOAA provides funding and national guidance, with each site managed daily by a lead state agency or university with input from local partners.

The nationwide network of research reserves covers more than 1.3 million acres of estuaries that are focused on the following:

- **Stewardship** – Each site undertakes the initiatives needed for estuary health.
- **Research** – Reserve-based research and monitoring data are used to aid conservation and management efforts on local and national levels.
- **Collaboration** – Local and state officials are better equipped to introduce local data into the decision-making process as a result of reserve training efforts.
- **Education** – Thousands of children and adults are served through hands-on laboratory and field-based experiences. School curriculums are provided online.

Visit Coast.NOAA.gov/NERRS to learn more.