

# STATE OF THE RESERVE

## GUANA TOLOMATO MATANZAS NATIONAL ESTUARINE RESEARCH RESERVE

PRESENTATIONS & PROGRAM SUMMARY  
FEBRUARY 23, 2018



THE GTM RESEARCH RESERVE IS COMPRISED OF A NETWORK OF PUBLIC LANDS MANAGED BY THE RESEARCH RESERVE, FLORIDA FISH & WILDLIFE CONSERVATION COMMISSION, FLAGLER COUNTY, ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, FLORIDA STATE PARKS, THE FLORIDA FOREST SERVICE, AND THE NATIONAL PARK SERVICE. THE MAP TO THE LEFT ILLUSTRATES MANAGED AREAS THAT FALL WITHIN THE RESERVE BOUNDARIES AND THE WATERSHED AREA.

FOR MORE INFORMATION, CONTACT THE  
GTM RESEARCH RESERVE ENVIRONMENTAL EDUCATION CENTER

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## TABLE OF CONTENTS

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A LETTER FROM THE DIRECTOR, <i>MICHAEL SHIRLEY, PH.D., GTM NERR</i> .....	3
FEATURED PROJECTS OF 2017, <i>PRESENTED AT THE 2018 SCIENCE SYMPOSIUM</i> .....	4
ADDITIONAL RESEARCH AT THE GTM NERR, <i>PRESENTED AT THE 2018 POSTER RECEPTION</i> .....	14
THE GTM NERR: POST- IRMA.....	18
THE GUANA ECOSYSTEM: A SHORT HISTORY AND RESULTS FROM AN ONGOING WATER QUALITY STUDY .....	20
OYSTER MONITORING REPORT 2014-2016.....	22
PRESCRIBED BURN TECHNIQUES OF THE GTM NERR .....	24
EDUCATION AND INTERPRETATION ARE FLUID, JUST LIKE OUR TIDES.....	26
UNIVERSITY OF NORTH FLORIDA’S COASTAL AND MARINE BIOLOGY FLAGSHIP PROGRAM.....	28
A YEAR OF THE NERRDS.....	30
CROSSWORD AND NOTES.....	32
GTM NERR BY THE NUMBERS 2017.....	34
FRIENDS OF THE GTM RESERVE.....	35
ACKNOWLEDGEMENTS.....	36

**Special thanks to our featured cover artists from Hickory Creek Elementary School who participated in the “Spreading Seeds of Estuary Health” grant, which is highlighted on page 11.**

**State of the Reserve 2018 Coordinators**

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**Program Editor** Patrician Price, Public Information Specialist II

**Front Cover Artwork** Shannon Dunnigan, SWMP Manager, and Kenneth Rainer, Education Coordinator

**Program Printing** Foxtrot Creative Studio

*Special thanks to our planning committee Nikki Dix, Ph.D., Shannon Dunnigan, Brooke Ellis, Patrician Price, Ellen Leroy-Reed, and Lia Sansom*

The scientific method ensures that our understanding of the world around us is ever changing and improving. Every discovery builds on past knowledge. The challenge for modern society is how and when to use this ever-changing knowledge to drive science-based decision making. This year's theme, "The Art of Science," explores this topic and invites the audience to be active participants in this important quest. The more variable the dataset, the more time it takes to reach a solid conclusion. Waiting too long to react also has its consequences.

Central to the designation of a Research Reserve is the establishment of baseline datasets. Several of the presentations given at this workshop will highlight projects and studies that track changes over time. Research and monitoring conducted by Reserve staff, volunteers and visiting scientists from all over the world are informing management decisions to improve harvest of oysters, protecting water quality, and restoring habitats. This research is also helping us learn how nature responds to disturbances such as hurricanes. Our long term monitoring network programs, such as the System-Wide Monitoring Program, allows us to assess the impacts of coastal storms and begin to develop baseline information to understand future storm events. As each storm has a unique impact on water quality or coastal habitats, understanding and predicting impacts is difficult.

The transition of saltmarshes to mangrove habitats presents many opportunities for research. Scientists from many institutions have been examining these ecotones within the GTM NERR. Researchers from the Smithsonian Environmental Research Center provide a global and historical perspective on these changes. University of Georgia researchers are examining the specific interactions between these two important habitats during this transition.

Our ability to collect even more water quality information presents both challenges and opportunities. University of Florida scientists are exploring techniques to summarize this myriad of information into water quality indicators to make it



easy for us all to understand potential impacts of future land-use decisions.

Citizen-science projects continue to play an important role in helping us to understand changes in the natural environment. An effort led by University of Florida's Whitney Laboratory for Marine Bioscience has recruited coastal property owners as "Oyster Gardeners." The information collected by this project helps to expand our understanding of the ecology of the region's oyster communities.

Thanks for attending the State of the Reserve. Continuing and enhancing existing projects, and initiating new projects, are only possible with the generous support and hard work of many dedicated community leaders, volunteers, scientists and educators. Special thanks this year goes to the University of North Florida's Coastal and Marine Biology Flagship Program for co-sponsoring this event, along with the Friends of the GTM Reserve.

Sincerely,

A handwritten signature in black ink that reads "Michael A. Shirley". The signature is written in a cursive, flowing style.

Michael Shirley, Ph.D.  
Director, GTM Research Reserve



## FEATURED PROJECTS OF 2017

*These projects were presented as featured projects of 2017 at the 2018 State of the Reserve.*

### UTILIZING LONG-TERM DATA SETS TO EVALUATE LOCAL STORM IMPACTS TO THE GTM NERR ESTUARY



Hurricanes Matthew (2016) and Irma (2017) had major impacts on our community. Together with nor'easters, the tropical cyclones caused extensive flooding and coastal erosion in St. Johns County. Here, we seek to better understand how major coastal storms can impact both the estuarine environment and local communities by integrating standardized, high quality meteorological, water quality, and emergent vegetation monitoring datasets from the National Estuarine Research

Reserve's System-Wide Monitoring Program (SWMP). The effects of Hurricanes Matthew and Irma were investigated using data from the GTM NERR weather station and comparing pre- and post-storm data on water quality and local marsh communities. No two storms have the same effect on water quality or coastal habitats, making storm impacts difficult to predict. However, long-term monitoring networks, like SWMP, provide opportunities to assess the spatiotemporal effects of coastal storms within relevant time frames and serve as a baseline to examine storm events across years.



**PRESENTERS:** Shannon Dunnigan, SWMP Manager, and Pam Marcum, Biologist



**Shannon Dunnigan** (left) is the SWMP manager at the GTM NERR. She attended Florida State University for her B.S. degree and the University of North Florida for her M.S. Her background lies within studying the ecology of fishes, particularly how habitat setting affects their abundance, distribution, and behavior. In graduate school she studied the habitat value of an artificial intertidal oyster reef constructed within the GTM NERR on juvenile fish and benthic macroinvertebrate assemblages.



**Pam Marcum** (right) is the lead biologist at the GTM NERR. She attended Arizona State University for her B.S. degree and Nova Southeastern University for her M.S. She has worked as a field biologist in several of Florida's coastal estuarine systems. In South Florida she collected, identified, and measured fish and invertebrate specimens for a long-term monitoring project, in addition to conducting vegetation surveys of seagrass beds.

**Co-authors:** Silas Tanner and Nikki Dix, Ph.D., GTM Research Reserve

## A TALE OF TWO HURRICANES: HERITAGE MONITORING SCOUTS EFFORTS AT THE GTM NERR

Heritage Monitoring Scouts (HMS Florida) is a statewide citizen science program aimed at monitoring heritage that is at risk. Climate change impacts and coastal dynamics are affecting thousands of cultural resources across Florida. Continuous monitoring of these sites has proven the best strategy to record changes, learn more about sites themselves and aid in management decisions.



In 2016, the Florida Public Archaeology Network (FPAN)

partnered with the GTM NERR for a pilot program focused on training volunteers while monitoring sites on the Guana Peninsula. After the first year, FPAN has trained 30 people through four workshops and have monitored three sites.

Through the training programs and monitoring efforts, FPAN staff and volunteers

has tracked the impacts of two hurricanes and routine natural processes over the past year on sites at the Reserve. Documenting the changes at the sites has allowed better understanding of regional impacts on archaeological sites, as well as gathered additional information about the sites themselves. Most notably, the program has been used to document extensive shoreline loss at Shell Bluff Landing (8SJ32). In fact, the site has become one of the flagship case studies for HMS Florida.



Monitoring efforts at Shell Bluff Landing and of the Minorcan Well



HMS Training at Shell Bluff Landing

**PRESENTER:** Emily Jane Murray, public archaeology coordinator, Florida Public Archaeology Network

*Emily Jane Murray earned an M.A. in anthropology from Brandeis University where she focused on public archaeology and site museums in northeast Florida, and a B.A. in communications from Flagler College. She has worked as an archaeological consultant throughout the southeastern United States and created numerous outreach tools including videos, activities and museum displays. She currently works as a public archaeology coordinator for the Florida Public Archaeology Network Northeast Region and serves on the boards of the St. Augustine Archaeological Association and the Florida Anthropological Society. Her interests include Florida's prehistoric archaeology, historic cemeteries and public archaeology and interpretation.*

**Co-author:** Sarah E. Miller, Florida Public Archaeology Network

**Project Assistants:** HMS Florida volunteers



## MANGROVES AND CLIMATE CHANGE:

### LEVERAGING HISTORY TO UNDERSTAND THE PRESENT AND TO PREDICT THE FUTURE



Climate change is causing a poleward shift in the distribution, phenology, and abundance of many species and ecosystems around the world. Temperate and tropical plants and animals are migrating poleward in response to global warming, displacing native species, altering biodiversity patterns, and modifying ecosystem structure and function. The Smithsonian Institution has been studying the consequences of climate change for coastal wetlands at the transition between temperate and tropical zones. The goal is to investigate the current and future climate-driven displacement of temperate salt marshes by tropical

and subtropical mangroves. However, it is difficult to predict the future if the past is unknown. To understand changes that have occurred in the mangrove-saltmarsh landscape along the coast of Florida over the past ~two centuries, the Smithsonian Institution has analyzed the following resources: 1) Landsat images between 1984 and 2011; 2) historical aerial photography and satellite imagery between 1942 and 2014; 3) and historical accounts dating back to 1765. Historical records coupled with the recent data show that mangrove range shifts are happening now and have also happened in the past. Long-term patterns indicate that these shifts are neither gradual nor monotonic. Rather, the range edge is both advancing and contracting in response to climatic conditions and disturbance events, which result in periodic regime shifts in the dominant foundation species.



**PRESENTER:** Ilka C. Feller, senior scientist, mangrove ecologist, Smithsonian Institution



*Ilka Feller, Ph.D. is an ecologist at the Smithsonian Environmental Research Center, which conducts research and education on linked ecosystems of the coastal zone around the world. She has a B.A. in biology from the University of North Carolina at Greensboro and a Ph.D. in biology from Georgetown University in Washington, DC. Her research is focused on the biology of animal-plant interactions in mangrove ecosystems. Candy has established a coordinated distributed network of 25 long-term fertilization experiments along latitudinal gradients around the world to investigate the interaction of nutrient over-enrichment and climate change on the structure and function of mangrove ecosystems. She has published more than 100 scientific papers and has been project leader on multidisciplinary research programs focused on understanding the biocomplexity of mangrove ecosystems. She is currently the PI on an NSF Macrosystems Biology and NASA Climate Change grant. She is an adjunct*

*professor at Florida Atlantic University and has advised eleven postdoctoral fellows, ten masters, twelve doctoral students, and ten undergraduates for their senior thesis projects.*

**Co-authors:** Emily Dangremond, Todd Osborne, Ph.D., Lorae Simpson, John Parker, and Kyle Cavanaugh

## MANGROVE EXPANSION IN THE GTM NERR: HOW DOES SALTMARSH WRACK AFFECT MANGROVE PROPAGULE ESTABLISHMENT AND DEVELOPMENT?

Tropical mangrove species are expanding into temperate saltmarshes worldwide, representing a global, climate-driven transition. Along the north Florida coast, black mangrove *Avicennia germanins* is rapidly moving into saltmarshes, and the northern range limit of this species is located within the Guana-Tolomato-Matanzas (GTM) estuary. The rate of mangrove expansion is influenced by interactions with both live standing *Spartina* and with substantial subsidies of dead *Spartina*



Mangrove propagule within dead saltmarsh wrack line



Mangrove establishment along saltmarsh wrack

wrack. On high tides, extensive mats of *Spartina* wrack are stranded in coastal wetlands, and wrack presence frequently coincides with the stranding of hydrochorous mangrove propagules. The interest of this project was in how the co-occurrence of wrack and mangrove propagules affect propagule establishment and survival in the field. To examine effects of wrack on mangrove propagule development, field experiments were performed in the GTM estuary near Crescent Beach, Florida. Here, mangrove propagules were planted at paired saltmarsh only and mixed saltmarsh-mangrove habitats into the following treatments: saltmarsh, saltmarsh with wrack, and in bare plots (trimmed saltmarsh). Propagules were measured for survival and growth, as well as changes in vegetation stem density in the plots over the course of nine months. Wrack facilitated propagule establishment by trapping and stabilizing propagules, but over the long term, propagules in the wrack treatment showed stunted growth and development. Wrack can facilitate initial propagule establishment but can hinder propagule growth and survival over longer time periods.

**PRESENTER:** Rachel Smith, Ph.D. candidate, University of Georgia  
*Rachel Smith is a Ph.D. candidate at the University of Georgia. Here, her dissertation research is focused on understanding how biotic interactions influence mangrove expansion into saltmarshes. Prior to graduate school, she graduated with a degree in biology from Northwestern University in Illinois. She also worked as a research technician studying fouling community development in Australia, and expansion of invasive seaweeds and crabs on the Georgia coast. As she gets closer to finishing her dissertation, she is excited to present on her work that has been done right here in the GTM NERR.*

**Co-authors:** Julie A. Blaze, Todd Osborne, Ph.D., and James E. Byers



## MAPPING LAND USE CHARACTERISTICS AND WATER QUALITY IMPACTS TO SUPPORT POLICY AND DECISION MAKING



For agencies at all levels of government, developing policy that both supports development and protects the natural environment is a challenging process. A big part of that challenge is accessing and understanding the vast wealth of information that is available. In Florida, available sources of information include the EPA Storet database, Florida Department of Environmental Protection (FDEP) Storet database, Florida Department of Revenue (FDOR), county property appraiser data, water management district data, Florida Fish and Wildlife Conservation Commission (FWC), Florida Department of Agriculture and Consumer Services

(FDACS), and the United States Geological Society (USGS), just to name a few. The time and labor required by staff to review and process this information is intensive. Agencies are additionally tasked with distilling these sources of information into one easy to use and readily understandable resource that can inform policy makers, development review staff, environmental management agencies, the public and other stakeholders. This project focuses on development of a resource to assist GTM NERR personnel and related stakeholders with understanding the status of the Reserve's natural resources and to identify those which are stable or those facing challenges. This project was driven by a similar project that assessed three specific creek sheds and has been expanded to encompass the whole of the GTM NERR. The project provides a central point of access for several different views of land development and the results of water quality tests conducted by multiple agencies within Reserve boundaries. Aggregating all this information into a single platform that provides easy visualization of the status of area development along with key water quality indicators makes it easy for Reserve staff to prioritize projects, public officials to understand potential development impacts, and municipal staff to develop environmental policies that are built upon a robust base of information.

**PRESENTER:** Tricia Kyzar, data analyst and Ph.D. candidate, University of Florida



*Tricia Kyzar is currently a data analyst with the Program for Resource Efficient Communities, an IFAS program with the University of Florida. Her work focuses on GIS and statistical analysis of water and energy consumption and conservation for utility companies and local municipalities. In this role, she applies spatial analysis to utility resource consumption data to establish comparable consumption baselines for properties with similar building characteristics. Her work also includes analysis to evaluate the effectiveness of conservation programs. Utilities and municipalities use these analyses to help high resource users to reduce consumption, and to improve conservation program offerings.*

*Kyzar is also a Ph.D. candidate at the University of Florida, Department of Urban and Regional Planning. Her research centers around the impact of urban development on water quality. Using spatial analysis technologies, she quantifies the relationship between different land use forms and key water quality indicators. Analysis results are used to inform local and regional planning policies and assist in urban development design review to reduce development impacts to the aquatic environment.*

**Co-author:** Eban Bean, Ph.D., University of Florida

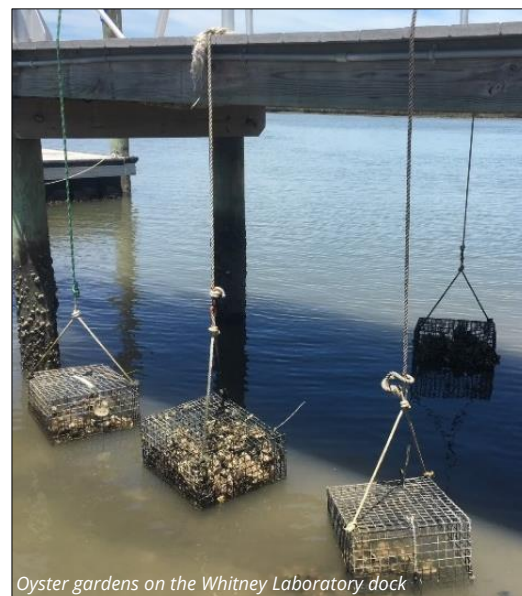


## OYSTER GARDENING IN NORTHEAST FLORIDA: A COMMUNITY-BASED PROGRAM THAT ENGAGES CITIZEN SCIENTISTS, ADVANCES OUR UNDERSTANDING OF OYSTER ECOLOGY, AND RESTORES OYSTER HABITATS

As ecosystem engineers, oysters play critical roles in estuarine systems by improving water quality, shoreline protection and habitat for a vast number of aquatic organisms. Unfortunately, multiple stressors increasingly threaten oysters in our estuaries. These stressors include water quality degradation, disease, predation, reduction of suitable substrate for colonization, and disturbance from boat wakes. Recognizing the need to protect and restore oyster habitats and to increase community awareness of their role and importance, the Whitney Laboratory initiated a community-based, citizen scientist oyster gardening program in St. Johns and Flagler counties. This oyster gardening program engaged local citizens in environmental restoration by growing oysters at their docks for use in regional restoration efforts.

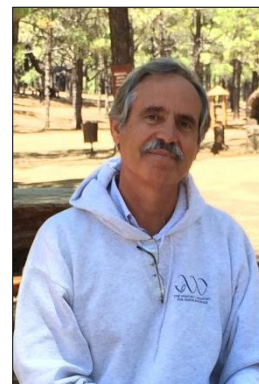


In the summer and fall of 2016, Whitney Laboratory recruited and trained over 60 oyster gardeners with access to docks connecting to the Intracoastal Waterway from Vilano Beach (St. Johns County) to Flagler Beach (Flagler County). Each gardener was provided two oyster habitats (cages), an oyster gardening manual, basic water quality monitoring equipment and recycled oyster shells covered with live spat (baby oysters < 25 mm). They also had access to an online field guide developed by the Whitney Lab for the identification of oyster reef associated biota.



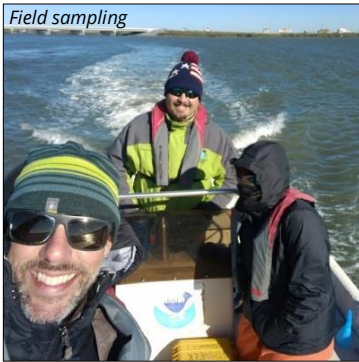
Oysters habitats were retrieved from the gardeners after 8 to 9 months of growth. Morphometric, recruitment and growth rate data were collected with the help of community volunteers, and the data were analyzed along with their corresponding water quality results. Results showed that recruitment and growth rates of oysters were clustered and spatially variable. During the program's first year, oyster gardeners succeeded in raising many oysters for use in restoration projects, and in generating valuable information that enhances our understanding of the ecology of the region's oyster communities.

**PRESENTER:** José Núñez, research scientist, Whitney Laboratory for Marine Bioscience  
*José Núñez has a B.S. in biology from the Universidad Central de Venezuela, Caracas and a M.S. in ecology from the University of California, Davis. Since 1994, he has been a researcher at University of Florida's Whitney Laboratory for Marine Bioscience, with a 3-year appointment as the Flagler County School District STEM/service-learning coordinator. Prior to that, José was a researcher at the Hawaii Institute of Marine Biology, University of Hawaii, and at the University of California, Davis. His research fields to date include aquatic ecology, aquatic toxicology and cancer research (using fish as models), and aquaculture and developmental biology of fresh and saltwater fish, shrimps and bivalves. For 13 years José volunteered with the Flagler County Legacy Program at the Princess Place Preserve, for which he developed a high school salt marsh curriculum. From 2000-2008, he was a Florida Master Naturalist instructor. Currently, he is a part of Dr. Todd Osborne's lab at the Whitney Lab, where he heads the Oyster Restoration and the Matanzas River Basin Biodiversity initiatives and manages the bivalve hatchery.*



**Co-authors:** Trish Reonas and Todd Osborne, Ph.D., Whitney Laboratory for Marine Bioscience, University of Florida

## AN INVESTIGATION OF WATER QUALITY ASSOCIATED WITH THE SUMMERHAVEN RIVER DREDGING AND RESTORATION PROJECT



Prior to 2008, the Summerhaven River historically flowed to the east of State Road A1A south of Matanzas Inlet and east of the main Intracoastal Waterway in St. Johns County. A series of tropical storms and hurricanes, beginning in 2008, breached the dune line adjacent to the Summerhaven River and over time the Summerhaven River flow stopped as the river continued to fill in with sand.

In Spring 2016, the State of Florida approved \$2.8M in funding to dredge the Summerhaven River with the proposed goals of re-establishing the river flow, restoring navigation, and restoring oyster and clam habitat. The dredging and restoration project began in January 2017 and as of late September 2017 the Summerhaven River was opened

and flowing once again. The primary objective of this research was to establish a water quality sampling program at six sites within the Summerhaven dredging project to monitor potential changes in water quality parameters as the Summerhaven River dredging and restoration project was initiated and moved forward.

As part of a funded, collaborative research effort between the GTM NERR, the University of Florida, and Flagler College, a bimonthly sampling program was initiated in November 2016, two months prior to the start of the dredging and restoration project. To date, samples have been collected twice each month for over a year for the determination of chlorophyll-*a*, major nutrients, turbidity, total suspended solids, and basic hydrographic parameters. This water sampling effort has captured pre-dredging (closed river), during dredging, and post-dredging (open river) conditions. While sampling will continue through August 2018, results will be presented and discussed that highlight the potential impacts of dredging and sediment removal on phytoplankton biomass and water quality in the region.



**PRESENTER:** Matthew Brown, *Ph.D.*, associate professor, Department of Natural Sciences, Flagler College  
*Preceded by an undergraduate B.S. degree in chemistry (Old Dominion University), Dr. Matthew Brown completed an M.S. (oceanography) at the University of Hawaii and a Ph.D. (ocean sciences-marine chemistry) at University of California, Santa Cruz. Prior to beginning his doctoral work, Dr. Brown worked for two years as an oceanographic research specialist where he took part in several major oceanographic cruises related to the US CLIVAR repeat hydrography program. To date, Dr. Brown has spent over 300 days at sea, performing shipboard analysis of both macronutrients and dissolved trace metals. Dr. Brown arrived at Flagler College in 2011 and is now in his seventh year in the Natural Sciences Department. There, with the help of undergraduate students, he finds purpose in continuing research in the fields of water quality and marine chemistry, particularly in the areas of nutrient chemistry and phytoplankton dynamics. His research helps provide students with an education in marine science, environmental science, and global climate change. Outside of work, Dr. Brown enjoys spending time with his wife and daughter, surfing, swimming, fishing, and coffee.*



**Co-authors:** Alicia Castle, Flagler College; Nikki Dix, *Ph.D.*, GTM NERR; Todd Osborne, *Ph.D.*, University of Florida; and Joel Steward, Dredging and Marine Consultants, LLC

**Project Assistants:** Amanda Aydlett, Christopher Byrd, Trinity Hopkins, Breona Green, and Alexis Morris, Flagler College

## SPREADING THE SEEDS OF ESTUARY HEALTH

Salt marshes and tidal creeks maintain healthy water, protect coastal communities from flooding and erosion, provide nursery and essential habitat for commercial and recreational fisheries, and support recreational activities that are a part of the coastal lifestyle. This project educated K-12 students on the importance of restoring these ecosystems, using approaches that also meet current science curriculum standards.

The Guana Tolomato Matanzas, ACE Basin, North Inlet, North Carolina, and Sapelo Island reserves have created a region-wide student-driven program for teachers that furthered the understanding of restoring degraded or lost estuary habitats. The project built upon the successes of previous efforts to teach the importance of the salt marsh habitat through cultivating and transplanting smooth cordgrass, *Spartina alterniflora*, the dominant plant in this region's salt marshes. The project team transferred information on successful growing techniques for smooth cordgrass among the southeast region reserves. Using existing data on smooth cordgrass cultivation and experiences from past and current efforts, reserve



Students constructing hydroponic systems



Students at participating elementary school

staff, in partnership with the Sea Grant Consortium, created an online, interactive resource center with a topic-based elementary-targeted curriculum. Teachers have been trained to use these products through four professional development opportunities, one in each of the southeastern states. Ultimately, this will increase the community of practice among participating schools and teachers, increase the use of standards-based curriculum, increase plant growth success, and increase the project's overall long-term success.

**PRESENTER:** Kenneth Rainer, M.S., GTM Research Reserve

*Kenneth has an M.S. in biology from Texas A&M University at Corpus Christi, Texas, with a focus in marine population genetics, and a B.S. in biology from Texas A&M University at Galveston, Texas, with a focus in marine biology. He is currently working on his Ph.D. in environmental education from University of Florida. Rainer is interested in teacher professional development for inservice and preservice educators in context of experiential environmental education and the utilization of asynchronous learning techniques. Most specifically, he is interested in examining self-efficacy and confidence in teaching environmentally-based scientific concepts. Since September 2011 Kenneth has worked diligently and enthusiastically as the GTM Research Reserve's education coordinator.*



**Co-authors:** Julie Binz, ACE Basin NERR; Beth Thomas, North Inlet-Winyah Bay NERR; Lori Davis, North Carolina NERR; Adam Mackinnon, Sapelo Island NERR; and EV Bell, South Carolina Sea Grant Consortium

## SHARKS OF THE GTM NERR: RESULTS FROM 8 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. Due to this, it is important to characterize shark habitat use in suspected “shark nurseries” so that these habitats and the benefits that they provide to overall shark populations can be protected.

As part of a larger, long-term study on shark population trends in northeast Florida and southeast Georgia, the University of North Florida’s Shark Biology Program has examined shark habitat use in the Tolomato River, a component of the GTM NERR, since 2010 using bottom longline fishing. The results of our now 8-year survey indicate that a minimum of 11 shark species inhabit waters of the GTM NERR, 3 of which comprise >80% of catch: The Scalloped Hammerhead (*Sphyrna lewini*), the Atlantic sharpnose shark (*Rhizoprionodon terranovae*), and the Blacktip shark (*Carcharhinus limbatus*). Over 95% of individuals captured in the Tolomato River were neonates, illustrating the importance of this site as a juvenile refuge. The identification of this site as a nursery for neonate scalloped hammerheads, in particular, is a novel finding, as 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 NERR is seasonal, with abundance peaking in summer months. Abundance declined significantly between 2010 to 2011, but has remained comparatively stable over the past 7 years. Interannual variations in shark abundance appear to be largely driven by changes in salinity, which in turn reflect annual changes in precipitation.

**PRESENTER:** Jim Gelsleichter, Ph.D., associate professor of biology; director, UNF Coastal and Marine Biology Flagship Program, University of North Florida



*Dr. Gelsleichter joined the University of North Florida faculty as an assistant professor of biology in August 2008, and was promoted to associate professor in Fall 2014. He is also current director of UNF’s Coastal and Marine Biology Flagship Program, one of the University’s most prestigious academic programs. He teaches introductory-level and advanced courses in topics such as general biology, endocrinology, environmental toxicology, and shark biology to UNF undergraduates and graduate students. Since his arrival in 2008, Jim has managed the UNF Shark Biology Program, a highly active and well-funded research program focusing on the biology and ecology of sharks and rays with special emphasis on shark populations in northeast Florida. The UNF Shark Biology Program has been monitoring the species composition and abundance of sharks off the northeast Florida and southeast Georgia coasts for the past 10 years, providing data critical for the management and conservation of these*

*important marine animals. The program is also well known for its highly publicized work on the development and use of nonlethal approaches for studying reproduction in sharks and rays, including the endangered smalltooth sawfish, and its studies on the effects of environmental pollution on shark populations, including those impacted by the 2010 Deepwater Horizon Oil Spill. Jim completed his doctorate at the College of William and Mary’s School of Marine Science, working on the Virginia Institute of Marine Science’s Shark Survey, the longest-running fishery-independent study of shark populations in the world. After receiving his degree, he was also employed as a shark biologist for 10 years at the Mote Marine Laboratory, an independent non-profit marine research institution well-known for its long history of conducting shark research.*

## HOW OYSTERMEN AND FISHERMEN USE AND THINK ABOUT OYSTERS IN THE ST. AUGUSTINE REGION OF FLORIDA

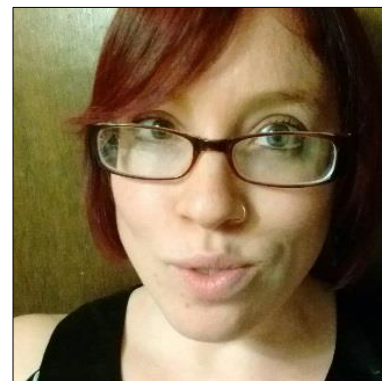
Oysters provide a multitude of services that can be tied to human well-being including direct shellfish harvest and the support of healthy local populations of finfish. However, data regarding provision of harvest within Florida can be limited and low-resolution in quality. Management decisions in support of maintaining or improving oyster harvest and fishing opportunities can benefit from additional information regarding stakeholder behaviors, perceptions, and values.

The goal of this research was to examine how recreational and commercial oystermen and fishermen targeting finfish near oyster beds use and think about oysters within the St. Augustine area. Participants were identified by snowball sampling and engaged in one-on-one semi-structured interviews. They answered a series of questions designed to elicit information about what makes a desirable oyster bed; how beds in the region are used temporally and spatially; how use has changed over time and perceived barriers to access; and what benefits oysters have beyond harvest.



**PRESENTER:** Carrie Schuman, Ph.D. candidate, School of Natural Resources and Environment, University of Florida  
*Carrie hales from New England and is in the process of completing her Ph.D. in interdisciplinary ecology. Her prior degrees are in marine and freshwater biology (B.S., University of New Hampshire) and marine science and technology (M.S., University of Massachusetts, Boston). Her interests range from natural resource management to policy to education, outreach, and science communication. In Carrie's free time, some of her creative pursuits include blogging ([www.themeanderingscientist.com](http://www.themeanderingscientist.com)), music, and photography.*

**Co-author:** Shirley Baker, Fisheries and Aquatic Sciences, University of Florida



## ADDITIONAL RESEARCH AT THE GTM NERR IN 2017

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*These projects were presented as posters at the 2018 State of the Reserve.*

### **An Investigation of Gopher Tortoise Burrow Characteristic Preferences at the GTM NERR**

The GTM NERR coastal strand habitat has a high density of gopher tortoises. This project focused on the gopher tortoise, *Gopherus Polyphemus*, and its potential burrow preferences based on measurable physical parameters. The three measured characteristics were height of burrow, orientation of burrow, and location of burrow relative to a blowout section of dune. There are multiple working hypotheses: 1) *G. polyphemus* prefers burrows that are located at greater heights on the dunes; 2) *G. polyphemus* prefers burrows facing east due to exposure to sunlight; and 3) *G. polyphemus* prefers burrows that are located in a blowout because there is less vegetation and more open sand for burrowing. There is very little literature pertaining to the question of burrow characteristic preferences of *G. polyphemus*.

**Cody Burns, Mallory Hopkins**, Barbara Blonder, Danielle Cayouette, Scott Rowan, and John Cepeda, *Flagler College*

### **Do Hardened Structures on Vilano Beach Affect Erosion Rates on Adjacent Properties?**

Following Hurricane Matthew, October 2016, many Vilano Beach residents responded to the damage caused by placing hardened structures, such as seawalls, on the beach side of their homes with hopes that hardened structures would reduce damage caused by future storms. This project hypothesized increased erosion of adjacent, non-hardened properties because of severe weather events. Beach profiling measured the change in elevation and assessment of erosion using the Emery method near hardened structures. Measurements were performed at the middle and the leeward side of each hardened structure to identify how the placement of these structures behind residences could directly affect the amount of sand deposited and eroded. Additionally, ArcGIS was used to measure changes in dune erosion.

**Colin Herbert, Trinity Hopkins**, Aubrey Kemer, Sydney Hayes, Jessica Veenstra, Ph.D., Barbara Blonder, and Adebykola Adeyemi, Ph.D., *Flagler College*

### **Dune Blowout Morphology: A Time Series**

Longshore currents, active tidal zones, and wind work in cohesion to deposit sediment, which over time has formed a dynamic, linear dune system and coastal strand ecosystem on a variably thin strip of land parallel to the ocean at the GTM NERR. Development of roads, paths, and other structures reduces the stability of dunes, leading to the formation of dune blowouts, sandy depressions void of vegetation. This project hypothesizes that dune blowout size will increase following disturbance events. Two components of this study were: 1) an analysis of historic and current aerial imagery tracking changes in shape, size, and recovery of blowouts and 2) an exploratory in-situ salt deposition experiment to determine whether patterns of salt deposition within blowouts impact plant successional patterns in dune recovery.

**Tristen Utic, Mac Byram, Madison Hess**, and Barbara Blonder, *Flagler College*

### **Estimating Food Habits of a Coastal Population of Gopher Tortoises in the GTM NERR**

The coastal strand ecosystem in northeast Florida is home to a variety of species including the threatened keystone species gopher tortoise, *Gopherus polyphemus*. There is little information on gopher tortoise dietary preferences for inland populations, and even less for coastal populations. Gopher tortoise fecal samples were collected from the coastal strand foredune in the northern segment of the GTM NERR to determine their diet. Analysis of fecal matter was conducted with plant expert assistance and identification guides. Once identified, the mass of each vegetative family was used to determine the relative importance of specific vegetative groups in their diet. The significance of understanding the diet of *G. polyphemus* can aid in future conservation efforts.

**Rosemary Rice**, Amanda Aydlett, Kerry Smetana, Lee Newsom, Ph.D., Barbara Blonder, and Carrie Grant, Ph.D., *Flagler College*

### **Geotechnical Aspects of Re-Engineered Estuarine Shorelines in Response to High Energy Waves**

A current study investigating techniques to mitigate the adverse effects of high-energy waves on estuarine shorelines relies on geotechnical aspects where energy dissipation is critical to its success. One aspect is the stability of porous break walls and their ability to dissipate wave energy. Wall stability is dependent on the soil conditions at the site. The loading on the porous walls is a function of their porosity, which must be considered to optimize the dissipation effects. Another aspect is the stability of the loose saturated soils on the river bed and upland into the marsh during the hydrodynamic wave events. The strength of loose and unstable soils is easily exceeded leading to erosion around rigid to semi-rigid, fixed objects such as break walls, oyster gabions, and marsh grass. Soil stress and pore pressure monitoring during the high-energy wave events will provide data for models and analytical expressions to predict soil strength which can be used in designing effective mitigation techniques and forecasting during extreme events.

**Sofia Roman** and Scott Wasman, *University of Florida*

### **Hurricane Irma Effects on Water Quality**

Dissolved organic matter (DOM) influences biogeochemical cycling and water quality in wetland systems. When disturbance events occur, and increase the influx of DOM into waterways, these biogeochemical cycles are altered and may take several months to return to normal. The disturbance created by Hurricane Irma caused salinity and DOM fluctuations throughout Pellicer Creek. Through water sampling and data sonde deployment, it is apparent that the influx of DOC off the landscape affected many water quality parameters during and for several weeks after the hurricane. The large DOC input into Pellicer Creek from upland systems created a nutrient and salinity gradient that varied a lot from pre-disturbance conditions, potentially affecting long-term nutrient cycling.

**Tracey Schafer**, Todd Osborne, Ph.D., K.R. Reddy, Kelly Smith, Ph.D., Trent Dye, and Kaley Rice, *University of Florida- Whitney Laboratory for Marine Biosciences*

### **Interactive effects of wood traits and intertidal exposure on shipworm infestation in southeastern US estuaries**

Shipworms, a group of wood-boring bivalve mollusks, have caused millions of dollars in damages to wooden structures across the world. Given their ease of transport, they have become ubiquitous in virtually all coasts and estuaries and continue to pose a threat to wooden marine structures. To date there is no treatment that is completely effective against shipworm boring. Thus, wood in marine environments has a limited life span and must be continually replaced. This project examined the resilience of four tree species – laurel oak, sweetgum, crepe myrtle, and black mangrove – to shipworm infestation, and manipulated branch diameter and distance from the sediment surface. The shipworm damage was quantified as wood volume lost to shipworm burrows and found large branches to be more resilient against shipworms and burrowing to be limited to the first twenty centimeters above the sediment. This knowledge can inform construction in marine environments by determining desirable characteristics of the wood employed, distance from sediment shipworm impact is noted, and extend the lifespan of wooden marine structures, such as wooden breakwalls, used as living shorelines techniques.

**Ada Bersosa** and Christine Angelini, Ph.D., *University of Florida*

### **Monitoring Gopher Tortoise Burrow Changes at GTM NERR; Pre-and Post-Hurricanes**

The coastal strand foredune habitat at GTM NERR was surveyed for gopher tortoise (*Gopherus polyphemus*) burrow population density and other characteristics following the occurrence of two hurricanes, Matthew and Irma. Burrows were evaluated based on their activity status (active, inactive, or abandoned) and size. Burrows were surveyed between the northernmost boundary of the GTM NERR south towards the North Beach parking entrance. Data (post-Hurricane Irma) was compared to previous data collected from the same site pre-Hurricanes Matthew and Irma in 2016. Most of the burrows were faced east of the dunes and higher frequencies were noted at higher elevations than before.

**Danielle Cayouette, Scott Rowan, John Cepedo**, Barbara Blonder, Kurt Sebastian, Thomas Hamilton, Mallory Hopkins, and Cody Burns, *Flagler College*

### **Oyster Shell Recycling in Northeast Florida**

Oysters and oyster reefs are a ubiquitous sight in intertidal zones of estuarine marshes throughout the southeast. They provide numerous ecological services and economic value. Anthropogenic impacts such as pollution, development, and overharvesting have reduced global oyster populations to 15% of their historical populations. The Northeast Florida Aquatic Preserves and GTM NERR have been involved with oyster restoration projects in Northeast Florida since 2012. In response to a regional need for suitable restoration material, an oyster shell recycling program was created to collect discarded shell as a cultch material. Throughout this time, collected shell has been utilized in different restoration and collaborative research applications. Restoration design and materials vary, and are continually tested to inform future restoration efforts.

**James D. Tomazinis** and Scott Eastman, *Northeast Florida Aquatic Preserves, GTM Research Reserve*

### **Protecting shorelines with constructed oyster reefs: evidence in the sediment**

Shoreline erosion is an increasingly important issue in many coastal communities. Constructed oyster reefs (living shorelines) can protect against erosion by dissipating wave energy. In addition, constructed oyster reefs and their associated fine sediments provide intertidal habitat for organisms. In 2012, the GTM NERR constructed a series of intertidal oyster reefs using bagged shell at Wright's Landing on the Tolomato River. In 2016, sediment core samples were collected landward of three constructed reef sites and three control core samples south of constructed reef sites. For each subsample, sediment particle size was determined by dry sieving for coarse, medium, fine, and very fine sands, as well as by wet sieving for silt and clay. If the constructed reefs effectively reduce wave energy, finer sediments were found near the surface in the constructed reef sites and coarser sediments in the control sites.

**Colin Herbert, Mallory Hopkins**, Jessica Veenstra, Ph.D., Melissa Southwell, Ph.D.,  
and Danielle Cayouette, *Flagler College*

### **Results of the GTM NERR Butterfly Monitoring Project**

The GTM Butterfly Monitoring Project began in April 2008 and regularly submits data to the Florida Butterfly Monitoring Network. Data obtained from this monitoring allows researchers to assess species richness, faunal similarity, uniqueness, phenology, and species commonality. Monitoring occurs on four transects including open habitat and different habitats within the forest trail system. September has the highest average species richness and abundance and February has the least. Currently, 66 species have been recorded from the GTM. There are 11 butterflies that are considered common and two-thirds of the butterfly fauna at the GTM are either rare or uncommon. The online iNaturalist guide provides information on description, similar species, distribution in North America, larval description and host plants, GTM occurrence data, habitat, and conservation status.

**Michael G. Pogue** and many volunteers, *GTM Research Reserve*

### ***Spartina alterniflora* floating nurseries: growing plants to reduce pond nutrient loading and enhance coastal shoreline restoration**

Retention ponds are common features of urban landscapes, collecting runoff that would otherwise pool on concrete structures and roads. They also accumulate nutrients and pollutants that can enter groundwater. This project goal was to harvest wetland plants, help them develop strong root networks in nutrient rich retention ponds, then use those wetland plants for shoreline erosion control. Plants were harvested from a donor plot developed through the *Spartina* Transplant and Restoration program in the GTM NERR. Plant plugs were deployed in floating treatment wetlands (FTW) in two retention ponds at the University of North Florida then transplanted to a shoreline restoration site to reduce shoreline erosion. Change in root volume measured biomass growth and photosynthetic efficiency yield measured health for plants. Pond water quality and *S. alterniflora* health and growth were monitored prior to, and throughout deployment.

**Ben Mowbray**, Kelly Smith, Ph.D., and Nicole Llinas, *University of North Florida*



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## THE GTM NERR: POST-IRMA

SHANNON DUNNIGAN, SWMP MANAGER, AND PATRICIAN PRICE, PUBLIC INFORMATION SPECIALIST II

Still recovering from the damage of Hurricane Matthew the previous year, our coastal communities and the entire state suffered again from the impacts of Hurricane Irma. Though our community was able to learn and prepare from Hurricane Matthew, Hurricane Irma brought with it new challenges, and new damage to areas still in recovery. Through the hard work and dedication of our staff and volunteers, we have been able to make great strides in our recovery efforts.

Like most of the region, post-Irma recovery efforts are still underway at the GTM Research Reserve.

Immediately after Irma, our facility was without power for several days, and was without phone access for weeks.

The water filters used for our on-site animals were running on generators due to electrical issues. Not having power also meant that we could not boil water on-site during the boil water advisory, and the staff and volunteers who assisted with clean-up efforts had to bring their own water for the day. Nevertheless, many people arrived the day after the storm to assess damages and start recovery efforts.



Matanzas River near Rattlesnake Island



Marine debris from storms

The GTM NERR's volunteer coordinator reached out to our supporting volunteer base and scheduled seven work days, where 47 volunteers performed 138 volunteer hours. Most of these volunteers helped the GTM NERR despite still having damage at their own homes. A lot of debris, heavy wooden structures, and even a toilet were removed. The GTM NERR will continue to have staff and community beach cleanups as debris continues to wash ashore.

During clean-up efforts, many events had to be cancelled or postponed, including Guided Explorations, a National Science Foundation Project Team meeting, a Management Advisory Group meeting, Family Seining, and an International Coastal Clean-up. Thanks to the hard work and effort of the clean-up crew, all of our programs and research projects are back on a normal schedule.



Damage of the South Beach boardwalk

As with Hurricane Matthew, the beach access boardwalks and trails along the Guana Peninsula saw heavy water and wind damage. Our staff and volunteers worked hard to remove the downed trees, and cleaned debris on the beaches and waterways. The South Beach access parking lot is still closed while repairs are being made to the boardwalk. Significant erosion on the Guana Peninsula along the Tolomato River has been documented at an important cultural site, the Minorcan Well. The Florida Public Archaeology Network and the Heritage Monitoring Scouts documented the erosion by taking photographs and measurements. Efforts are still being made to ensure the proper restoration and protection of the Minorcan Well.



*Erosion at the Minorcan Well*

Throughout Hurricane Irma, our System-Wide Monitoring Program (SWMP) data sondes continued to collect water quality. One of the initial impacts that the research team investigated was the change in salinity, as it is a good indicator of rainfall during storms. During Hurricane Irma, the Pine Island SWMP station, which typically has an average salinity of 29 psu, had a daily salinity average of 2 psu. Although the area continued to experience heavier than average rainfall due to nor'easters, the average salinity has returned to a normal level.



*Maintenance on flooded trails*

In addition to our own clean-up efforts, the GTM NERR was asked to assist the Coast Guard with sunken vessel removal. A staff member was provided to serve as the Natural Resource Advisory (NRA) during removal efforts. The NRA reviewed applications to determine if a representative should be present during the removal of derelict vessels in order to protect natural resources, such as oysters, seagrasses, cultural resources, etc. Since Hurricane Irma, approximately 2,300 derelict vessels have been removed from Florida waterways, and

no longer pose a threat to boaters and the environment.

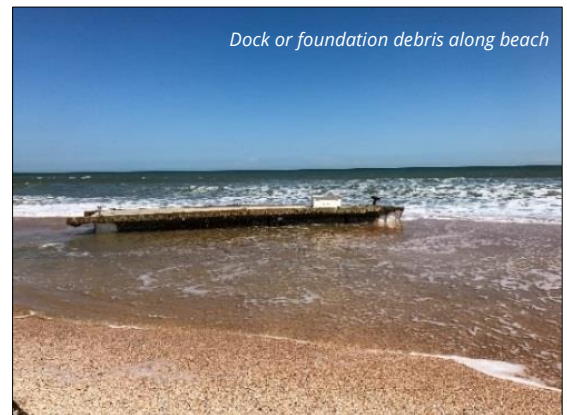
Hurricane Irma immediately changed the coastline in St. Johns County, and we will continue to see these changes in the future. Be sure to check out shoreline changes from before and after Hurricane Irma with the St. Johns County image slider (<https://tinyurl.com/SJCSlider>).



*Derelict vessel*



*Vegetation browning from prolonged periods of wind and salt exposure*



*Dock or foundation debris along beach*

# THE GUANA ECOSYSTEM: A SHORT HISTORY AND RESULTS FROM AN ONGOING WATER QUALITY STUDY

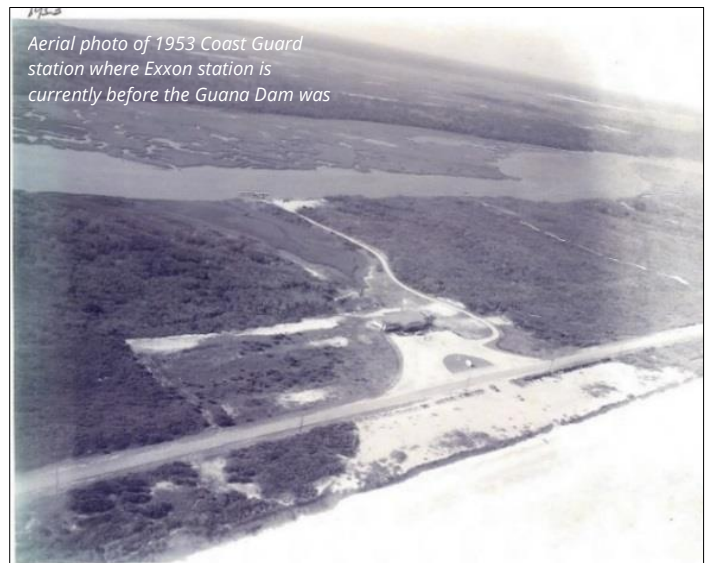
KAITLYN DIETZ, NIKKI DIX, PH.D., SHANNON DUNNIGAN, SCOTT EASTMAN, SILAS TANNER, AND JIMMY TOMAZINIS

## History

Although many residents of St. Johns County enjoy the Guana Lake today, many do not know the historical significance of the area that surrounds it. Since the dam's construction in the 1950s, the water quality of the Guana Lake has largely been unstudied. As new attempts are underway to understand this ecosystem, it is important to look back at the history of the Guana River area.

Though evidence of ceramic materials suggests that this area was populated as far back as the late archaic period, it wasn't until the early 1900s that significant ecological change was introduced to the region. After the river was dredged in 1911, the Tolomato River became a part of the Intracoastal Waterway, running 3,000 miles from Boston, Massachusetts, to Brownsville, Texas. This led to the establishment of a mining facility, extractions of minerals from beach sand, land development, paved roads, timber harvesting, land leasing for cattle, hog grazing, hunting, and more. All of these new developments and activities left a lasting impact on the Guana region.

In the 1950s development efforts began to shape the area to how we know it today. In 1957, the Florida Game & Fresh Water Fish Commission (now FWC) leased the 12,000 acre peninsula from an investment company, which initiated fish and wildlife management projects to provide habitat and refuge for species, as well as recreational purposes. The construction of the Guana River Dam in 1961 created the Guana Lake, enhancing the habitat for wintering waterfowl. In 1982, Herb Peyton, owner of Gate Petroleum, purchased the land. Only two years later, the state purchased the property for \$48 million through the Conservation and Recreational Lands and Save Our Coasts programs. After that purchase, the southern 2,300 acres became the Guana State Park, which was managed by the Department of Environmental Protection (DEP). The northern 9,815 acres was established as a wildlife management area by the FWC. One year later, the property was designated by the DEP as the Guana River Marsh Aquatic Preserve, and was still managed as a state park. In 1999, the area was designated as a National Estuarine Research Reserve, including the entire Guana peninsula, as well as expanding to include conservation lands and parks in the Matanzas/Marineland areas.



The Guana Lake and Guana River mentioned in this historical story are considered Outstanding Florida Waterbodies. They are within both a state Aquatic Preserve and a National Estuarine Research Reserve, designations intended to protect the health of Guana waters for long-term recreational enjoyment, commercial fishing/oyster harvesting, research, and education. Today, the Guana ecosystem remains a fundamental part of the northeast Florida community, especially popular for outdoor recreational activities including bird watching, paddle sports, fishing, and waterfowl hunting. There are many commercially and ecologically significant species for which the Guana ecosystem provides habitat, including American eel, *Anguilla rostrata*, and American alligator, *Alligator mississippiensis*. The Guana River was once a praised harvest area for shellfish, but due to decreased water quality and human health risks,

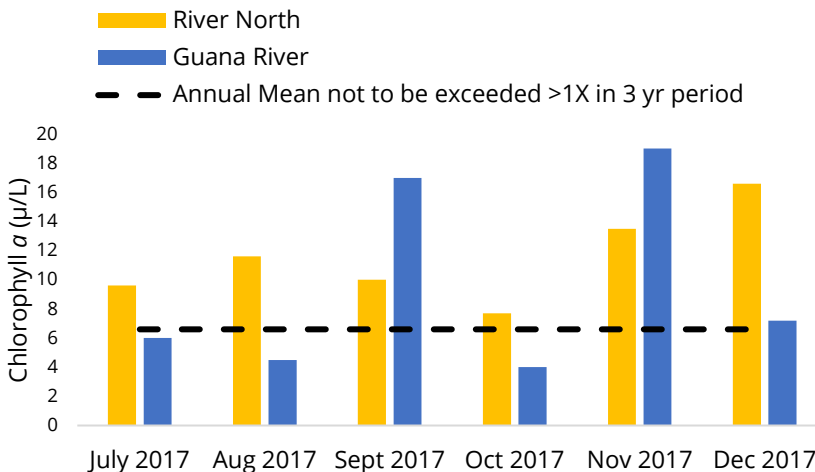
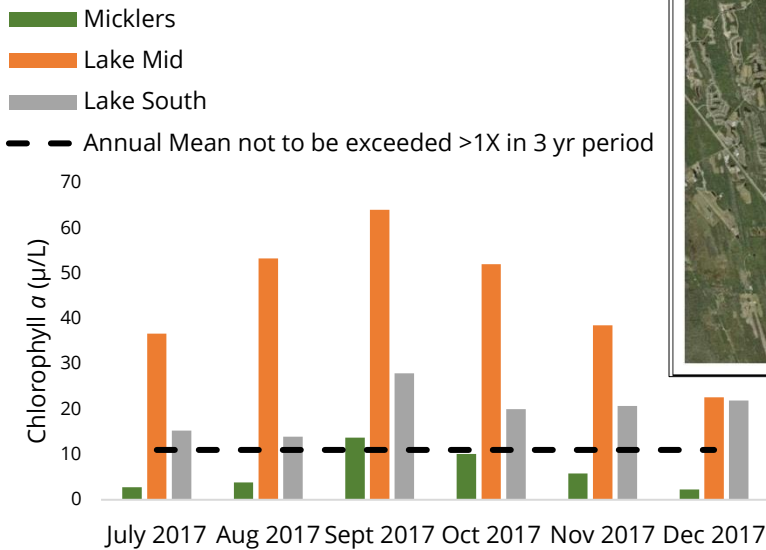
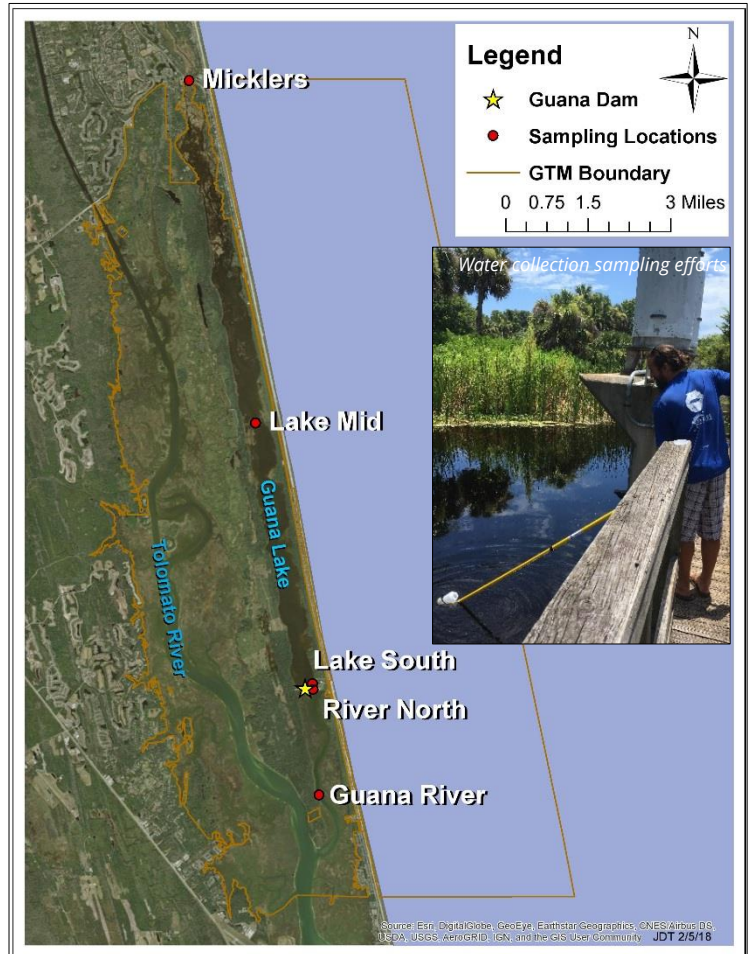
Florida's Department of Agriculture and Consumer Services has restricted harvest since the mid-1990s. Unfortunately, a lack of regular sampling has led to a scarcity of knowledge about current water quality conditions.

Inspired by momentous community interest and a common research priority, multiple sponsors including the Audubon Society and the Friends of the GTM Reserve, generously funded water quality sampling and subsequent laboratory analyses starting in July 2017.

Monthly sampling, a collaboration between GTM NERR and Northeast Florida Aquatic Preserves, occurs during high outgoing tides at five locations: Micklers, Lake Mid, Lake South, River North, and Guana River (see map right).

### Results

The first six months of sampling has revealed some concerning water quality conditions, especially in the middle of Guana Lake. One indicator of an imbalance in nutrients is the biomass of microscopic algae (phytoplankton), estimated by the photosynthetic pigment, chlorophyll *a* (see graphs below). State standards for chlorophyll *a* are 11 µg/L in the lake and 6.6 µg/L in the river.



In the middle of the lake, chlorophyll levels have been 2 - 6 times higher than the threshold. High levels of bacteria and nitrogen have also been observed in both the lake and the river.

### Where are we going with this?

We hope to continue sampling these sites as long as funding allows. If interest and funding were to expand, we would add sites in the river, lake, and above Micklers in, Lake Ponte Vedra, to get a more holistic view of spatial patterns in water quality conditions. We would also hire a graduate research assistant to lead the project for a thesis. Regardless of funding, we will continue to coordinate with local agencies and private citizens through the Oyster and Water Quality Task Force to work to improve water quality in this ecosystem.

# OYSTER MONITORING REPORT 2014-2016

PAM MARCUM, BIOLOGIST, AND NIKKI DIX, PH.D., RESEARCH COORDINATOR

Oysters provide many valuable services in estuaries and coastal communities including:

- filtering pollutants from our waters by suspension feeding;
- improving water quality;
- reducing erosion and acting as natural breakwaters to mitigate shoreline loss; and
- providing shelter and a productive ecosystem for foraging for many birds, fish, and invertebrates.

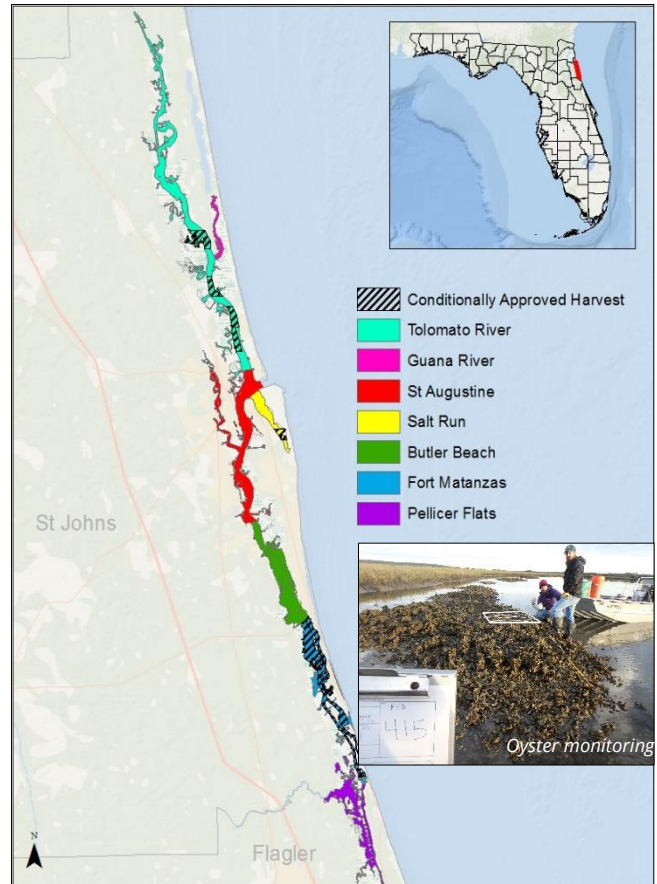
Unfortunately, the importance of oysters and their functions have been highlighted by losses in oyster populations. Nearly 85% of oysters have been lost globally. The loss can be attributed to a combination of centuries of fishing pressure, habitat degradation, and parasitic diseases. Current monitoring efforts across the U.S. will establish baselines to be used for management and restoration.

Pilot monitoring of intertidal eastern oyster reefs within the GTM NERR and surrounding waters was initiated in 2014. The main objectives were to:

1. evaluate the **status of oyster populations** in the area;
2. provide **abundance and size estimates** to inform the quantification of ecosystem services provided by oysters;
3. provide baseline **estimates of reef, population, and community structure** metrics for future assessments; and
4. evaluate **methods for long-term monitoring**.

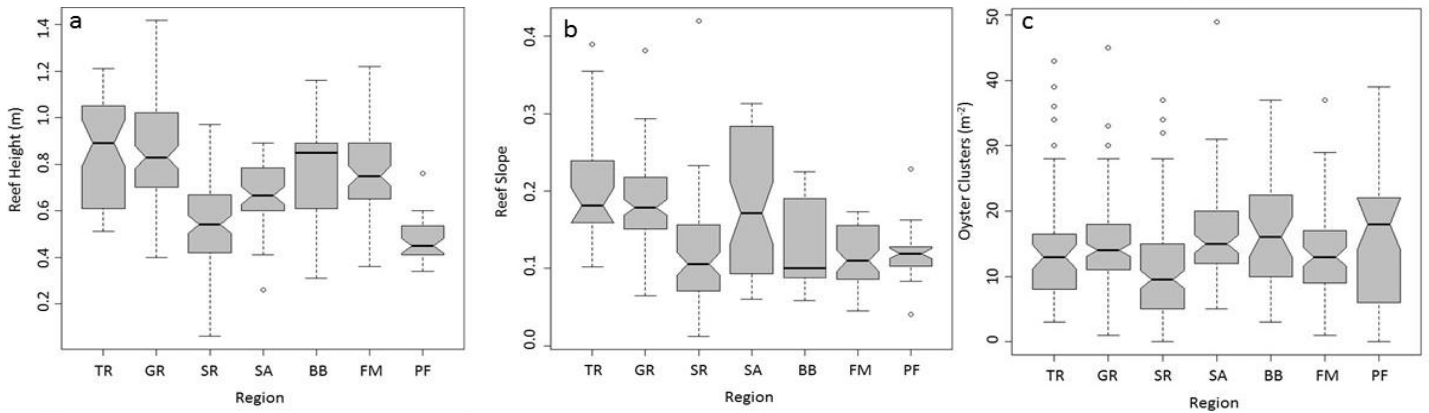
Oyster reefs were sampled in the winter (Jan-Mar) and summer (Jul-Sep) during 2014 – 2016 (summer only in 2014). Sampling metrics fell into three main characterizations: reef structure, oyster population structure, and community structure (see table below).

Overall, 210 reefs were sampled across the seven regions (see map above).



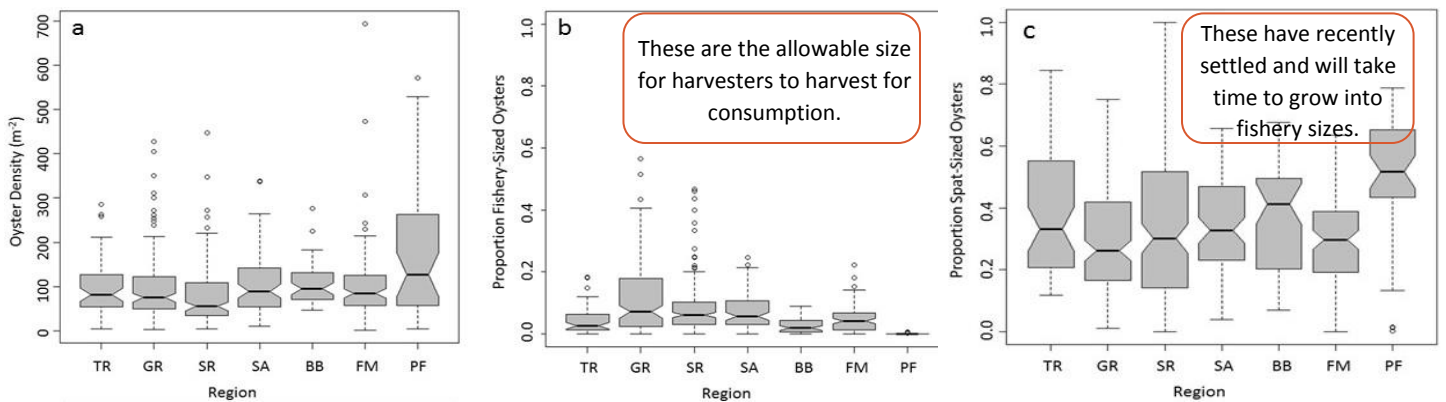
Reef Structure	Oyster Population Structure	Community Structure
reef height	oyster density	mussel density and size
reef slope	size class	barnacle density
percent cover of live and dead oysters	frequencies	crown conch density
percent cover of sediment		other gastropod presence/absence
oyster cluster density		clam density and size





From the above **reef structure** boxplots, there are several results worth noting:

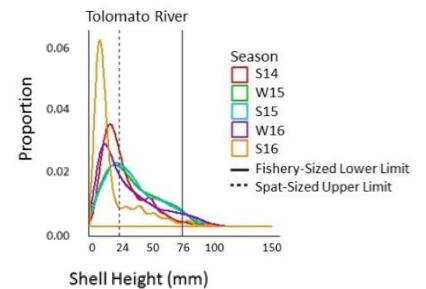
- (a) reefs were tallest in the Tolomato (TR) and Guana (GR) rivers. Reefs were lowest in Pellicer Flats (PF),
- (b) reefs were steeper in TR, GR, and St. Augustine (SA),
- (c) oyster clusters densities were lowest in Salt Run (SR), where harvesters frequently break them apart, but there was no evidence of differences in oyster cluster density among other regions, and
- reef structure did not differ between the winter and summer seasons.



Overall, an average of 1,621 oysters per m<sup>2</sup> was observed in this study. From the above **oyster population structure** boxplots, there are several results worth noting:

- (a) oyster density was lowest in SR and highest in PF,
- (b) the proportion of fishery-size oysters was highest in GR, SR, SA, and Fort Matanzas (FM), and
- (c) reefs in PF had no fishery-size oysters and the highest proportion of spat.

Size frequency distributions, an indicator of the age structure of a population, were mostly skewed to the right (right), indicating mortality at sub-adult stages.



Data collected during 2014-2016 provided an opportunity to assess methods and develop recommendations for a long-term oyster monitoring program. Significant correlations between oyster density and all associated fauna suggest that oyster density may be an appropriate indicator for habitat function. A correlation between live cover and oyster density indicates that cover could be used to estimate oyster density. The ease and relative quickness of measuring percent cover would facilitate increased sample sizes and spatial coverage in a non-destructive manner to better assess reef function and services provided on intertidal reefs.

Future work will include more sampling for oyster density and size. However, understanding implications for the oyster fishery and long-term population sustainability will also require estimation of growth and mortality rates and population modeling.

**For the full report and additional information, please contact Nikki Dix, Ph.D. ([Nikki.Dix@floridadep.gov](mailto:Nikki.Dix@floridadep.gov)).**

## PRESCRIBED BURN TECHNIQUES OF THE GTM NERR

CHERYL MANNEL, FACILITIES SERVICES SPECIALIST

The resource management sector at the GTM NERR manages the upland portions of the Reserve's northern component which includes coastal habitats of maritime Hammock, mesic pine flatwoods, freshwater marsh, and coastal strand. Most of these habitats are adapted to recurrent fire which maintains the balance between tall woody species and short grasses. The resource management team conducts prescribed burns along the Guana Peninsula and along scenic A1A, particularly within the coastal strand habitat.

Restoration site before prescribed burn



While fire is a natural occurrence, it is important for coastal communities to have control of fires which is done through prescribed burns. Prescribed burns are important to not only manage the balance of healthy and native vegetation, but to also suppress invasive species, reduce weeds, restore habitat and diversity, and to mimic the natural fire regime, thus promoting positive land stewardship. Care is always taken to ensure that there are adequate escape corridors for wildlife to avoid harming resident creatures. The safe and effective execution of these burns requires considerable training, extensive planning, public notifications, and strict weather parameters.

### Freshwater Marsh

In the fall of 2017, approximately 300 acres along the Guana Peninsula were targeted in a prescribed burn. While most portions of the Guana Peninsula had a low flame intensity during the burn, some fire adapted plants, such as saw palmetto (*Serenoa repens*) and other grasses, burned more intensely. The reduction in shrub density will allow more sunlight to penetrate to the ground layer which will promote the growth of grasses, forbs, and other forage plants. With the growth of more ground layer

Restoration site immediately after prescribed burn





vegetation, there should be benefit to numerous animal species who depend on this forage for their dietary needs.

The most active portion of the peninsular burn occurred in the freshwater marsh areas where the high density of continuous grasses fueled a medium-intensity fire, which created a more complete burn of the vegetation than the low-intensity flames. Periodic prescribed burns in the marsh aid in reducing the occurrence of trees and shrubs which use more water (comparatively) than the marsh grasses. Maintaining an appropriate ratio of grasses to woody species ensures the continued hydrological health of the freshwater marsh.

### **Coastal Strand**

Along scenic A1A is the coastal strand habitat which is dominated by shrubs, stunted scrub live oaks, and saw palmetto. The coastal strand habitat was densely populated with stunted scrub oaks and saw palmetto that required a different management technique than the freshwater marsh that was burned. Instead of solely a prescribed burn, the coastal strand was pre-treated mechanically before the prescribed burn to increase the effectiveness of the burn. Mechanical pre-treatments included mowing and roller chopping. Mowing reduced tree and grass height to ground level using a specialized mulching head mounted on a tractor. Roller chopping achieved a similar but rougher effect by dragging a heavy bladed drum behind a tractor which had the added benefit of chopping thick palmetto trunks and reducing regrowth. To ensure a more dynamic native landscape, numerous small areas were selected to be roller chopped while leaving adjacent areas untreated prior to burn. The resulting mosaic landscape will offer open areas for foraging and dense areas for cover. Prescribed fire was applied in fall of 2017, and as the spring and summer seasons approach, an increase of grasses and other groundcover plants used for forage are expected to fill in previously burned surfaces. This management technique used within the coastal strand habitat will support larger numbers of coastal strand plant and animal species, such as gopher tortoises.

**Even land management can have an artistic side which will promote the growth of numerous flora and faunal species.**



## EDUCATION AND INTERPRETATION ARE FLUID, JUST LIKE OUR TIDES

KENNETH RAINER, EDUCATION COORDINATOR



In 2015, the GTM NERR education sector, received a NOAA Procurement, Acquisition and Construction (PAC) grant to begin an interpretive master plan for the Environmental Education Center Exhibit Hall, trails, and beaches. The Interpretive Master Plan provided a framework for how visitors intellectually and emotionally connect with the GTM NERR and find meaning in the landscape, experiences, objects, and people found there. It conceptually integrates all existing and future interpretive materials and programs allowing visitors to achieve a cohesive message carrying them from one part of the Reserve to the next. A visitor's experiences walking on a trail, catching a fish, or attending an event are unified by a common thread. Interpretive materials often raise awareness, inspire, and potentially motivate individuals to take action. Visitors will not only learn about and support the Reserve, but also discover how to take personal actions to build more resilient communities.

Through the interpretive master plan, six themes emerged serving as focal storylines through the updates at the GTM NERR. The main theme, "sustaining a resilient reserve" incorporates climate change, the ocean, the estuary, the

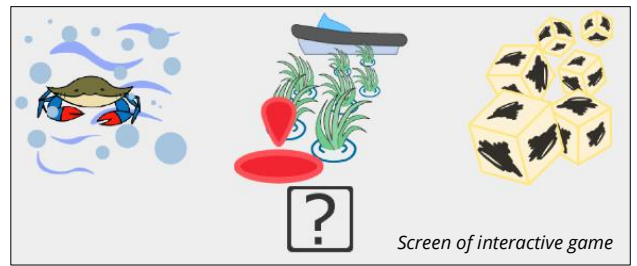
forests, and the people. The future of the GTM NERR will be determined by the people, starting with those who visit the GTM NERR and its interactive Exhibit Hall, trails, and beaches.

From the interpretive master plan, to date, 31 kiosks throughout the GTM NERR have been updated at the three beach parking lots, trailhead pavilion, sensory trail, cultural sites, and all citizen science picture posts. Yes, you read sensory trail! A new trail was added this year at the trailhead pavilion. This 0.25-mile loop trail traverses the maritime forest and was developed to engage your senses beyond sight, to step out into nature, listen, smell, and hear the GTM NERR around you. This trail invites all visitors to engage senses with an accessible trail surface and signage.

Within the Exhibit Hall, two interactive touchscreens have been completed. Several others will soon be displayed after further development of their interactive components and displays which are being developed through a National Science Collaborative Science Transfer grant.



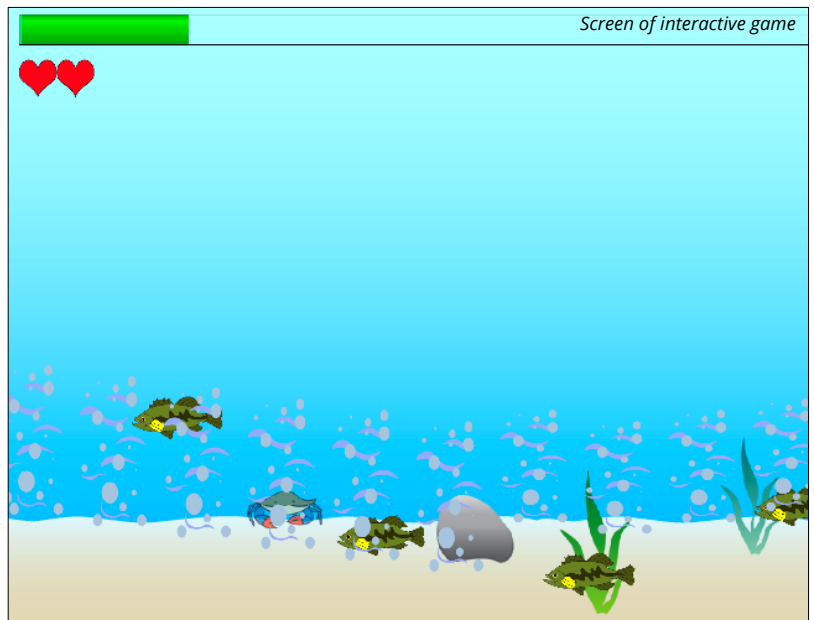
The National Science Collaborative Science Transfer grant was awarded to the education sector in September 2016. The grant will continue to further develop the touchscreen interactive components. With the University of Delaware, Delaware NERR, and Mission-Aransas NERR, undergraduates have been creating interactive software to be used by Reserve visitors.



This project will support the development of new, innovative visitor displays at the three National Estuarine Research Reserves. The visitor's centers at the Guana Tolomato Matanzas, Mission-Aransas, and Delaware National Estuarine Research Reserves currently have hands-off exhibits with limited interactive components. The reserves will partner with students at the University of Delaware to produce gesture controlled, educational computer games that promote interactive, learning opportunities. The experiential games will be designed for use on interactive screens that will be available for public use in each reserve's exhibit hall.

Participants will be able to freely navigate through different experiences, acquiring a better understanding of the estuary's role in our ecosystem. Participants can discover that an estuary is a dynamic place on which plants, animals, and people depend, and where everyone plays a part in shaping the past and protecting the future.

Focusing on the sub-themes of climate change, estuarine dynamics, people, and actions, trial testing of the interpretive tools will be complemented by user surveys to inform software refinement. The project team will share the product development process and lessons learned with the broader reserve network through an online webinar. The project team will employ software design and graphic design students during the summers to produce testable and final products allowing for regular information updates. The project approach and products will also be shared more broadly with the reserve system.



Through this project, Reserve visitors will have access to new, innovative interpretive resources that share locally relevant science and have improved awareness of estuarine conservation. It also provides valuable experience in the fields of software engineering and graphic design to undergraduate students at the University of Delaware.

**For additional information, please contact Kenneth Rainer ([Kenneth.Rainer@floridadep.gov](mailto:Kenneth.Rainer@floridadep.gov)).**

# UNIVERSITY OF NORTH FLORIDA

## COASTAL AND MARINE BIOLOGY FLAGSHIP PROGRAM

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The faculty and students that make up the University of North Florida's Coastal and Marine Biology Flagship Program are happy to welcome you to the 2018 State of the Reserve!



The Coastal and Marine Biology Program is an educational and research program of the University of North Florida's Department of Biology that focuses on the study of aquatic life, ranging from the tiniest microbes to the largest marine vertebrates living in the rivers to the seas.

Our mission is to discover and educate others about coastal and marine life with the goal of preserving it for future generations.

The Coastal and Marine Biology Program was awarded UNF Flagship Program status in 2006, establishing it as a center for excellence in this field. It is one of only six UNF programs to receive this prestigious distinction, which is awarded to academic programs that have achieved levels of national prominence.

### WHAT DO WE DO?

Our lives revolve around water. It makes up 71 percent of the Earth's surface and up to 78 percent of the human body. It is required for life and provides us with food, jobs, medicine, innovation, and enjoyment.

However, Earth's water resources are at growing risk from a variety of stressors such as coastal development, climate change, pollution, overfishing, invasive species, and much more.

Faculty members in UNF's Coastal and Marine Biology Flagship Program **conduct research** on a diverse array of marine organisms and a broad range of issues critical to our understanding of the Ocean. Our work is important because it helps us maximize human benefits from the Ocean while still conserving Earth's water resources in a responsible manner.

The Flagship Program also **educates undergraduate and graduate students** pursuing degrees in Coastal and Marine Biology at UNF. Our students have the benefit of working directly with accomplished faculty members conducting research on a broad range of exciting and important topics in coastal and marine biology. Students have the opportunity to take all the courses needed for a successful career in coastal and marine biology, including several field-intensive courses, and can gain hands-on experience and academic credit by interning with local zoos and aquariums, state and federal fishery management agencies, conservation groups, and other marine science institutions.

Lastly, the Flagship Program is committed to increasing public awareness about coastal and marine biology and the threats that our Oceans face. We do this by participating in local school programs, environmental festivals, public lecture series, summer camps, and other community events such as the State of the Reserve.

### WHAT IS OUR CONNECTION TO THE GTM NERR?

The UNF Coastal and Marine Biology Flagship Program and the GTM Research Reserve work closely together to conduct several research activities and educational initiatives important for the conservation of the Reserve. Some of these activities will be featured at this year’s State of the Reserve meeting, including the following:

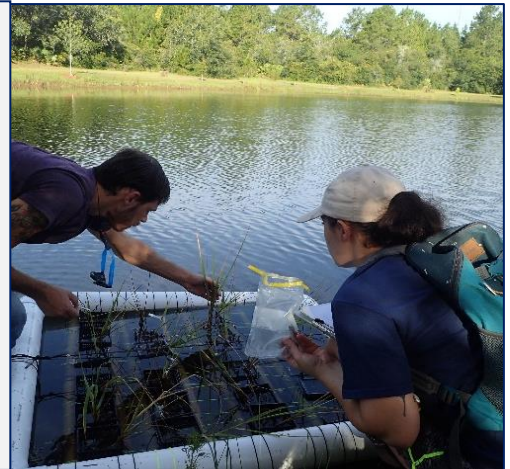


#### SHARKS OF THE GTM NERR

The UNF Shark Biology Program has been monitoring shark diversity and abundance in portions of the GTM NERR annually since 2010 to determine whether it serves as a “nursery” for juvenile sharks; habitat critical for their survival because it provides food for growth and development and/or protection from predators. Our work has demonstrated that the Tolomato River serves as nursery habitat for a number of commercially-important species, most notably the scalloped hammerhead shark, which is critically endangered in some portions of its range due to overfishing. Work of this nature is critical for the management and conservation of U.S. shark populations.

#### BENEFITS OF FLOATING WETLAND PLANT NURSERIES

Dr. Kelly Smith is examining whether wetland plants harvested from donor plots in the GTM NERR can be successfully grown in floating nurseries in nutrient-rich retention ponds and later transplanted to shoreline estuarine sites. The purpose of this work is to determine if these “floating plant nurseries” can reduce nutrient levels in often highly-polluted retention ponds, while at the same time, producing high-quality transplants that could be used as a natural buffer against shoreline loss in highly impacted estuaries.



#### WHAT IS THE STATUS OF AMERICAN EEL POPULATIONS?

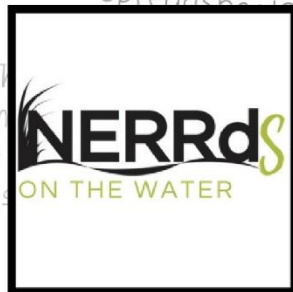
From January to early March, UNF Flagship Program faculty and students, and GTM Research Reserve staff and volunteers team up to monitor the abundance of juvenile American eels, also known as glass eels, at the Guana River Dam. As a catadromous fish, these eels are born in saltwater and make their way to freshwater habitats like the Guana River to live until they return to the sea to spawn and die. They are a commercially important fish, highly valued for use in aquaculture. Therefore, surveys such as ours are important for monitoring the size and health of their population.

Photo credit: John Pemberton/Florida Times-Union

# A Year of NERRds.



Hard to believe we celebrated the one-year anniversary of the GTM Research Reserve's research blog "NERRDs on the Water" this past September. This blog began as a creative way for the research staff to share their stories and it has blossomed into a collaborative outlet for local scientists and other folks within the National Estuarine Research Reserve System. We couldn't be happier. Thanks for the support and may the next year bring many more great stories!

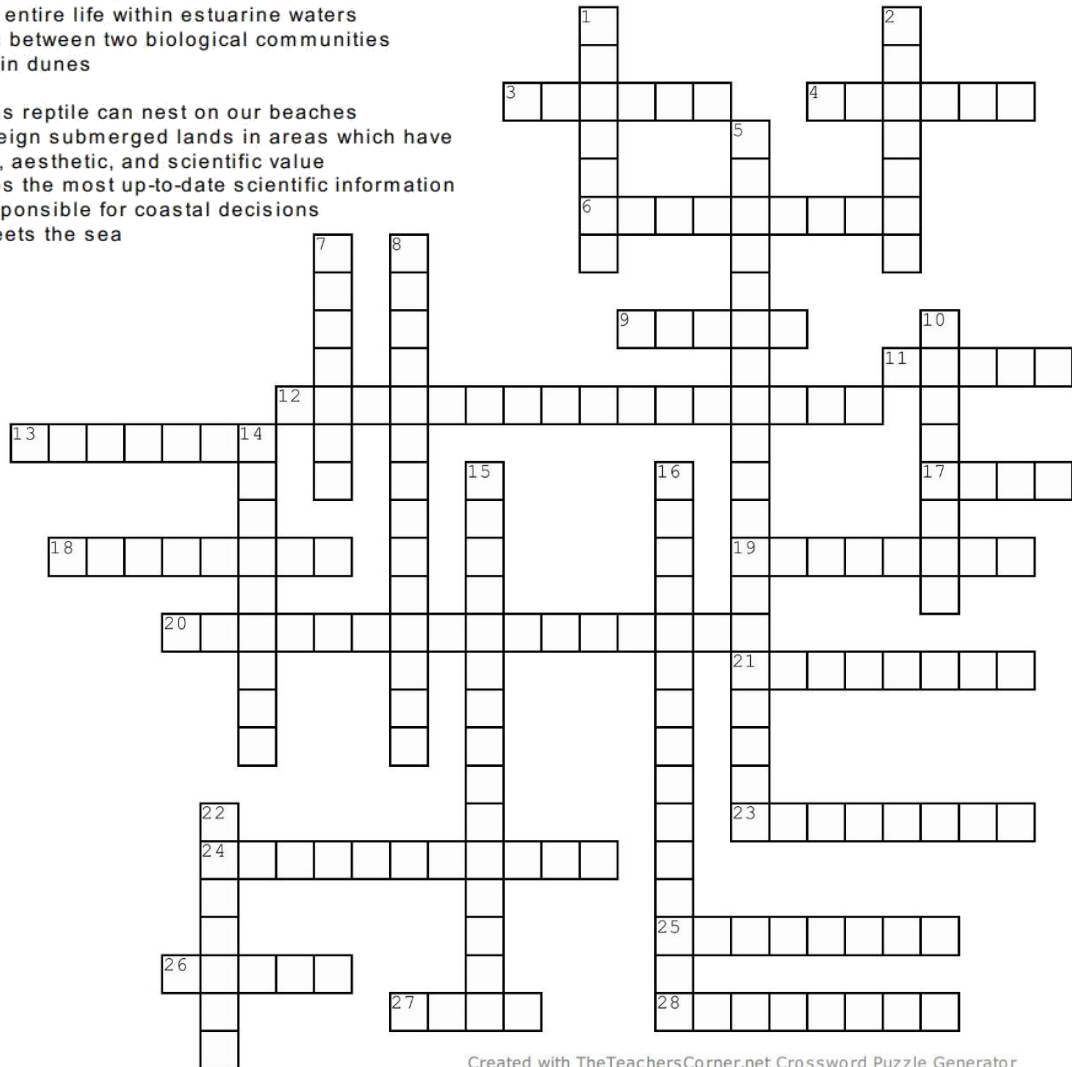


[www.nerrdsonthewater.com](http://www.nerrdsonthewater.com)



**Down**

- 1. Three lots along A1A that allow you to stick your toes in the sand at these
- 2. A recreational activity that can be excellent at times for redfish, seatrout, croaker, and black drum
- 5. Reptile that spends entire life within estuarine waters
- 7. Region of transition between two biological communities
- 8. Digs deep burrows in dunes
- 10. Inlet, river, fort
- 14. Four species of this reptile can nest on our beaches
- 15. State-owned sovereign submerged lands in areas which have exceptional biological, aesthetic, and scientific value
- 16. Sector that provides the most up-to-date scientific information and tools to those responsible for coastal decisions
- 22. Where the river meets the sea



**Across**

- 3. There are 15 miles worth of these on the Guana Peninsula
- 4. Important megafauna bivalve
- 6. Sector that provides formal and informal activities including public outreach
- 9. River, peninsular, wildlife management area
- 11. Essential to life and the estuary
- 12. Pink marsh bird
- 13. The non-profit support system that supports all sectors of the GTM Research Reserve
- 17. Federal partner
- 18. Microscopic living beauties of plants and animals
- 19. Intracoastal Waterway alongside the Guana Peninsular
- 20. Name of the research blog
- 21. Sector that monitors water quality, weather, oysters, vegetation
- 23. Pesky insects that attack ankles on the beach
- 24. Sector that uses the best available science to maintain and restore ecosystems
- 25. These plants and animals can negatively impacts environment, human health, or economy
- 26. A unique way to see the water on a single person 'boat'
- 27. State partner
- 28. Maintained by FWC for waterfowl habitat and water quality, but is also used for American glass eel surveys

Created with TheTeachersCorner.net [Crossword Puzzle Generator](http://www.theteacherscorner.net)







**4** continuous water quality stations  
and **1** weather station

**33** NERRsOnTheWater blog posts

**284** data downloads of water quality, nutrients, meteorological, vegetation, GIS data from people across the country



**32,297 pounds** of oyster shell collected for recycling

**205 acres** of land were mechanically treated

**314 acres** of lands were treated with prescribed burns

**146 acres** of upland habitat has been restored from treatments

More than **262,000** visitors

**4,953** participants at **43** outreach programs

**2,720** students participated in **103** educational programs

**310** stakeholders reached through **13** coordinated meetings



# GTM RESEARCH RESERVE 2017

by the numbers



**10,496** volunteer hours valued at \$247,286\*

\*Value calculated by the Points of Light

[WWW.GTMNERR.ORG](http://WWW.GTMNERR.ORG)

On behalf of the board of directors and members of the Friends of the GTM Reserve, I'd like to welcome you to the 2018 State of the Reserve!

Since its inception, the Friends have sponsored this symposium and reception because we believe sharing the Reserve's findings with community stakeholders will ensure that the decisions we make about our coastal ecosystems are based on science and fact. A very special thank you to our donors who give generously year after year to fund programs like State of the Reserve.

This year's theme, "The Art of Science," should be of interest to all of us. As private citizens, we rely on our community leaders to make timely decisions about the health of our environment. Those leaders rely on scientists and researchers, like those at the GTM Research Reserve, to provide the data needed to make their decisions. But, how do they make decisions today when there is more information to be gathered tomorrow? This year's State of the Reserve symposium opens this discussion with community stakeholders and all of us so we can better understand the art of science.

We sincerely hope you enjoy your time at the Reserve today and that you leave with a greater understanding of how valuable science and data are to all of us and the critical need we have for places like the GTM Research Reserve to exist and flourish.

Remember, this is YOUR Reserve and with your support even more can be accomplished. Consider becoming a Friend of the GTM Reserve and pledge your commitment to science in our community.

**Ellen M. Leroy-Reed, LEED AP**

*Executive Director*

*Friends of the GTM Reserve*

The GTM Research Reserve needs you. To continue stewarding our precious resources, providing education programs, and monitoring our coastal ecosystems, we need resources, funding, and support.

**We need YOU.**

Here's how you can get involved:

*Volunteer*

Become a citizen scientist! Get your feet wet and your hands dirty. Volunteer at the GTM Research Reserve and assist with the research and monitoring team that is so important to the mission.

*Join*

Our Friends are the foundation of our mission. They are our greatest champions and strongest supporters. Membership is for everyone.

*Donate*

Each year, meritorious research goes unfunded and needed education programs sit on the shelf. Funding from our donors brings science to life and programs to fruition. Donations are tax-deductible and go towards local programs and research.



[www.GTMNERR.org](http://www.GTMNERR.org)

## ACKNOWLEDGEMENTS

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Along with the GTM NERR staff, the following groups aided in providing information, education and recreation to more than 262,000 visitors in 2017:

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

**Commissioner Barry Benjamin**, St. Augustine Port, Waterway, and Beach District  
**The Honorable Carl Blow**, Florida Inland Navigation District  
**Commissioner Charles Ericksen, Jr.**, Flagler County Commission  
**Chris Farrell**, St. Johns County Citizen Representative  
**Donald Crichlow**, City of St. Augustine  
**Ellen Leroy-Reed**, Friends of the GTM Reserve  
**Eric J. Smith, Ph.D.**, St. Johns County Citizen  
**Eric Ziecheck**, St. Johns County Citizen, *Chair*  
**Frank Usina**, St. Johns County Citizen  
**Gordon J. Wilson**, National Park Service  
**Commissioner Henry Dean**, St. Johns County Commission  
**Jeffrey Darr**, Florida Department of Agriculture and Consumer Services, Division of Forestry  
**Kelly J. Smith, Ph.D.**, Duval County Citizen  
**Kelly Rankin Legault, Ph.D.**, Army Corp of Engineers  
**Kimberly Decker**, St. Johns County Citizen  
**Maia McGuire, Ph.D.**, UF-IFAS SeaGrant  
**Michael Cullum**, St. Johns River Water Management District  
**Michael Lagasse**, Town of Marineland  
**Pierre Pierce**, St. Johns County Citizen, *Vice Chair*  
**Renee Paolini**, Florida Department of Environmental Protection, Division of Recreation & Parks  
**Steve Swann**, Duval County Citizen  
**Susie Hetrick**, Florida Department of Transportation  
**Tim Telfer**, Flagler County Citizen  
**Todd Osborne, Ph.D.**, Flagler County Citizen  
**Wade Brenner**, Florida Fish & Wildlife Conservation Commission

**The Friends of the GTM Reserve** is a non-profit citizen support organization established to support and enhance environmental education, stewardship of natural and cultural resources, and scientific research of the GTM NERR through volunteer initiatives, citizen involvement and community partnership. They are hosts of the reception at the 2018 State of the Reserve. The current board members are:

**Staci Janel Bitting**, President  
**Mark Ryan**, Vice President  
**Julie Edwards**, Secretary  
**Amanda Ryan**, Treasurer  
**Margarita Cabral-Maly, Ph.D.**  
**Karen Ford, Ph.D.**  
**Drew Frick**

**Courtney Hackney, Ph.D.**  
**Laura Hinds**  
**Deborah Brennan Magri**  
**Amanda Morrow**  
**Eric Smith, Ph.D.**  
**Chuck Snavely**

**Ellen Leroy-Reed**, Executive Director  
**Brooke Ellis**, Administrative Assistant