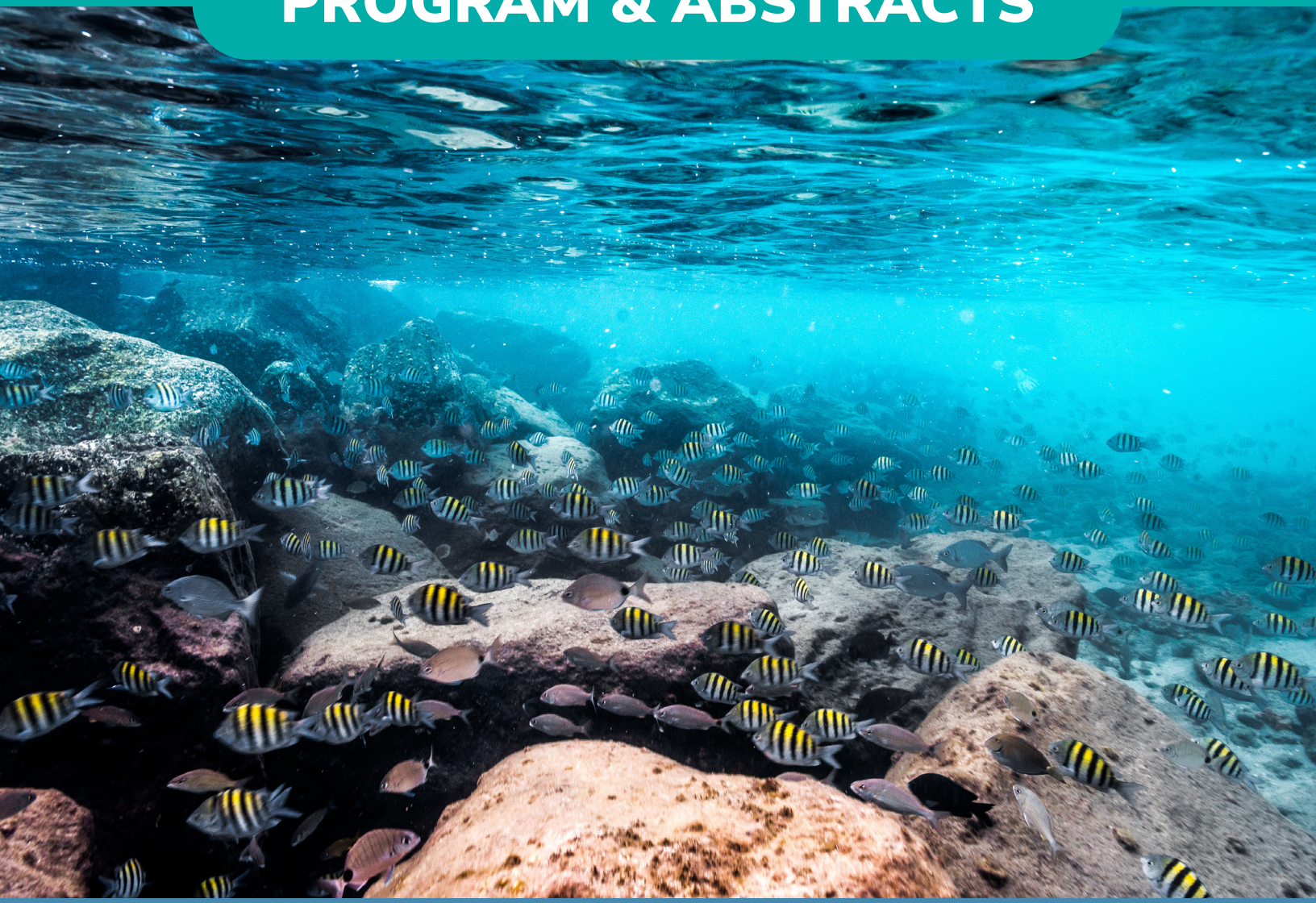
lake worth lagoon

SCIENCE SYMPOSIUM

PROGRAM & ABSTRACTS



November 15, 2022
Riviera Beach, Florida

PALM BEACH COUNTY FLORIDA

lake worth LAGOON

lake worth lagoon

SCIENCE SYMPOSIUM

November 15, 2022

Marina Village Event Center
Riviera Beach, FL

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ORGANIZING COMMITTEE

Mayra Ashton
Senior Environmental Analyst
Palm Beach County
Department of Environmental
Resources Management (ERM)
West Palm Beach, FL

Jennifer Báez
Environmental Program Supervisor
Palm Beach County
Department of Environmental
Resources Management (ERM)
West Palm Beach, FL

Matt Mitchell
Environmental Manager
Palm Beach County
Department of Environmental
Resources Management (ERM)
West Palm Beach, FL

PARTNER AGENCIES

The Lake Worth Lagoon Initiative (LWLI) is an informal forum for stakeholders to exchange information to increase collective awareness of the health and future of the Lagoon. A Steering Committee and three Working Groups focused on the topics of Habitat, Water and Sediment Quality, and Public Outreach meet periodically through the year. These meetings are open to the public and everyone with an interest in the Lagoon is encouraged to attend and participate.

The Initiative is managed by a Steering Committee which includes representatives from each of the following agencies: Palm Beach County Board of County Commissioners, South Florida Water Management District, Florida Department of Environmental Protection, Palm Beach County League of Cities, Florida Inland Navigation District and Florida Fish and Wildlife Conservation Commission.

Since 1998, when the Initiative was formed, the Florida Legislature has appropriated over $23 million for the restoration and enhancement of the Lagoon through the Initiative's Legislative Funding Request Program. These funds have been effectively leveraged with over $66 million in local, state and federal funds to support 67 projects completed throughout the Lagoon and its watershed, totaling over $90 million to date invested in restoring the Lagoon.

The Initiative and its partner agencies also help develop and support the Lake Worth Lagoon Management Plan and the annual LagoonFest celebration.

To learn more about the Lake Worth Lagoon and the Initiative, please visit the following URL:
https://discover.pbcgov.org/erm/Pages/Lake-Worth-Lagoon-Initiative.aspx

WELCOME ATTENDEES!

Thank you for joining us for the Lake Worth Lagoon Science Symposium!

On behalf of Palm Beach County and the Lake Worth Lagoon Initiative (LWLI), welcome to the 2022 Lake Worth Lagoon Science Symposium along the waterfront at the Riviera Beach Marina Village Event Center. The 2022 Lake Worth Lagoon Science Symposium comes on the heels of the 2021 Lake Worth Lagoon Management Plan update and brings together natural resource managers, researchers, educators and other stakeholders to learn more about the lagoon, its watershed and all of the factors that influence the health and restoration of this unique urban estuary.

The Symposium includes concurrent sessions with presentations on the research, restoration, and education efforts ongoing within the Lagoon. Specific presentations touch on everything from large-scale habitat restoration and water quality efforts down to the research and management of listed species within the lagoon. Following the morning and afternoon sessions, we will be hosting a special joint panel session focused on the issues affecting other estuary systems around the state, as well as the multi-faceted efforts and initiatives to address them. Upon completion of the sessions and panel, guests are invited to a Poster Session Social hosted at FPL's Manatee Lagoon.

We are proud to bring attention to our home waters while being represented by our Federal and State environmental agencies, multiple universities, non-profit organizations and technical consultants, all with a stake in the protection and management of the lagoon and its valuable resources.

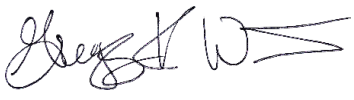
A very special thank you to our many sponsors whose collaboration and support truly made this event possible. Please enjoy your time here with us and Dive on In–It's Worth It!

Sincerely,

Senator Lori Berman

Senator Bobby Powell

Representative Mike Caruso



Vice-Mayor Gregg K. Weiss

THANK YOU TO OUR SPONSORS

Without their generous support, this symposium would not be possible.

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Palm Beach County

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lake worth lagoon

SCIENCE SYMPOSIUM

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South Florida Water Management District

Bronze Level

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ATM, a Geosyntec Company

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ATM, a Geosyntec Company, is an international leader in coastal engineering, marina consulting, and waterfront engineering. ATM provides comprehensive best-value solutions for nearshore, upland, and in-water improvements for our waterfront clients. Offices are located throughout Florida, the U.S., and internationally.

Chen Moore and Associates

www.chenmoore.com

Chen Moore and Associates (CMA) specializes in civil and electrical engineering, landscape architecture, planning, and environmental consulting. Locally, we have a significant focus on utilities, water resources, and public spaces as they effect the environment. From septic to sewer projects in several PBC parks, to structure replacements in Stormwater Treatment Areas and the planning and design of the transformation of Currie Park, our work supports ongoing improvements to the LWL.

Coastal Eco-Group Inc.

www.coastaleco-group.com

Coastal Eco-Group Inc. is a woman-owned environmental consulting firm with offices in Deerfield Beach and Village of North Palm Beach. Coastal Eco-Group was established in 2005 and represents over 100 years of collective professional experience in marine and estuarine ecological surveys, including coral reef, hardbottom and seagrass mapping, monitoring, and impact analysis; coral relocation and success monitoring; and development of nearshore hardbottom and seagrass habitat mitigation plans.

Cummins Cederberg

www.cumminscederberg.com

Cummins Cederberg is a consulting and engineering firm specializing in the marine and coastal environments - services include Coastal Engineering, Marine Engineering, Waterfront & Coastal Development, Environmental & Permitting.

Ecological Associates, Inc.

www.ecological-associates.com

EAI is a multi-disciplinary environmental consulting firm offering professional services focusing on species and ecosystem management, monitoring, and research. EAI scientists and associates have extensive experience providing environmental monitoring, permitting and consultation services in support of coastal construction, dredging operations, utility corridor construction/maintenance, stormwater management system improvements, and land conservation and management.

Fish & Wildlife Foundation of Florida

www.wildlifeflorida.org

The Fish & Wildlife Foundation of Florida is a nonprofit 501(c)(3) organization that seeks to protect our outstanding animals and plants and the lands and waters they need to survive. We work closely with the Florida Fish and Wildlife Conservation Commission (FWC) and many other public and private partners. Since our founding in 1994, we have raised and donated more than $60 million for conservation and outdoor recreation, including youth outdoor education.

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Florida Association of Environmental Professionals - Treasure Coast Chapter

www.tcc-faep.org

The Treasure Coast Chapter of FAEP is a group of environmental professionals dedicated to practicing with integrity, developing students and young professionals, providing a forum for information exchange, and improving our community through environmental projects.

Florida Fish & Wildlife Conservation Commission (FWC)

www.myfwc.com/

FWC regulates the state's fish and wildlife resources and enforces related laws and its mission is to manage fish and wildlife resources for their long-term well-being and the benefit of people.

Florida Inland Navigation District

www.AICW.org

The Florida Inland Navigation District (FIND) is a State special taxing district established for the continued navigational management and maintenance of Florida's Intracoastal Waterway (ICW) from the Georgia/ Florida border through Miami-Dade County and the Okeechobee Waterway (OWW) in Martin and Palm Beach Counties, working alongside the U.S. Army Corps of Engineers to maintain these waterways. FIND offers a grant assistance program for public development of waterway access and improvements.

Florida Power & Light Company

www.fpl.com/environment.html

As America's largest electric utility, Florida Power & Light Company serves more customers and sells more power than any other utility. FPL operates one of the cleanest power generation fleets in the U.S. At FPL, we go the extra mile to protect the air we breathe, the water and land we use and the plants and animals that share our planet. This includes Manatee Lagoon – An FPL Eco-Discovery Center® - designed to educate visitors on importance of helping manatees and protecting our ecosystem.

Force-E Scuba

www.force-e.com

The best scuba diving in Florida starts in West Palm Beach and at the Blue Heron Bridge. Force-E Scuba has diving and snorkeling centers strategically located to serve you and your access to the most incredible reefs and wrecks in Florida. Take classes, book a trip, get your gear and let's go explore.

Friends of Manatee Lagoon

www.friendsofmanateelagoon.org

Friends of Manatee Lagoon is dedicated to funding environmental exhibits, educational programs, and critical research projects that inform the community about the challenges manatees encounter in Florida's coastal regions.

LagoonKeepers.org

www.LagoonKeepers.org

LagoonKeepers.org is a local non-profit caring for our waters by removing flotsam and jetsam ranging from styrofoam cups to sunken vessels. In the last 20 years we have removed over 400 derelict vessels improving the water quality and safety for everyone.

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Lewis, Longman & Walker, P.A.

www.llw-law.com

For over 25 years, the attorneys at Lewis, Longman & Walker, P.A. have helped the individuals, businesses and governments that have shaped Florida's future. We offer solutions to issues associated with complex local, state, and federal laws and regulations. We focus on the specific, technical, and seemingly ever-changing areas of Environmental, Land Use, Legislative and Governmental Law. Offices in Jacksonville, St. Petersburg, Tallahassee, Tampa and West Palm Beach.

Manson Bolves Donaldson Tanner, P.A.

www.mansonbolves.com

Law Firm specializing in Water Law
Manson Bolves Donaldson Tanner is a Florida based law firm specializing in water, environmental, administrative, and governmental law as well as business, contracting and construction. We offer a full range of services, from siting and permitting through mediation or litigation. In addition, our legislative practice represents clients with local, regional, and state bodies. We assist our clients by negotiating with state and local agencies, and navigating issues through the complex, and sometimes conflicting, governmental process.

Marine Industries Association of Palm Beach County

www.marinepbc.org

The Marine Industries Association of Palm Beach County, Inc. (MIAPBC) is a not-for-profit organization created to promote and protect the sound growth of the marine industry in Palm Beach County for the benefit and education of its members, the community, and the environment.

Palm Beach County

discover.pbcgov.org/erm

ERM administers environmental programs that protect, preserve, and enhance Palm Beach County's natural resources on land and in and under water. ERM's programs include artificial reefs, coastal resources, mosquito control, resource protection, and over 31,000 acres of natural areas free for all to enjoy passive, nature-based activities such as hiking, bird watching, and environmental education.

Palm Beach County Diving Association

www.divepbc.com

The Palm Beach County Diving Association (PBCDA) is a not-for-profit organization whose purpose is to promote dive-related tourism in Palm Beach County, while at the same time ensuring the highest level of professionalism among the dive-oriented businesses. The Association's mission also includes promoting the reefs and surrounding underwater habitats as a sustainable resource that is essential to the South Florida Tourism economy.

Palm Beach County Fishing Foundation

www.westpalmbeachfishingclub.org

The Palm Beach County Fishing Foundation (PBCFF) is the charitable affiliate of the venerable West Palm Beach Fishing Club. The PBCFF was created as an extension of the Fishing Club to address specific educational outreach needs and issues related to fishing and the health of our resources. To accomplish this mission the PBCFF collaborates with local entities on various projects such as reef building, oyster enhancement, mangrove plantings, game fish tagging and other related efforts.

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Port of Palm Beach

www.portofpalmbeach.com

The Port of Palm Beach is a full-service diversified landlord port located in Riviera Beach, Florida. The port and its dozens of tenants continue to be a powerful engine for economic development and job creation; employing more than 3,800 people in the South Florida region and the state. Its efficiency is unparalleled, processing more than $14 billion in commodities, 2.5 million tons of cargo and 700,000 cruise passengers annually.

South Florida Water Management District

www.sfwmd.gov

The South Florida Water Management District (SFWMD) works to protect and restore America's Everglades, the largest ecosystem restoration effort in the world. The SFWMD is also responsible for regional water supply and flood protection infrastructure. Sound science and data are used to drive important decisions about the protection of South Florida's water resources and significant progress is being made on critical Everglades restoration projects located north, south, east, and west of Lake Okeechobee. Learn more at SFWMD.gov.

Tetra Tech

www.tetratech.com

Tetra Tech is a leading, global provider of consulting and engineering services. We are differentiated by Leading with Science® to provide innovative technical solutions to our clients. We support global commercial and government clients focused on water, environment, sustainable infrastructure, renewable energy, and international development. With 21,000 associates worldwide, Tetra Tech provides clear solutions to complex problems.

Town of Palm Beach

www.townofpalmbeach.com

Approximately 9,000 citizens make Palm Beach their year-round home, and about 20,000 more have a seasonal home in Palm Beach during the winter. Together, these residents of Palm Beach donate more money per capita to charities than any other community in America. A great many have helped to make the Town of Palm Beach the beautiful and special place that it has become over the last century, and we are dedicated to a strong community commitment, substantial investment, and a proactive vision for a coastal management program necessary for positive change.

THANK YOU SPONSORS

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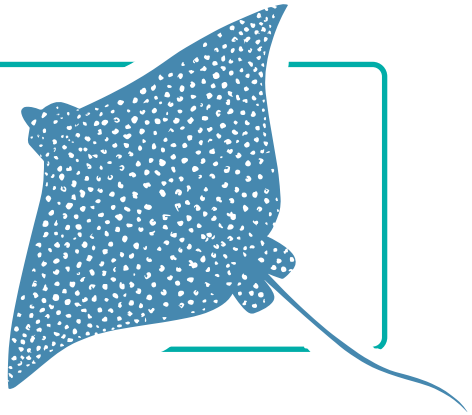

PLENARY SPEAKERS & PANELISTS

Albrey Arrington

Loxahatchee River District

Born and raised in Jupiter, FL, Albrey is passionate about healthy, functional natural systems. He holds a B.S. from the University of Florida, and a Ph.D. from Texas A&M University's. He is the Executive Director of the Loxahatchee River Environmental Control District, whose mission is to protect public health and preserve the Loxahatchee River watershed. Albrey has authored 55 peer-reviewed publications dealing with a diverse array of environmental issues.

Mayra Ashton

Palm Beach County Environmental Resources Management

Mayra helps design monitoring and restoration projects within Lake Worth Lagoon focused on habitat enhancement for estuarine flora and fauna. Mayra coordinated the update to the 2021 LWL Management Plan, identifying the most pressing restoration and management needs for this urban estuary. Prior to joining the County, Mayra worked throughout south Florida's diverse coastal and estuarine systems while employed with FDEP and SFWMD. She holds a Ph.D. in Biological Oceanography from the University of Puerto Rico and B.S. in Marine Sciences from University of Miami.

Jennifer Báez

Palm Beach County Environmental Resources Management

Leading the Ecosystem Management section for Palm Beach County Department of Environmental Resources Management, Jennifer's work focuses on restoring and enhancing estuarine habitats, conducting ecological monitoring and strategically planning for long term management of Lake Worth Lagoon. A south Florida native, Jennifer earned her bachelor and master's degrees at Florida State University's Dept. of Biological Science. She has worked for Palm Beach County ERM since 2015 and previously worked with FWC, DEP, and University of Miami as a contractor to NOAA.

Irela Bagué

Biscayne Bay

Irela Bagué is Miami-Dade County's first Chief Bay Officer (CBO). The CBO focuses on water quality issues, policies, and appropriations related to the health and recovery of Biscayne Bay. She acts as an advisor to the County Mayor and County Commission and a liaison between County departments and boards, external agencies, stakeholder groups, and local, state, and federal governments.

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Deborah Drum

Palm Beach County Environmental Resources Management

As Director of Palm Beach County ERM, Deborah Drum leads a team of scientists, engineers, project managers, and other environmental professionals focused on protecting, preserving and restoring Palm Beach County's natural land and water resources, including the Lake Worth Lagoon and Loxahatchee River. Ms. Drum has a long and distinguished career working on south Florida environmental issues, from protecting wetlands and restoring coastal and freshwater ecosystems, to responding to extensive and impactful cyanobacterial blooms, and working to improve water quality and protect the Indian River Lagoon. Ms. Drum has a Bachelor's degree from the University of Miami and a Master's degree from the University of Miami Rosenstiel School of Marine and Atmospheric Science in Marine Science Affairs.

Jennifer Hecker

Coastal & Heartland National Estuary Partnership

Jennifer Hecker is the Executive Director of the Coastal & Heartland National Estuary Partnership (CHNEP, part of the US EPA National Estuary Program), responsible for working with diverse stakeholders and local, state and federal governments to protect and restore water and wildlife habitat in the 10-county CHNEP area in Central and Southwest Florida. She serves as a Science Advisory Committee member to Everglades Restoration, as well as the Chair of the Environmental Advisory Committee for the Southwest Florida Water Management District.

Kathy Hill

Indian River Lagoon National Estuary

Kathy Hill is the Deputy Director for the Indian River Lagoon National Estuary Program (IRLNEP). Kathy graduated from the University of Massachusetts with a degree in Biology and worked in HIV/AIDS research before coming to Florida in 1995 to pursue a Masters' degree in Marine Biology. She graduated from Florida Institute of Technology in 1998 and worked in lagoon research for 9 years at the Smithsonian Marine Station before joining the NEP in 2007 as the Outreach and Education Coordinator. In 2016, Kathy became the Communications Director for the program and in 2018 became Deputy Director. Kathy works on developing and aligning the Program's internal and external communications and public outreach strategies, managing contracts, and developing print, web, and social media publications.

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Megan Houston

Palm Beach County Office of Resilience

Megan leads the County's climate mitigation, climate adaptation, and sustainable development initiatives. Prior to this role, Megan advocated for energy efficiency in multifamily buildings with the Institute for Market Transformation. She has interned with the U.S. Environmental Protection Agency and the New York City Department of Environmental Protection. Megan holds a J.D. from Brooklyn Law School, an M.S. in Urban Environmental Systems Management from Pratt Institute, and a B. Design from the University of Florida.

Matt Mitchell

Palm Beach County Environmental Resources Management

Matt serves as Manager of the Environmental Enhancement and Restoration Division for Palm Beach County's Department of Environmental Resources Management. His responsibilities include the oversight of habitat restoration projects and environmental regulatory programs, as well as the development and implementation of management plans, listed species protection plans and resource conservation strategies. He is a Florida native who has spent his entire career in the environmental field in both the public and private sectors. Matt holds a Bachelor's Degree from Florida State University and a Master's Degree in Marine Biology and Coastal Zone Management from Nova Southeastern University's Oceanographic Center.

Lindsey Nieratka

City of Boca Raton Office of Sustainability

Lindsey Roland Nieratka joined the City of Boca Raton in 2018. As the City's first Sustainability Manager. Prior to joining the City of Boca Raton Ms. Nieratka was the sustainability coordinator for the City of Hollywood, FL, has worked for environmental non-profits, and served as a Peace Corps volunteer. She currently lives in Boca Raton.

LTC Todd Polk

U.S. Army Corps of Engineers

Lieutenant Colonel Todd Polk joined the Jacksonville District as the Deputy District Commander for South Florida, U.S. Army Corps of Engineers in August 2019. In his capacity he oversees the planning, construction, and operations of US Army Corps projects in central and south Florida with a Congressionally appropriated annual budget of $1.5 billion. During his 24 year career, Lieutenant Colonel Polk, served in leadership positions from Platoon Leader to Battalion Executive Officer; he has multiple overseas operational and combat deployments, and now a resident of Loxahatchee, with two young children attending Palm Beach County Schools.

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Thomas Reinert

Florida Fish and Wildlife Conservation Commission

Dr. Thomas Reinert is Regional Director for the Florida Fish and Wildlife Conservation Commission (FWC) South Region. Prior to that, Tom spent 11 years as a Research Administrator in FWC's Manatee Rescue and Recovery Program, supervising manatee field staff across the state. Tom grew up in Athens, Georgia, attended Wake Forest University (B.S.) and Louisiana State University (M.Sc.) before returning to Athens and the University of Georgia for his Ph.D.

Tom Twyford

West Palm Beach Fishing Club

Tom Twyford is a graduate of Marshall University with a degree in Parks and Conservation. Before moving to Palm Beach County, Twyford lived in the Florida Keys working for the Boy Scouts of America at the Florida High Adventure Sea Base. He has worked at the West Palm Beach Fishing Club since 1988 and is the organization's President. Tom is 2022's recipient of the Atlantic Coast Fish Habitat Conservation Melissa Laser Fish Habitat Conservation Award. This annual Award is bestowed upon individuals deemed to further the conservation, protection, restoration, and enhancement of habitat for native Atlantic coastal, estuarine-dependent, and diadromous fishes in a unique or extraordinary manner.

DETAILED AGENDA

	TUESDAY, NOVEMBER 15, 2022
7:30am	**Doors Open: Attendee Arrival and Registration** Sponsors Move-in Display Materials
7:30am-8:30am	**Coffee, Tea & Networking in the Sponsor Display Area**
8:30am-9:35am	**OPENING GENERAL SESSION** [Newcomb Hall Ballroom]
8:30am	Welcome — ***Mayra Ashton,*** Palm Beach County Environmental Resources Management
8:35am	Introduction — ***Deborah Drum,*** Department Director, Palm Beach County Environmental Resources Management
8:50am	Federal Partnering on Eco-Island Creation within Lake Worth Lagoon — ***LCT Todd F. Polk,*** U.S. Army Corps of Engineers
9:05am	Lake Worth Lagoon Wildlife Interconnectivity — ***Thomas Reinert,*** Florida Fish and Wildlife Conservation Commission
9:20am	Assessing Climate Change Vulnerabilities and Impacts in Southeast Palm Beach County and Beyond — ***Megan Houston*** *and* ***Lindsey Nieratka,*** Palm Beach County Office of Resilience and City of Boca Raton Office of Sustainability
9:35am-10:05am	**Morning Refreshment Break & Networking**

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	CONCURRENT SESSIONS	
	SESSION 1	**SESSION 2**
	[Newcomb Hall East]	**[Newcomb Hall West]**
10:05am-11:55am	**Habitat & Biological Resources**	**Water & Sediment Resources**
Moderator	***Erin McDevitt,*** Florida Fish and Wildlife Conservation Commission	***Phyllis Klarmann,*** South Florida Water Management District
10:05am	**Session Introduction**	**Session Introduction**
10:10am	Status of Seagrasses in the Lake Worth Lagoon: Palm Beach County's Long-Term Monitoring Program — ***Cheryl Miller,*** Coastal Eco Group	Water Quality Patterns and Trends in Lake Worth Lagoon and Northern Biscayne Bay — ***Christopher Buzzelli,*** Coastal Ecosystems, LLC.
10:25am	Historical Manatee Use and FPL's Riviera Beach Energy Center — ***Kristin Eaton,*** Florida Power & Light	Changes in Nitrogen and Phosphorus within a Decade in Waters along a Major Canal and Estuary in South Florida — ***Mohsen Tootoonchi,*** University of Florida
10:40am	A History of Fisheries Monitoring Effort in Lake Worth Lagoon, Palm Beach County, Florida — ***Jacob Schneider,*** Florida Fish and Wildlife Conservation Commission	C-51 Reservoir Project- Benefits to LWL and the Loxahatchee River — ***Ernie Cox,*** Family Lands Remembered, LLC.
10:55am	Establishing an Acoustic Footprint in Lake Worth Lagoon Through Collaboration — ***Sarah Webb,*** Florida Fish and Wildlife Conservation Commission	C-51 Sediment Trap - Preventing Sediment Loading to Lake Worth Lagoon — ***Tom Conboy,*** South Florida Engineering and Consulting
11:10am	Green Turtles *(Chelonia mydas)* in an Urban Estuary System: Lake Worth Lagoon, Florida — ***Jeffrey Guertin,*** Inwater Research Group, Inc.	PBC-ERM's Role in Water Quality Monitoring Efforts for the Lake Worth Lagoon — ***Aleah Ardelean,*** Palm Beach County Environmental Resources Management
11:25am	Research and Conservation of South Florida's Juvenile Manta Rays — ***Jessica Pate,*** Marine Megafauna Foundation	Microplastics in the Surface Waters and Mangrove Sediments of the Lake Worth Lagoon — ***Kayla O'Brien,*** Florida Atlantic University
11:40am	Shorebirds, Seabirds, and Management at the Lake Worth Lagoon — ***Kimberly Rigano,*** Florida Fish and Wildlife Conservation Commission	Historical Changes in the Lake Worth Inlet Flood Shoal — ***Leonard Barrera Allen,*** Cummins Cederberg, Inc.
11:55am-1:05pm	**Group Luncheon on the Rooftop Terrace**	

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	CONCURRENT SESSIONS	
	SESSION 3	**SESSION 4**
	[Newcomb Hall East]	**[Newcomb Hall West]**
1:05pm-2:55pm	**Environmental Restoration & Enhancement**	**Education, Public Outreach & Partnerships**
Moderator	***Jennifer Báez,*** Palm Beach County Environmental Resources Management	***Alicia Andersen,*** Palm Beach County Environmental Resources Management
1:05pm	**Session Introduction**	**Session Introduction**
1:10pm	Evaluation of Shoreline Conditions of Lake Worth Lagoon — ***Melinda Donnelly,*** University of Central Florida	Sustainable Education: A Local Case Study in an Educational Paradigm Shift — ***Melissa Landis,*** Lake Worth Waterkeeper
1:25pm	An Overview of Coral Monitoring, Restoration, and Education Efforts At Peanut Island — ***Leneita Fix,*** The Reef Institute	Virtual LIVE Field Trips: Connecting Kids with Nature — ***Benji Studt,*** Palm Beach County Environmental Resources Management
1:40pm	17 Years of Oyster Monitoring in the Lake Worth Lagoon — ***Nicole Maloney,*** Florida Fish and Wildlife Conservation Commission	Using Citizen Science to Investigate Marine Debris Motion in the Lake Worth Lagoon Region — ***Amanda Waite,*** ANGARI Foundation
1:55pm	Lake Worth Lagoon Restoration: Partnerships and Beneficial Reuse of Dredge Material at Tarpon Cove — ***Eric Anderson,*** Palm Beach County Environmental Resources Management	Manatee Lagoon: The Importance of Public Education and Outreach during an Unusual Mortality Event — ***Rachel Shanker,*** Manatee Lagoon
2:10pm	The American Oystercatcher and Lake Worth Lagoon Habitat Restoration: A Fortuitous History of Success — ***David Carson,*** Palm Beach County Environmental Resources Management	Building an Innovative Resilient Island through a Public-Private-NGO Partnership — ***Joseph Schmidt,*** The Nature Conservancy
2:25pm	The Harbor Branch Seagrass Nursery for Seagrass Restoration in the Indian River Lagoon — ***Dennis Hanisak,*** Florida Atlantic University Harbor Branch Oceanographic Institute	Visualizing Sea Level Rise in West Palm Beach — ***Serena Hoemann,*** Florida Atlantic University
2:40pm	Can Submerged Aquatic Vegetation be a Tool? — ***Ryan Brushwood,*** Sea & Shoreline, LLC.	Currie Park: Parks Equity and Resiliency in West Palm Beach — ***Cristobal Betancourt,*** Chen Moore and Assoc.
2:55pm-3:25pm	**Afternoon Refreshment Break & Networking**	

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3:25pm	**General Session:** [Newcomb Hall Ballroom] **"Estuary Partner Panel – The Future of Florida Estuaries "** Moderator: **Matt Mitchell**, Palm Beach County Environmental Resources Management **PANELISTS:** ***Albrey Arrington,*** Loxahatchee River District ***Irela Bagué,*** Biscayne Bay ***Jennifer Hecker,*** Coastal and Heartland National Estuary Partnership ***Deborah Drum,*** Lake Worth Lagoon ***Kathy Hill,*** Indian River Lagoon National Estuary
4:15pm	**Featured Presentation:** Conservation through Collaboration, ***Tom Twyford,*** West Palm Beach Fishing Club
4:30pm	**Presentation of the Melissa Laser Fish Habitat Conservation Award** ***Kent Smith,*** Florida Fish & Wildlife Conservation Commission (FFWCC) on behalf of the Atlantic Coast Fish Habitat Conservation This award is bestowed annually upon individuals deemed to further the conservation, protection, restoration, and enhancement of habitat for native Atlantic coastal, estuarine-dependent, and diadromous fishes in a unique or extraordinary manner. The award was established in memory of Dr. Melissa Laser, who was a biologist with the Maine Department of Marine Resources where she worked tirelessly to protect, improve, and restore aquatic ecosystems in Maine and along the entire Atlantic coast.
4:40pm	Closing Remarks — ***Mayra Ashton,*** Palm Beach County Environmental Resources Management
4:45pm	**Sessions Conclude** (Sponsors Remove Displays)
5:00pm-7:00pm	**Poster Session Social at Manatee Lagoon - An FPL Eco-Discovery Center** [6000 N. Flagler Drive, West Palm Beach, FL 33407]
7:00pm	**SYMPOSIUM CONCLUDES**

NOTES

POSTER SESSION SOCIAL

Held at Manatee Lagoon - An FPL Eco-Discovery Center

November 15, 2022 | 5:00pm-7:00pm | 6000 N. Flagler Drive, West Palm Beach, FL 33407

FRIENDS
OF MANATEE LAGOON

On behalf of our board and our volunteers, we are proud to host the post-symposium Poster Presentation Social at Manatee Lagoon because the work that will be shared is directly tied to our mission. The more we know, the better equipped we are to protect our Lagoon. The tipping point for water quality in Florida is upon us and it is conversations like this, by people who care, that can put us on the right path. We thank the members and sponsors associated with the 2022 Lake Worth Lagoon Science Symposium.

Friends of Manatee Lagoon (FOML) is a nonprofit organization dedicated to expanding environmental education opportunities for all ages in Palm Beach County and beyond through future enhanced exhibits and experiential learning opportunities. The ongoing challenges Florida manatees face have propelled interest in understanding how the health of our estuaries, including Lake Worth Lagoon, is so critical. Our team is honored to welcome the scientists and researchers who have invested and shared their time and talents to study our local waterways and to understand and record their findings.

FOML is located in Riviera Beach, FL., and is situated at Manatee Lagoon – An FPL Eco-Discover Center, along the Lake Worth Lagoon estuary. FOML works with environmental partners to conduct research and present information that will lead to healthier coastal ecosystems.

POSTER INSTALL & REMOVAL TIMES

Poster Installation:	**Tuesday, November 15, 4:45pm–5:00pm** Once sessions conclude at the Marina Village Event Center, go to Manatee Lagoon, and put your poster on the assigned board by 5:00pm. Posters will be on display in the main room on the second floor.
Poster Removal:	**Tuesday, November 15, 7:00pm**
***Organizers are not responsible for lost posters discarded by the board vendor. Thank you.**	

POSTER DIRECTORY

Posters are listed in order by **presenter last name**.

Poster #	First Name	Last Name	Organization	City	ST	Topic	Abstract Title
5	Alicia	Andersen	Palm Beach County Environmental Resources Management	West Palm Beach	FL	Education, Public Outreach & Partnerships	LagoonFest: Connecting Our Community with Lake Worth Lagoon
24	Eric	Anderson	Palm Beach County Environmental Resources Management	West Palm Beach	FL	Environmental Restoration & Enhancement	Lake Worth Lagoon Restoration: Partnerships and Beneficial Reuse of Dredge Material at Tarpon Cove
23	Katelyn	Armstrong	Palm Beach County Environmental Resources Management	West Palm Beach	FL	Environmental Restoration & Enhancement	Artificial Reefs of the Lake Worth Lagoon
3 & 4	Mayra	Ashton	Palm Beach County Environmental Resources Management	West Palm Beach	FL	Education, Public Outreach & Partnerships	2021 Lake Worth Lagoon Management Plan - Watershed Management Approach
2	Carolyn	Beisner	Palm Beach County Environmental Resources Management	West Palm Beach	FL	Education, Public Outreach & Partnerships	Sawfish Island Restoration Project
9	Chelsea	Bennice	Florida Atlantic University	Boca Raton	FL	Habitat & Biological Resources	Unique Skin Microbiome: Insights to Understanding Octopus Health in a South Florida Lagoon
22	David	Carson	Palm Beach County Environmental Resources Management	West Palm Beach	FL	Environmental Restoration & Enhancement	The Bonefish Cove Habitat Enhancement Project
14	Thomas	Chesnes	Palm Beach Atlantic University	West Palm Beach	FL	Habitat & Biological Resources	Seagrass Abundance and Diversity in Lake Worth Cove: Trends from 2010-2022
28	Haley	Davis	FAU Harbor Branch Oceanographic Institute	Vero Beach	FL	Water Quality & Sediment Quality	Hyposalinity Tolerance Thresholds and Disease Susceptibility in Two South Florida Stony Coral Species
30	Jeff	Eble	Florida Institute of Technology	Melbourne	FL	Water Quality & Sediment Quality	Implications of Enhancing Oceanic Exchange to Improve Lagoon Water Quality: Preliminary Findings and Pilot Project Design
20	Leneita	Fix	The Reef Institute	West Palm Beach	FL	Environmental Restoration & Enhancement	An Overview of Coral Monitoring, Restoration, and Education Efforts at Peanut Island
13	Rachel	Harris	Loxahatchee River District	Jupiter	FL	Habitat & Biological Resources	*Labyrinthula protists* on Seagrass in the Loxahatchee River Estuary?
1	Serena	Hoermann	Florida Atlantic University	Jupiter	FL	Education, Public Outreach & Partnerships	Visualizing Sea Level Rise in West Palm Beach
19	Kelly	Kibler	University of Central Florida	Orlando	FL	Environmental Restoration & Enhancement	Hydrodynamic Modeling Applied to Design of Living Shorelines in Lake Worth Lagoon

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Poster #	First Name	Last Name	Organization	City	ST	Topic	Abstract Title
26	Phyllis	Klarmann	South Florida Water Management District	West Palm Beach	FL	Water Quality & Sediment Quality	Interagency Coordination for Water Quality Monitoring in the Lake Worth Lagoon
16	Anne	Laird	Cummins Cederberg, Inc.	Jupiter	FL	Habitat & Biological Resources	Key Elements in Successful Coral Relocation, Survivorship, and Resiliency during Jetty Reconstructions in South Florida
Web Only	Bill	Louda	Florida Atlantic University	Boca Raton	FL	Habitat & Biological Resources	*In situ* Monitoring of Seagrass Epiphytes, Mesograzers and the Macrograzers they Support
6	Katherine	Marin	University of Florida/ IFAS	Homestead	FL	Education, Public Outreach & Partnerships	Building Resource Capacity for Underserved Youth in the Topic of Lagoon Ecosystems (18-24)
8	Carole	Marshall	Broward Shell Club	Lake Worth Beach	FL	Education, Public Outreach & Partnerships	Mollusks of the Lake Worth Lagoon
10	Brent	McKenna	Florida Atlantic University	Davie	FL	Habitat & Biological Resources	Site Fidelity, Home Range, and Movement of Mutton Snapper *(Lutjanus analis)* in the Lake Worth Lagoon
17	Jerry	Metz	Loxahatchee River District	Jupiter	FL	Habitat & Biological Resources	Using HOBO Pendant Light Loggers to Determine Water Column Light Attenuation Coefficient (Kd) in the Loxahatchee River Estuary
15	Anthony	Milluzzo	Bentley University	Waltham	MA	Habitat & Biological Resources	Spatial and Temporal Trends in Long-term Seagrass Coverage in Palm Beach County, Florida
27	Kayla	O'Brien	Florida Atlantic University	Boca Raton	FL	Water Quality & Sediment Quality	Microplastics in the Surface Waters and Mangrove Sediments of the Lake Worth Lagoon
21	Beth	Orlando	Palm Beach County Environmental Resources Management	West Palm Beach	FL	Environmental Restoration & Enhancement	Providencia Cay Habitat Restoration: The Key West of the West Palm Beaches
12	Richard	Paperno	Florida Fish & Wildlife Conservation Commission	Melbourne	FL	Habitat & Biological Resources	Identification of Fish Habitat Hotspots and Suitability for Use in Prioritizing Conservation and Restoration Projects in Coastal Rivers
7	Lydia	Pleasants	ANGARI Foundation	West Palm Beach	FL	Education, Public Outreach & Partnerships	Using Citizen Science to Investigate Marine Debris Motion in the Lake Worth Lagoon Region
18	Landolf	Rhode-Barbarigos	University of Miami	Coral Gables	FL	Environmental Restoration & Enhancement	SEAHIVE: A Shoreline Protection System That Supports Environmental Restoration
29	John	Roberts	UF/IFAS Palm Beach County Extension	W. Palm Beach	FL	Water Quality & Sediment Quality	Soil Denitrification Dynamics in Urban Impacted Riparian Zones throughout Tampa, FL
25	John	Sprague	JH Sprague Consulting. LLC	Stuart	FL	Water Quality & Sediment Quality	Managed Mooring Fields, Reducing Environmental Impacts

ABSTRACT COMPILATION

Abstracts are listed in alphabetical order by **presenter last name**.

LagoonFest: Connecting Our Community with Lake Worth Lagoon

Alicia Andersen
Public Outreach, Palm Beach County Environmental Resources Management, West Palm Beach, FL

LagoonFest started as a grass-roots effort in 2014 organized by the Lake Worth Lagoon Initiative partners (Palm Beach County Environmental Resources Management, South Florida Water Management District, Florida Department of Environmental Protection, Florida Inland Navigation District and Palm Beach County League of Cities) along with Discover the Palm Beaches (DTPB). A festival to celebrate the lagoon's natural, recreational, aesthetic, and economic value and to facilitate awareness and a real connection to this vital urban estuary. Situated along the lagoon waterfront in downtown West Palm Beach, LagoonFest encourages attendees to enjoy playing, learning, mingling with lagoon themed mascots, participating with exhibitors as well as uniquely experiencing Lake Worth Lagoon ON the water with guided boat tours, kayak tours, Yoga paddleboard lessons and more. Come discover and learn about habitat restoration efforts happening in this urban estuary.

Lagoonfest has enthusiastically developed into an annual festival with thousands of visitors that enjoy the interactive and informative exhibits offered by passionate, eco-themed partners. Many governmental, academic, and non-profit organizations, although very diverse in what they bring to the event, collectively, they make an impact connecting attendees to the lagoon and offering ways to become involved in protecting this critical estuary habitat.

DISCOVER A LOCAL TREASURE: LAKE WORTH LAGOON

What did Lagoonfest accomplish? How do we measure its success?

The Intracoastal Waterway, just a highway for boat traffic? NO WAY! It is Lake Worth Lagoon, our urban estuary that needs awareness, protection, and service!

-List of LWLI partners and DTPB

-List of exhibitors

-Pictures of Lagoonfest

Lake Worth Lagoon Restoration: Partnerships and Beneficial Reuse of Dredge Material at Tarpon Cove

Eric Anderson
Palm Beach County Environmental Resources Management, West Palm Beach, FL

Tarpon Cove is Palm Beach County's newest habitat creation project in Lake Worth Lagoon (LWL), the county's largest estuary. Tarpon Cove's design began in 2017 and has since blossomed into not only incredible new habitat, but a shining example of what can be done with broad partnerships between municipalities, local governments, state agencies, the federal government, businesses, and the community. Thus far, the Florida Fish and Wildlife Conservation Commission (FWC) and Department of Environmental Protection have helped the county secure $3.8 million in state and federal funding for the project, and the Rybovich Superyacht Marina, Town of Palm Beach and The Florida Inland Navigation District have collectively donated $11 million worth of clean sand for the restoration work.

This restoration project will create over 45 acres of habitat that includes five mangrove islands in addition to seagrass and oyster reef, providing long term wildlife and water quality benefits within LWL. The construction process builds marine habitat by filling existing dredge holes (biological "dead zones"), raising the lagoon floor elevation to create a shallow, sun-drenched bottom surface for seagrass recruitment. The islands encourage the recruitment of oysters and mangroves, both critical species that improve water quality and overall health benefits for the LWL ecosystem. In addition to the formation of valuable marine habitat, the finished project offers a natural breakwater along an extensive concrete sea walled shoreline of the lagoon, helping to protect critical infrastructure. After the first islands were completed in 2020, the sandy shores of Tarpon Cove became green with the help of 100 volunteers from the El Cid community, the West Palm Beach Fishing Club, Lagoon Keepers, Palm Beach Day Academy, Conservation Conservatory School, MANG Gear, Lake Worth Waterkeepers, and FWC who planted 2,500 mangroves and 4,000 cordgrass plants. A second volunteer planting event will be scheduled later this year to plant the latest islands completed. The cherry on top of this success story is that for a second year in a row, American Oystercatchers, Black Skimmers and Least Terns have nested on the newly created islands.

PBC ERM's Role in Water Quality Monitoring Efforts for the Lake Worth Lagoon

Aleah Ardelean
Palm Beach County Environmental Resources Management, West Palm Beach, FL

Palm Beach County Environmental Resource Management (ERM) Staff have been performing water quality monitoring in the Lake Worth Lagoon for over 30 years. We have an established partnership with both South Florida Water Management District (SFWMD) and Florida Department of Environmental Protection (FDEP) to collect surface water grab samples and monitor physical parameters for a total of 33 sites combined. There are three major freshwater canals that discharge into the lagoon that carry various amounts of nutrients, suspended, and dissolved organic matter, contaminants, and toxins. Water quality monitoring data is used to determine if water bodies meet the water quality standards for specific parameters. The parameters we collect for are: Ammonia, Nitrite-Nitrate, Total Nitrogen, Total Phosphorus, Ortho-phosphorus, Chlorophyll-a, Total Suspended Solids, and Turbidity. We also record data from a multi-parameter YSI water quality meter that provides us with temperature, pH, specific conductivity, salinity, and dissolved oxygen levels. DEP uses this data to determine if water bodies exceed the standard nutrient criteria limit and if so, are deemed impaired. If a water body is deemed impaired, such as the central segment of the Lake Worth Lagoon, it may require an establishment of a Total Maximum Daily Load to limit the discharge of the pollutant(s) of concern. All of the data we collect is entered into databases, and is shared with local governments, State Agencies, and stakeholders to track water quality conditions, determine trends, upstream water management operations, and long-term restoration projects. We also assist with two high-frequency salinity sondes that were deployed and maintained in partnership with the SFWMD in 2019 to monitor and document salinity in the Central Lagoon. The County maintains its own salinity probes at John's Island Natural Area and at Munyon Cove. The overall goal of our program is to reduce nutrient loadings from land-based sources to meet water quality targets and support living resources. Also, to reduce bacterial contamination and Harmful Algal Blooms such as Blue-Green Algae in order to maintain recreational uses and ecological health.

Artificial Reefs of the Lake Worth Lagoon

Katelyn Armstrong *and Jena McNeal*
Palm Beach County Environmental Resources Management, West Palm Beach, FL

Palm Beach County is home to 47 miles of natural reef habitat and over 150 artificial reefs. Of those artificial reefs, 20 are located within the Lake Worth Lagoon. Each with a slightly different design, these man-made structures have been intentionally placed to enhance fisheries with new habitat and improve recreational opportunities for fishing, SCUBA diving, and snorkeling. This field-based study looked at 1) the various locations of artificial reefs currently located in the Lake Worth Lagoon, 2) how each structure varies by material, depth, and overall design, and 3) what type of marine life they are supporting.

2021 Lake Worth Lagoon Management Plan - Watershed Management Approach

Mayra Ashton[1]*, Jennifer Báez*[1]*, Matt Mitchell*[1] *and Nanette O'Hara*[2]

[1]Palm Beach County Environmental Resources Management

[2]O'Hara Communications, LLC

The fourth iteration of the Lake Worth Lagoon's Management Plan was adopted by the Palm Beach County Board of County Commissioners on July 13, 2021. The first management plan was adopted in 1998, followed by three updates in 2008, 2013 and most recently 2021. This latest plan identifies the priorities for the management, restoration, and protection of the Lagoon for the next decade.

This is the first plan to strategically include a watershed-based management approach that looks beyond the Lagoon's boundaries to incorporate its watershed in its management. This is a critical step since the health of the Lagoon is intrinsically linked to the land use characteristics and inputs received from its vast watershed that is 42 times the size of the Lagoon itself.

The Lagoon is bordered by 13 municipalities, from the Village of North Palm Beach in the north to the Town of Ocean Ridge in the south, but its watershed includes over 30 municipalities and unincorporated areas, in addition to 8 independent drainage or water management districts. There are close to 1 million residents that are part of the Lagoon's watershed and hence linked to the Lagoon.

The plan lays out 25 action plans that identify the management priorities for the Lagoon. These are organized into six sections which include Water and Sediment Quality, Habitat Enhancement and Protection, Fish and Wildlife Monitoring and Protection, Climate Change and Sea Level Rise, Public Outreach and Engagement and Public Uses of the Lagoon.

The successful implementation of the strategies identified for management of the Lagoon, including the restoration of water quality, protection of fish and wildlife and enhancement of its unique estuarine habitats requires coordinated efforts from all of the agencies with management responsibilities, including local, state, regional, and federal entities as well as the stakeholders and the community which work, live and enjoy the natural resources found throughout the Lagoon and its watershed.

It is crucial to work towards revitalizing and maintaining this important estuary for the long term not only for the diverse environmental and biological resources found here but also for the vast quality of life, recreational and economic benefits the Lagoon provides to the residents and visitors to this region.

The management plan was designed to be viewed on a digital platform versus print and can be accessed at https://discover.pbcgov.org/erm/Publications/LWLManagementPlan2021.pdf

Historical Changes in the Lake Worth Inlet Flood Shoal

***Leonard Barrera Allen**, PE, WEDG, ENV SP, CFM, Jannek Cederberg, PE, Jordon Cheifet, PE, CFM*
Cummins Cederberg, Inc.

This presentation will discuss the Coastal Engineering Analysis conducted to evaluate the potential effects of dredging areas of the Lake Worth Inlet flood shoal. The primary topic of interest is the development and calibration of a numerical model to simulate the hydrodynamic conditions within the flood shoal and surrounding waterways under the existing and proposed conditions to evaluate the current speeds and flows. An analysis of historical aerial photography dating back to 1947 to understand the flood shoal development over the last 70 years will be presented. The alternatives analysis will be discussed, which includes multiple dredging configurations to understand the sensitivity of the current speeds and flows relative to the proposed improvements.

The flood shoal is located between Peanut Island and Lake Worth Inlet and is a valuable recreational and biological resource within Lake Worth Lagoon in Palm Beach County. The proposed dredging is designed to increase access to the interior of the shoal, increase the navigable waterway east of the shoal, and improve access for law enforcement and first responders. Furthermore, the dredging of the central flood channel and the eastern perimeter will partially restore the sediment deposition capacity of the shoal, thereby reducing sedimentation in the adjacent navigational channels. The data collection effort and iterative design process to minimize impacts to seagrasses will also be presented.

Sawfish Island Restoration Project

Carolyn P. Beisner
Palm Beach County Environmental Resources Management

Sawfish Island, a 9.27-acre parcel, is located in the Loxahatchee River-Lake Worth Creek Aquatic Preserve along the Intracoastal Waterway 1.27 miles southwest of the Jupiter Inlet. Florida Inland Navigation District (FIND) owns 3.65 acres of land on Sawfish Island that was used for dredged material management. The remaining approximately 5.5 acres of mangrove community surrounding the FIND spoil areas is state-owned. The goals of this project are: (1) remove 2.65 acres of exotic vegetation and excavate the infested uplands to wetland elevations to provide additional habitat for fish and wildlife; (2) stabilize two inlets to the wetland basins and connect the two wetland basins via a historic mangrove ditch to improve flushing to the mangrove community; and (3) provide public access and promote environmental education and recreational opportunities.

The project includes the excavation of impacted uplands to create 1.46 acres of submerged basins and 0.22 acres of mangroves, the creation of 0.31 acres of mixed hardwoods and the restoration 0.54 acres of mixed hardwoods, and the restoration 0.65 acres of existing mangrove habitat. In addition, limerock riprap will be placed at the inlets for stabilization and potential oyster habitat. Public access features on the uplands include picnic benches and an informational kiosk.

Unique Skin Microbiome: Insights to Understanding Octopus Health in a South Florida Lagoon

Chelsea O. Bennice[1]*, Lauren Krausfeldt*[2]*, W. Randy Brooks*[1]*, Jose V. Lopez*[2]

[1]Charles E. Schmidt College of Science, Florida Atlantic University, FL

[2]Halmos College of Arts and Sciences, Nova Southeastern University, FL

Coastal marine ecosystems are among the most important providers of biodiversity and ecosystem services, but at the same time are heavily impacted by threats that could risk the health of key species to marine food webs. Despite their small size, microbes play a critical role in the physiology of animal hosts; however, little is known about bacterial symbionts with octopus and whether such associations may aid in octopus health. We analyzed the skin microbiome of two octopus species (*Octopus vulgaris* and *Macrotritopus defilippi*) along with environmental samples (sediment and water) to characterize the microbiomes within the Lake Worth Lagoon and to determine if octopus have a unique skin microbiome. High throughput sequencing (HTS) of the bacterial 16S rRNA gene (V3-V4 region) amplicons was performed using an Illumina MiSeq. Linear Discriminant Analysis (LDA) Effect Size (LEfSe) identified taxa and their relative abundances. . Microbial communities differed between octopus, sediment, and water samples. Alpha diversity was greatest for sediment, followed by octopus and water microbiomes, respectively. Actinobacteria, Proteobacteria, Chloroflexi, and Planctomycetes were the most abundant groups comprising sediment microbiomes with Bacteroidetes and Proteobacteria being most abundant in the octopus and water microbiomes, respectively. Flavobacteriia and Sphingobacteriia were two major classes representing Bacteriodetes for the octopus microbiome. These groups have been known to be pathogen-suppressing members. Specifically, Sphingobacteriia participate in multiple biological functions such as acting as receptors for toxins and predation of other bacteria and algae (Saprospiraceae). This was the first study to characterize the octopus skin microbiome with HTS of wild octopuses. Understanding the importance of bacterial symbionts can provide insight to the physiology and ultimately the health of these important animals in coastal and shallow marine environments.

Currie Park: Parks Equity and Resiliency in West Palm Beach

*Leah Rockwell, CPRP[1], Gina Chiello, WEDG[2], and **Cristóbal Betancourt**, PLA, AICP[3]*

[1]City of West Palm Beach, West Palm Beach, FL

[2]Cummins Cederberg, Jupiter, FL

[3]Chen Moore and Associates, West Palm Beach, FL

Currie Park was donated to the City of West Palm Beach in the 1920's by the City's former mayor, George Graham Currie. The park has served multiple generations of City residents providing opportunities for recreation along the water. It lies within the boundaries of the Northwest and Pleasant City CRA in West Palm Beach on the Lake Worth Lagoon. Learn how the current design was developed through extensive public engagement with the community to provide equity, resiliency, and economic opportunity for the north end neighborhoods of West Palm Beach. The park incorporates design strategies providing an inclusive user experience, creating opportunities for local business to support the activation and management of the park, and improving the park's environmental footprint. Our team's goals included developing an active park that accommodates current uses and incorporates new activities including improved water access for the public. The design includes best management practices for stormwater management to improve water quality; introduction of native landscaping to mitigate urban heat island effect and provide habitat for urban wildlife; the replacement of a failing seawall with rock revetment, living shoreline and mangrove restoration; and protection and restoration of existing seagrasses. In addition to active park uses such as playgrounds, sports courts, kayak launches, and fishing piers, the park will also provide educational programs and opportunities to learn about the park's history, the local environment and its flora and fauna. The design, permitting, and construction of the $30 million project is financially supported by the City of West Palm Beach, Community Redevelopment Agency, City of West Palm Beach Parks Bond, Florida Department of Economic Opportunity, Florida Building Resiliency Grant, and the Land and Water Conservation Fund.

Can Submerged Aquatic Vegetation be a Tool?

*Carter Henne, **Ryan Brushwood**, Katie Krammer, and Barchan Rodgers*
Sea & Shoreline LLC., Ruskin, FL

Submerged Aquatic Vegetation (SAV) can be used as a tool to enhance ecosystem services. This presentation will discuss which SAV ecotype and/or species is the best tool for the desired outcome. Additionally, this presentation will discuss the proper usage of SAV by reviewing demonstration projects where they have been successfully implemented in South Florida.

Water Quality Patterns and Trends in Lake Worth Lagoon and Northern Biscayne Bay

Christopher Buzzelli
Coastal Ecosystems LLC, Wilmington, NC

Lake Worth Lagoon (LWL) and North Biscayne Bay (NBB) have an abundance of shallow water habitat, essential living resources, and recreational possibilities. The two water bodies possess hardened shorelines, three canal discharge points, and similar bathymetric and flushing characteristics. Intense urbanization of the watershed with associated changes in canal inflow and material loading have impacted water and habitat quality. In fact, LWL and NBB each lost ~80% of seagrass habitat cover in recent years. This research effort combined two separate assessments of discharge, nutrient loads, and water quality patterns and trends in LWL and NBB. Time series analysis was used to evaluate trends in LWL inflow and salinity, chlorophyll a (CHL; µg L^{-1}), total nitrogen (TN; mg L^{-1}), total phosphorus (TP; mg L^{-1}), total suspended solids (TSS; mg L^{-1}), and turbidity (TURB; NTU) in LWL from 2007-2020. A stoplight classification system using median values and box plots was developed to assess CHL and TP patterns in the North, Central, and South Segments of the lagoon. The median CHL classified as green (3.0, 4.9, 5.0 µg L^{-1}) and red (5.0, 9.8, 8.3 µg L^{-1}) were used as reference values. The proportion of red zone CHL (~50%) and TP (~75%) values are increasing in the Central Segment. Monthly average CHL, TN, and TP were all positively correlated and have increased since 2007. Time series analysis, medians, and box plots were applied to CHL, TN, and TP concentrations from 2009-2020 at three locations in NBB (Biscayne Canal, Little River, Miami River). The median CHL values varied 1.2, 2.4, and 2.0 µg L^{-1} from north to south in NBB. The percentage of CHL values greater than the established water quality criteria ranged from 41.7-77.8% and 27.8-82.5% in the Northern and Southern NBB segments since 2015. While there was a weak positive trend for CHL in Northern NNB, CHL concentrations have increased in the Southern NNB since 2009. Average monthly TP and TN exhibited increasing trends in both segments. The loss of seagrass habitat in LWL and NBB is likely a function of non-linear interactions among inflow and circulation, shoreline alteration, sediment resuspension, and reduced submarine light on scales of days-decades. Maintenance and restoration of seagrass habitat in these two estuaries are important for the state of Florida, Palm Beach, and Miami-Dade Counties with projected changes in atmospheric, watershed and oceanic drivers.

The American Oystercatcher and Lake Worth Lagoon Habitat Restoration: A Fortuitous History of Success

David Carson

Palm Beach County Department of Environmental Resources Management, West Palm Beach, FL

There is no record of American Oystercatcher observations in the Lake Worth Lagoon prior to initiation of Palm Beach County's Lake Worth Lagoon habitat restoration program. American Oystercatchers inhabit beaches, sandbars, spoil islands, shell rakes, salt marsh, mud flats, oyster reefs, and associated marine and estuarine habitats. Coastal development has resulted in substantial habitat loss, leaving few suitable breeding sites. Where breeding occurs, nests are vulnerable to disturbance by beachgoers, boaters, pets, predators, and severe weather events. Accordingly, American Oystercatchers are listed as Threatened in the state of Florida. Historic dredging, filling, and seawall construction in the Lake Worth Lagoon over the past 100 years had virtually eliminated habitat suitable to sustain the American Oystercatcher. Palm Beach County began a program of habitat restoration in the Lake Worth Lagoon in the early 1990's, resulting in over 300 acres of estuarine habitat (mangroves, salt marsh, mud flats, oyster reefs and seagrass) being created or restored. These projects created the food resources and nesting habitat necessary to attract the American Oystercatcher. The first nesting pair of American Oystercatcher known in the Lake Worth Lagoon took up residence during construction of the Snook Islands Natural Area project, completed in 2005. This pair nested at Snook Islands from 2005-2014, and then moved to Grassy Flats from 2014-2022. Additional pairs began nesting at Bryant Park Wetlands in 2014, at Snook Islands in 2016, and at Tarpon Cove in 2019. These four pairs together have fledged 47 American Oystercatcher chicks since 2005. The Lake Worth Lagoon restoration program was aimed at creating/enhancing biologically productive shallow and intertidal fish and wildlife habitat in general. The addition of resident nesting American Oystercatcher's to the Lake Worth Lagoon was an unexpected, fortuitous outcome of the restoration program. As a result, berms suitable for American Oystercatcher nesting are being included in the design of many of Palm Beach County's restoration projects in an effort to increase the number of nesting American Oystercatcher pairs in the Lake Worth Lagoon.

The Bonefish Cove Habitat Enhancement Project

David Carson
Palm Beach County Department of Environmental Resources Management

Palm Beach County ERM, in partnership with the U.S. Army Corps of Engineers, Florida Inland Navigation District, Port of Palm Beach, and Florida Department of Environmental Protection, is working on plans for an environmental restoration project to create fish and wildlife habitat in the Lake Worth Lagoon just south of the Lake Worth Bridge (SR806). The Bonefish Cove project would include creation of a chain of inter-tidal mangrove islands and associated shallow submerged habitats that would improve the environment, provide fish and wildlife habitat, contribute to improved water quality, and provide shoreline protection. Over the years, habitat losses and water quality declines associated with dredging and filling activities and freshwater discharges have damaged the lagoon. Bonefish Cove would provide environmental enhancements aimed at improving lagoon conditions. Bonefish Cove consists of three inter-tidal mangrove islands, with adjacent seagrass and oyster habitats. The project encompasses 40.2 acres and would be located 1,100 feet from the east shore of the lagoon. Approximately 375,000 cubic yards of dredged material from Peanut Island will be excavated, transported, and graded to wetland elevations at the project site. Over 19,000 tons of limestone rock will be used to create the mangrove island wave breaks and oyster reefs. Approximately 35,000 red mangroves will be planted. Project construction would result in creation of 7.8 acres of mangroves, 1.7 acres of oyster reefs, and 26.8 acres of potential seagrass habitat, and 0.2 acres of shorebird nesting berms. Construction is expected to begin in May 2022 and take a year to complete.

Seagrass Abundance and Diversity in Lake Worth Cove: Trends from 2010-2022

Thomas C. Chesnes
Palm Beach Atlantic University, West Palm Beach, FL

Seagrass communities are considered to be one of the most valuable and productive aquatic ecosystems, providing an array of important ecological and economic services for coastal communities. Of recent note, declines in seagrass abundances in eastern Florida have been linked with occurrences in mortality of the federally protected West Indian Manatee.

Seagrass abundance and diversity has been documented since 2010 in Lake Worth Cove, a protected region of Lake Worth Lagoon within J.D. MacArthur Beach State Park in collaboration between the Palm Beach Atlantic University Department of Biology, Florida State Park scientists and volunteers. This historical record provided evidence of an incredibly productive system, once designated as the most biodiverse of any seagrass community in the western hemisphere. Since then, the subsequent declines in submerged macrophytes have been documented, along with the associated mortality of herbivorous charismatic megafauna. Results to date will be presented.

C-51 Sediment Trap - Preventing Sediment Loading to Lake Worth Lagoon

Tom Conboy[1]*, Jennifer Smith*[2]*, Jose Otero*[2]

[1]South Florida Engineering and Consulting, LLC, Lake Worth, FL

[2]South Florida Water Management District, West Palm Beach, FL

There is growing concern about the quantity of nutrients and sediment, from total suspended solids (TSS), entering the Lake Worth Lagoon through the C-51 Canal. Excess TSS causes negative impacts to submerged aquatic vegetation and biodiversity. The C-51 Sediment Trap Project was proposed near the intersection of I-95 and Forest Hill Boulevard, upstream of the S-155 water control structure, to reduce excessive TSS loading into the Lake Worth Lagoon. A tri-party agreement between Palm Beach County, the City of West Palm Beach, and the South Florida Water Management District (SFWMD), was executed in 2006 to share construction, maintenance, monitoring, and analysis responsibilities for this project. It was hypothesized that dredging a one-mile section of the C-51 canal, would provide an area that would capture excessive TSS before it was carried downstream by the canal flow into the Lake Worth Lagoon. The initial dredging of 1,500 linear feet along the C-51 Canal and the removal of 101,500 cubic yards of muck was completed from 2006 to 2008. A baseline post-dredging hydrographic survey was subsequently completed, depicting cross-sections of the canal bottom in the dredged area. Yearly hydrographic surveys were conducted to provide updates on the TSS rate of accretion versus erosion, in comparison to the baseline survey. An efficiency study was conducted in 2020 to determine the percentage of TSS retained by trap and to quantify the TSS load retained. The results of this study indicated the highest trap efficiency at retaining TSS was observed at a flow rate of 437 cubic feet per second (cfs). The study concluded that, in general, the trap should retain TSS at flows up to 600 cfs and export TSS at flows above 1,000 cfs. Based on the most recent hydrographic survey from 2022, the trap retains an average of approximately 2,550 cubic yards per year. The final conclusions made by the efficiency study indicate the percentage of TSS retained by the trap at low flow is small compared to the TSS being carried by canal flow toward the trap. The trap was estimated to be between 6% and 24% efficient at low flows. The study also found the percentage of trap efficiency became negative at flow rates higher than 1,000 cfs, indicating that the trap is exporting TSS at those rates. Overall, the study did not support the hypothesis that the trap would be an efficient means or location to capture excessive TSS. These findings provide a starting point for further discussions.

C-51 Reservoir Project – Benefits to Lake Worth Lagoon and Loxahatchee River

Ernie Cox
Family Lands Remembered, LLC, C-51 Reservoir Project Manager, Jupiter, FL

The C-51 Reservoir is a regional reservoir project that will reduce harmful discharges to the Lake Worth Lagoon from the C51 Canal (S-155 Structure) and use that excess stormwater for distribution during the dry season to recharge the Biscayne Aquifer, the primary source of drinking water for South Florida and for environmental purposes. Project benefits also include reduced sediment loading to the Lake Worth Lagoon, mitigation of saltwater intrusion from sea level rise, additional water for the restoration of the wild and scenic portion of the Loxahatchee River and connected wetland systems, improved freshwater flows to the Lake Worth Lagoon when needed and improved operational flexibility for this connected system. The presentation will address key topical areas of Environmental Restoration & Enhancement, Water Quality & Sediment Quality and Education & Outreach.

A 15-year collaboration with regional stakeholders has brought this project to fruition. Since 2006, Palm Beach County, Broward County, South Florida Cities, Lake Work Drainage District, South Florida Water Management District (SFWMD), Florida Department of Environmental Protection, the Florida Legislature and countless staff and interested citizens have been working toward the development of the C-51 Reservoir project in conjunction with the landowner Palm Beach Aggregates. The project has the capacity to provide 60,000 acre-feet of storage and significant reduction of Lake Worth Lagoon discharges. Phase I will occupy 450 acres of property, store 14,000 acre-feet of water and provide 35 million gallons a day of alternative water supply benefits, with expected completion in June of 2023. Phase II will provide another 46,000 acre-feet of storage for additional water supply, flood protection, Lake Worth Lagoon and Loxahatchee Restoration, and other environmental benefits. The Florida Legislature has appropriated $115.5 million to date to Palm Beach County for Cells 12 and 13 of Phase 2, which will provide another 14,000 acre-feet of storage, with construction starting in Summer of 2022 on the North Conveyance Improvements culverts to the L-8 Canal north of the existing SFWMD L-8 Flow Equalization Basin. Future cells within Phase 2 and related infrastructure will take place as additional funding is available.

This presentation will cover background and history, the regional collaboration to develop and implement the project, the innovative public-private partnership approach, design and construction, an explanation of how the project fits within the regional system, along with benefits to both the Lake Worth Lagoon and Loxahatchee River.

Hyposalinity Tolerance Thresholds and Disease Susceptibility in Two South Florida Stony Coral Species

***H.A. Davis**, and J.D. Voss*
FAU Harbor Branch Oceanographic Institute, Vero Beach, FL

Corals on Southeast Florida's coral reefs are often exposed to variable environmental conditions including dramatic changes in salinity due to their proximity to major watershed drainage zones such as Lake Okeechobee. Although some studies have examined sublethal effects of several drainage-associated stressors, lethal hyposalinity tolerance thresholds have yet to be determined for stony coral species in Southeast Florida including study species *Montastraea cavernosa* and *Porites astreoides*. Using replicated, controlled ex situ experiments, this project characterized lethal hyposalinity tolerances (experiment 1) and sub-lethal hyposalinity duration thresholds (experiment 2) for two common coral species. The study found that both study species had an acute tolerance threshold of 19 PSU, and that at 25 PSU P. *astreoides* had a chronic tolerance threshold of 17 days while *M. cavernosa* had a threshold of over 21 days. In a third experiment, we plan to investigate the interaction between chronic hyposalinity and Stony Coral Tissue Loss Disease susceptibility. This series of experiments is designed to contribute information on corals' responses to both hyposalinity and disease and provides threshold criteria to help inform freshwater management strategies for the Lake Okeechobee System and Southeast Florida in general.

Evaluation of Shoreline Conditions of Lake Worth Lagoon

Melinda Donnelly[1]*, Jennifer Báez*[2]*, Beth Orlando*[2]*, Kelly Kibler*[1]

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[2]Palm Beach County Department of Environmental Resources Management, West Palm Beach, FL

Estuarine habitat loss in Lake Worth Lagoon has led to declines in water quality, loss of ecosystem services, and reduced resiliency of communities to future environmental changes. Lake Worth Lagoon is a highly urbanized estuary with extensive alterations to shorelines and adjacent lands. These alterations change natural environmental conditions, reduce habitat for estuarine species, and often lead to hard-armoring of shorelines by construction of seawalls or hardened slopes for erosion protection. Palm Beach County has embarked upon an ambitious plan to recover lost ecosystem services and increase both community and ecological resiliency through habitat restoration and shoreline stabilization. To support these efforts, Palm Beach County has partnered with University of Central Florida to develop data-driven tools to guide restoration, conservation, and management. Here, we present results of a detailed shoreline assessment of Lake Worth Lagoon conducted in 2020 to document current conditions. Data was collected at 100 ft intervals and included presence of hard-armoring, extent of natural intertidal and subtidal habitats, identification of native and non-native plants, erosion severity, intertidal width, shoreline slope, and adjacent land use. In total, 1,264 locations were assessed along 86 miles of shoreline. Hard-armoring occurred on 68% (59 miles) of shorelines in Lake-Worth Lagoon. Seawall structures were the primary type of hard-armoring and covered 58% of shorelines. The remaining 10% of hard-armored shorelines were covered with rocks, rubble, or concrete debris for erosion protection. Hard-armored locations tended to have steep slopes and minimal area for intertidal habitat and native wetland vegetation. In comparison, areas without hard armoring (32% total shoreline) primarily had mangroves and other native wetland species, larger intertidal zones, and gradual slopes. The amount of hard-armoring found in this assessment highlights the need and urgency for Palm Beach County to conserve remaining natural habitats and work to increase the use of soft-armoring techniques, such as living shorelines, in the future. Shoreline characterization data will be used in creation of shoreline restoration prioritization model to guide restoration planning and a site-scale mangrove habitat suitability model to identify effective methods to maximize success of future shoreline restoration efforts.

Historical Manatee Use at FPL's Riviera Beach Energy Center

Kristin Eaton
Florida Power & Light Company, Juno Beach, FL

Florida Power & Light Company (FPL) has operated a power plant adjacent to the Lake Worth Lagoon since the 1940's. Overtime, manatees have used the once-through cooling water from the power plant as a warm-water refuge during the wintertime. FPL has been documenting manatee use at the power plant since the 1970's by conducting aerial surveys. Surveys have shown increased use of the site since the surveys started. Aerial surveys at this site, and other FPL power plants, help to understand the manatee population use at FPL power plants, not just in the Lake Worth Lagoon but at other power plants, as well.

Implications of Enhancing Oceanic Exchange to Improve Lagoon Water Quality: Preliminary Findings and Pilot Project Design

***Jeff Eble*[1]*, Jesse Blanchard*[2]*, Austin Fox*[1]*, Marcy Frick*[3]*, Kevin Johnson*[1]*, Matt Shelton*[3]*, Ralph Turingan*[1]*, Robert Weaver*[1]*, Gary Zarillo*[1]**

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[3]Tetra Tech, Cocoa, FL

Florida Tech faculty and students are exploring solutions for improving water quality in the Indian River Lagoon with construction of a temporary, small-scale pilot project to investigate system response to enhanced ocean inflows. The project is not intended to support an artificial inlet or suggest a complete solution to restoring IRL water quality. Project objectives include (1) determining potential impacts to water quality that could result from direct dilution by seawater and changes in geochemical cycling, and (2) predicting plankton and other biological community response to changes in water quality conditions. Preliminary modeling and field experiments indicate enhanced ocean inflow can reduce nutrient loads by improving sediment health and on-site nutrient removal. Final project results will provide information and analysis to state agencies and decision-makers to help determine the feasibility and implications of a full-scale, permanent ocean inflow system.

An Overview of Coral Monitoring, Restoration, and Education Efforts at Peanut Island

Leneita Fix
Executive Director, The Reef Institute, West Palm Beach, FL

The Coral Monitoring Project on Peanut Island began in the summer of 2018 to connect High School students to careers in marine science. The Reef Institute (TRI) initially identified several healthy coral colonies growing specifically in the south lagoon area of Peanut Island, and throughout the snorkel trail. The uniqueness of the discovery led to a monitoring and field study project assessing the health of coral in this area. While coral reefs take up a small space in the ocean, they protect the shoreline from erosion and storm surge, protect all coastlines from 97% of all wave energy, provide a habitat for 25% of marine life and help produce 70% of the world's oxygen. Unfortunately, coral reefs across the Caribbean and Florida are struggling to survive. This area is currently experiencing a widespread and lethal coral disease outbreak of Stony Coral Tissue Loss Disease (SCTLD). This disease effects more than 30 different species of stony corals. Prior to the discovery of SCTLD Florida's Coral Reefs were already struggling due to rising sea temperatures, ocean acidification, and human impact. To date since the disease was discovered in 2014 it is estimated that less than 2% of Florida's and 7% of the Caribbean's reef building corals remain. This is what makes the corals at Peanut Island so remarkable. Four years into monitoring corals at Peanut Island, TRI has identified 18-22 different species of stony corals and 2 species of soft corals in the south lagoon area. These corals remind us of the extremely hardy low alkalinity/pH, and high temperature resilient corals scientists are discovering in harsh condition lagoons in Australia that are providing insight into resiliency genes. Corals are traditionally believed to need a stable environment for true health. In addition to the high number of human interactions in this area, ever changing environmental elements of salinity, nutrient levels, temperature swings, weather, turbidity, and disease are creating a constant barrage on their health. Yet, these corals are defying the odds! TRI is working with the Florida Coral Rescue and Propagation Project and Palm Beach County Environmental Resource Management to assess the future of these corals. Additionally, education about the corals to the public. monitoring of spawning, and biodiversity of the reef has been an area of focus. The hope is to one day see coral out planting studies conducted at Peanut Island of juveniles reared at the Reef Institute.

Green Turtles (*Chelonia mydas*) in an Urban Estuary System: Lake Worth Lagoon, Florida

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Estuarine environments in Florida provide important developmental habitat for sea turtles. We present the first systematic survey of green turtles (*Chelonia mydas*) inhabiting Lake Worth Lagoon, a heavily urbanized lagoon in Palm Beach County, Florida. We characterized the distribution, abundance, size class structure, diet, sex ratio, and genetic origin of green turtles in LWL using vessel-based visual transect surveys and captures from 2005 to 2022. Data from 232 captured individuals showed the Lake Worth Lagoon aggregation was comprised almost entirely of juveniles, with a mean straight standard carapace length of 41.8 centimeters. Dietary analysis from 155 individuals showed changes in diet over time. A diet dominated by seagrass species (primarily *Thalassia testudinum*) from 2005-2013 shifted to one primarily dominated by various algal species from 2014-2018. More recent lavage analysis has indicated another dietary shift again dominated by seagrasses, primarily *Halodule wrightii*. Future analysis of historic LWL submerged aquatic vegetation data can be combined with lavage data to investigate these dietary changes from *Thalassia* to *Halodule*. We also quantified the prevalence and severity of fibropapillomatosis, a disease associated with impaired water quality, in the aggregation. The overall disease prevalence for the population was 48.3%, and both prevalence and severity of the disease appear to be stable over the period from 2005-2022. Long-term monitoring of this population may serve to provide an important barometer of overall lagoon health and assess the progress of ongoing efforts in lagoon restoration.

The Harbor Branch Seagrass Nursery for Seagrass Restoration in the Indian River Lagoon

M. Dennis Hanisak

Harbor Branch Oceanographic Institute at Florida Atlantic University, Fort Pierce, FL

The highly diverse Indian River Lagoon (IRL), one of the longest barrier-island estuaries in the U.S., harbors more seagrass species than any other North American estuary, with seven species total and five at their northern limits. Catastrophic loss of seagrass occurred in the IRL, due to two consecutive years (2011-2012) of unprecedented phytoplankton “super blooms” of nanochlorophytes and picocyanobacteria in 2011 and a subsequent brown tide (*Aureoumbra lagunensis*) in 2012. Shading resulted in widespread seagrass decline (up to 100% loss at many sites in the northern IRL; ~60% lagoon-wide). Limited recovery has occurred despite somewhat improved water quality. A feasibility study on seagrass restoration in partnership with St. Johns River Water Management District supported the hypothesis that the limited recovery is due to a lack of available recruits (vegetative fragments and seeds) rather than environmental factors. To address the bottleneck in recruitment, we have developed a land-based nursery to provide a supply of sustainable donor material. We have begun to successfully cultivate and transplant *Halodule wrightii* in the IRL. Our efforts are part of broader collaborative IRL seagrass restoration efforts, including designation by the IRL National Estuary Program as one of four regional restoration centers along the IRL. These efforts could be applied more broadly, including to the Lake Worth Lagoon.

Labyrinthula protists on Seagrass in the Loxahatchee River Estuary?

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'Seagrass wasting disease' describes the persistent abundance of pathogenic protists (*Labyrinthula* sp) which create lesions on seagrass blades and destroys plant tissue. Previous studies have identified the presence of pathogenic species of *Labyrinthula* associated with seagrass wasting disease in Florida Bay. Here we sought to establish if any *Labyrinthula* species, pathogenic and non-pathogenic, are present in the Loxahatchee River Estuary.

In August 2021, after a 2-month period of hyper salinity, we collected ten individual blades of each seagrass species (*Thalassia testudinum, Syringodium filiforme, Halodule wrightii, Halophila ovalis* (previously *johnsonii*), and *Halophila decipiens*). Samples were cultured from all species for 7-days and the presence of *Labyrinthula* spp was observed. Semi-quantitative observations indicated 43% prevalence of *Labyrinthula* spp, across two sites, which is 'moderate' compared to other studies in Florida.

Now that we have identified the presence of *Labyrinthula* spp in the Loxahatchee River Estuary, the next step is to determine if any *Labyrinthula* are of the pathogenic variety which may be contributing to an overall reduction in seagrass immune-stress-response. If the pathogenic species of protists are identified in seagrass, this will provide a focus for future research investigating the factors contributing to local seagrass declines.

Visualizing Sea Level Rise in West Palm Beach

*John L. Renne[1], Juliano Calil[2], Anna Carolina Muller Queiroz[3], Frederick Bloetscher[1], and **Serena Hoermann**[1]*

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Mitigating flooding impacts of the Lake Worth Lagoon on an underinvested area enhances overall resilience for the City of West Palm Beach while serving the community in the areas of resilience, disaster-preparedness, public safety and health, infrastructure, and transportation. However, obstacles to planning for sea-level rise mitigation may arise from lack of awareness of the risks or strategies, as well as attitudes toward climate impacts and allocation of resources. Mitigating the impacts of climate change requires educating the community and decision makers in highly creative, insightful, and practical ways. Emerging research shows that virtual reality (VR) experiences can promote prosocial behavior change, increase knowledge and preparation for natural disasters.[i] A recent study found that subjects who experienced flooding in 3D declared a higher intent to purchase flood insurance and to evacuate from at-risk areas, when compared with videos or slides.[ii] Virtual reality can support communication and community outreach on sea-level rise and its implications.[iii] Using immersive technology, this presentation aims to support the City of West Palm Beach's efforts to educate, plan, and act on sea-level rise mitigation strategies for public parks along the intracoastal waterway. Participants will have the opportunity to experience the virtual reality engagement and participate in the research study.[iv]

Symposium attendees who wish to participate in the research study and experience flooding using 3D virtual reality headsets can do so at the poster session social (signed consent form required).

[i.] Shriram, K.; Oh, S.Y.; Bailenson, J. (2017). Virtual reality and prosocial behavior. Soc. *Signal Process*. 304–316, doi:10.1017/9781316676202.022.

[ii.] Zaalberg, R.; Midden, C.J.H. (2013). Living behind dikes: Mimicking flooding experiences. *Risk Anal. 33*, 866–876, doi:10.1111/j.1539-6924.2012.01868.x.

[iii.] Calil, J., Fauville, G., Queiroz, A. C. M., Leo, K. L., Newton Mann, A. G., Wise-West, T., ... & Bailenson, J. N. (2021). Using virtual reality in sea level rise planning and community engagement—An overview. *Water*, *13*(9), 1142.

[iv.] Pending approval by the Florida Atlantic University Institutional Research Board

Assessing Climate Change Vulnerabilities and Impacts in Southeast Palm Beach County and Beyond

Megan Houston[1], Lindsey Roland Nieratka[2]

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[2]Office of Sustainability, City of Boca Raton

Climate change threats that range from sea level rise, increased flooding, droughts, and harmful algal blooms have current and future implications for the Lake Worth Lagoon and its watershed. Climate change vulnerability assessments (CCVAs) help jurisdictions understand local climate change threats and prioritize efforts to respond to such threats. This presentation will discuss two CCVAs in PBC that cover portions of the Lake Worth Lagoon. First, Lindsey Nieratka from the City of Boca Raton's Office of Sustainability will explain why Palm Beach County, Boca Raton, Boynton Beach, Delray Beach, Highland Beach, Lake Worth Beach, Lantana, and Ocean Ridge formed the Coastal Resilience Partnership of Southeast Palm Beach County (CRP) and why the CRP selected climate threats to assess that include rainfall-induced flooding, harmful algal blooms, pests and disease outbreaks, extreme heat, drought, shoreline recession, tidal flooding, storm surge, groundwater inundation, and saltwater intrusion. CCVA results will be outlined along with how the municipalities are using this information to increase the region's resiliency and sustainability. Then, Megan Houston from the Palm Beach County Office of Resilience will discuss how the County is moving forward with a $1.8 M vulnerability assessment and resilience action plan. The County's forthcoming CCVA will assess the County's unincorporated area, western municipalities, and County assets owned or maintained in other municipalities. The CCVA will measure the impacts of potential climate threats on the area and identify the degree at which selected assets (e.g., populations, property, and resources) may be affected. It will also produce a comprehensive flooding and sea level rise vulnerability study for unincorporated Palm Beach County to better understand and communicate the potential magnitude, severity, and extent of rainfall-induced flooding, tidal flooding, and current and future storm surge flooding in combination with various sea level rise projection scenarios. The County will use the CCVA results to create a county-wide resilience action plan. Both the CRP and the County's CCVAs have prioritized climate equity while developing the CCVAs.

Hydrodynamic Modeling Applied to Design of Living Shorelines in Lake Worth Lagoon

Kelly Kibler[1]*, Melinda Donnelly*[1]*, Jennifer Báez*[2]*, Beth Orlando*[2]

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Palm Beach County has partnered with the University of Central Florida to develop data-driven tools aimed at guiding restoration, conservation, and management of Lake Worth Lagoon shorelines. In 2020, field-based assessment of 86 miles of Lake Worth Lagoon shorelines was undertaken to document shoreline conditions. Findings of this assessment highlighted the urgency for Palm Beach County to conserve remaining natural habitats and apply soft-armoring techniques, such as living shorelines, to combat shoreline erosion. In the ongoing project phase, hydrodynamic modeling will be combined with the survey data to characterize suitability for restoration and to support site-specific restoration designs for Lake Worth Lagoon shorelines. To validate hydrodynamic modeling, a monitoring station will be established in the study area to simultaneously monitor wind speed, wind direction, and wave height and a camera will be used to identify wakes created by passing vessels. Sonic wave sensors will be deployed to collect highly resolved wave parameters. The observed data will be used to calibrate and validate hydrodynamic models. Relationships between modeled wave climate and species distribution (from field survey) will be used to establish the hydrodynamic habitat limitations of key ecosystem engineers applied in living shorelines. The project will create a living shoreline prioritization model and hydrodynamic habitat suitability models for Lake Worth Lagoon and will transfer the technology to end-users for direct application to restoration planning, design, and engineering.

Interagency Coordination for Water Quality Monitoring in the Lake Worth Lagoon

***Phyllis A. Klarmann[1]**, James Councilman[1], Matthew Mitchell[2], and Christopher Buzzelli[3]*

[1]South Florida Water Management District, West Palm Beach, FL

[2]Palm Beach County Dept. of Environmental Resources Management, West Palm Beach, FL

[3]Coastal Ecosystems, Inc., Wilmington, NC

Since 2007, the South Florida Water Management District (SFWMD) and Palm Beach County (PBC) have held a cooperative agreement for water quality monitoring in the Lake Worth Lagoon. The agreement is updated on a 5-year basis, and just renewed in September 2022 through 2027. The monitoring includes 14 monthly surface water grabs covering the northern, central, and southern segments of the lagoon, and includes parameters including but not limited to nutrients, total suspended solids, and salinity and temperature. In 2020, an amendment to the cooperative agreement expanded the monitoring network to include two continuous data sondes connected to the SFWMD's SCADA network, and an autosampler upstream of the S-155 water control structure on the C-51. The two sondes are placed to capture changes in salinity with freshwater inflows in the central lagoon, while the autosampler includes a weekly composite sample for total nitrogen and phosphorus to detect potential nutrient loading from upstream sources. Interagency coordination between SFWMD and PBC has been key to continued monitoring: PBC staff collects samples, takes *in situ* measurements, and provides filters and bottles. Samples are then delivered to the SFWMD laboratory where District staff process samples and uploads results to DBHYDRO, the District's publicly accessible environmental database that stores hydrologic, meteorologic, hydrogeologic, and water quality data. These data have been used to define water quality trends within and across lagoon segments, identify correlations with freshwater inflow, and explore other relationships between parameters to assess overall conditions and responses to water management. This information can be used to test hypotheses related to ecological responses to water quality changes in Lake Worth Lagoon (e.g., the distribution, diversity, and density of submerged aquatic vegetation).

Key Elements in Successful Coral Relocation, Survivorship, and Resiliency during Jetty Reconstructions in South Florida

Anne Laird

Sr. Project Manager/Marine Scientist, Cummins Cederberg, Inc., Jupiter, FL

The entrances into Palm Beach Harbor and Port Everglades are accessed through the Lake Worth and Port Everglades Inlets, both of which are bound by rock jetties to the north and south. Originally constructed in the 1920's and 1930's, the jetties have undergone several improvements and repairs over their lifespan. In 2017, as a result of Hurricane Irma, Lake Worth Inlet's north jetty and Port Everglades' south jetty were damaged by displacement and physical impacts to the boulders and stones forming the jetties. The Port of Palm Beach and Port Everglades are critical federal navigation projects, commercial processing hubs for billions of dollars in cargo, a gateway for international trade and cruise vacations, and are vital for coastal defense stations. In 2020, the US Army Corps of Engineers, as the federal sponsor, issued contracts for the rehabilitation of the jetties through placement of new stones, and substantial manipulation of existing stone to restore the jetties to their original design templates. As part of environmental permit conditions and contract specifications, the contractor was responsible for completing in-water benthic surveys to document sensitive marine resources within the project areas, as well as relocation of protected coral colonies to approved recipient sites prior to reconstruction of the two jetties.

The project areas were highly dynamic with strong currents and heavy maritime traffic. Timing, experience, successful site selection, and continual coordination were critical to ensure successful transplantation of the documented coral colonies and ensure the contractor could initiate construction on the jetties without delays. Cummins Cederberg's marine science team effectively worked with the state, federal and county regulators, local marine enforcement, and various stakeholders to develop a solid plan to harvest the protected colonies and relocate them to suitable habitats with similar conditions. Additionally, the project team worked with the Florida Coral Rescue Team and a local university to provide donor coral colonies for research, micro-fragmentation, and outplanting as part of a regional coral reef restoration program. The project's successful conclusion is attributed to effective coordination with the client and scientific-based site selection to ensure the coral colonies would thrive and have negligible impacts.

Sustainable Education: A Local Case Study in an Educational Paradigm Shift

Melissa Landis
Lake Worth Waterkeeper, Lake Worth Beach, FL

Our educational systems were created in a time of industry and no longer apply to a growing generation that faces global challenges of epic proportions. How do we prepare our youth for a sustainable future? Both the problem and solution are education. What and how we educate needs to be analyzed in a way that transcends past paradigms of educational goals as merely economic in nature to include building community for humans and nonhumans alike. With the pandemic, we have seen a rise in students and families leaving traditional classrooms to embark on a journey into alternative education. Many have turned to nature as their teachers. Lake Worth Waterkeeper started its LaGoonies program as a response to a need in a small homeschool group. Finishing up its second year, it has grown into a well-loved 10-week program that offers a comprehensive look at our local Lake Worth Lagoon watershed. Additionally, this fall, we started a year-long experiential program called Minnows and Mangroves that combines learning about our watershed as they do in LaGoonies with history, math, and literacy while focusing on local community issues that have global impacts. LaGoonies and Minnows and Mangroves are an exercise in global trends towards an education that is practical and caters to the whole child. They embrace systems theory and facilitate participants' love for this Earth starting in their own backyards.

In situ Monitoring of Seagrass Epiphytes, Mesograzers and the Macrograzers They Support

J. William Louda*[1]*, *Alya G. Singh-White*[1,2]*, and Annabelle M.L. Brooks*[3]

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Seagrasses serve many purposes. They stabilize sediments and produce organic carbon for numerous heterotrophic consumers. It is well known and advertised that turtles and manatees use seagrass as food and are part of tourist attractions. However, the bottom-up contributions of seagrass epiphytes as a large part of the food webs supporting fish and other consumers is not well covered in the lay literature. Both resident and tourist fishing interests need to be better informed as to the impact of seagrass and their epiphytes. This effects fish productivity and thereby the economy.

Informing government officials and local managers of this ecosystem kink (i.e. fishing) should greatly help getting enhanced funding for seagrass restoration, a large part of which is nutrient pollution abatement.

We have shown that fake seagrass (aka epiphytometers) is an excellent method to determine the epiphyte composition and growth rates. Comparison of epiphyte communities on real and fake seagrass reveal excellent taxon matches using pigment-based chemotaxonomy. This method using taxon-specific pigments to determine the amount of chlorophyll-a (CHLa) contributed by each taxon. Then those contributions are divided by the total CHLa to obtain the percent cyanobacteria (=zeaxanthin), chlorophytes (=Chlorophyll-b), diatoms (fucoxanthin), dinoflagellates (=peridinin), and cryptophytes (=alloxanthin). Deployment of these epiphytometers allows an exact time zero (=deployment) and allows tracing the growth rate of epiphytes and their taxonomic distribution. The growth rate and total amount of epiphytes will then be able to be compared to nutrient supply / pollution.

Deploying cameras, such as the Go-pro series, which can take a picture every 15 minutes day and night, will then also provide needed information on meso- and macro-consumers. Together epiphytometers and *in situ* picture capture is proposed as a needed methodology to reveal the bottom-up support of fisheries.

17 Years of Oyster Monitoring in the Lake Worth Lagoon

***Nicole Maloney**, and Stephen Geiger*
Florida Fish and Wildlife Research Institute, St. Petersburg, FL

Our objective for this project was to summarize oyster population monitoring at three natural reef and four restored reef stations in Lake Worth Lagoon. This project was funded by SFWMD (2005-2014) and Palm Beach County (2015-2023). Settled oyster density was monitored semi-annually in the spring and fall at each station by haphazardly deploying 15 replicate ¼-m^2 quadrats at each station and counting all live oysters and all dead oysters with articulated shells within the quadrat. In addition, shell height was measured for a maximum of 10 live oysters per quadrat. Mean live oyster density, ratio of dead oysters to total oysters, and live mean oyster shell heights were calculated for each station. Disease (*Perkinsus marinus*) prevalence and intensity, reproductive development (undifferentiated, developing, ripe/spawning, spent), juvenile recruitment and water quality (salinity, temperature, dissolved oxygen concentration, pH, depth, and Secchi depth), were monitored on a monthly basis. Gonadal development stage and gender were pooled by site category (natural vs restoration) rather than by station due to the variability of reproductive development. Mean infection intensity and the percentage of infected oysters were calculated for each station. Spat monitoring consisted of three replicate arrays at each station. Retrieved shells were examined for oyster spat with the aid of a magnification lamp or dissecting scope. Mean numbers of spat per shell per month were calculated for each station.

Live oyster density for the natural sites have increased from 2008-2013 and decreased from 2013–2022. Similarly, the restoration sites increased in live oyster density from 2015-2019 and decreased from 2019-2022. Dermo disease infection intensity has remained present at moderate levels of infection. Lower dermo intensity values are most often seen during the spring and early summer. Higher dermo intensity values are often seen in the late summer through winter. Recruitment has varied throughout the monitoring period and has experienced years of high levels of recruitment as well as years that have been substantially lower. Oysters in the natural and restoration reef stations on average start spawning in April and recruitment often continues through December. Peak recruitment rates typically occur from June through October. Salinity has typically remained high through the duration of the project though several major freshwater events have occurred.

Building Resource Capacity for Underserved Youth in the Topic of Lagoon Ecosystems (18-24)

Katherine Marin
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Background: The lagoon ecosystem is one of the world's most essential and diverse ecosystems, home to a wide variety of plant and animal life, including many endangered species. Lagoon ecosystems are also some of the most productive, providing a vital food source and livelihood for millions worldwide. However, lagoon ecosystems are threatened by several environmental problems, including pollution, overfishing, and climate change. To help protect lagoon ecosystems and improve their resilience to these threats, it is crucial to implement creative and collaborative team projects that engage young people in protecting and enhancing these vital ecosystems. Content creation presented in infographic formats is often more straightforward, making them an ideal tool for engagement, outreach, and education.

Description of the program: To increase and enhance the knowledge of essential life skills and to help young people connect with the challenges of an increasingly interconnected and complex world, it is important to implement creative and collaborative team projects. Infographics via team collaboration effort are often more engaging and memorable than traditional methods of learning. Additionally, by tapping into the youth's existing interests and skills, such as art or technology (CANVA), youth can create content that really speaks to them. By bringing together different perspectives from different individuals with different strengths and interests, we can help to promote meaningful learning experiences that equip our young people with the tools they need not only to succeed in the modern world but can help them connect with the challenges of an increasingly interconnected and complex world.

Objectives: To increase and enhance youth's knowledge of Lagoon Ecosystems, via team project collaboration.

Methods: From 2021 to 22, the agent partnered with the Active Learning (Youth-Internship) Program (ALP) to develop and engage youth in a collaborative infographics project. This project introduced the topic of focus (Lagoon Ecosystems), basic CANVA skills, team-collaboration, and exploratory research to the participants. My role was to mentor and guide participants in topic research, collaboration, and design to create infographics that would effectively communicate findings. By providing guidance and feedback at every step, I played a crucial role in enabling team members to develop the skills necessary to bring complex research findings to life. As a result, the agent and 12 team-participants collaborated to create 12 youth infographics, 3 in the topic of focus.

Results: In a post-program survey, 100% of youth (n=12) indicated that they increased their knowledge of essential life skills and the topic of focus, and 89% of youth (n=12) indicated that they would adopt one or two of the tips or strategies suggested by the infographic.

Conclusion: Through collaboration, students learn to effectively communicate their ideas, handle disagreements constructively, and refine their skills and techniques. Ultimately, collaborative projects enable young people to develop the tools they need to navigate the challenges of an increasingly interconnected and complex world.

Mollusks of the Lake Worth Lagoon

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There are over 759 species of mollusks documented from the Lake Worth Lagoon. I would like to present you with some of the more notable explorers who first documented species from the Lagoon, species found in different parts of the lagoon and some species that were prolific in the past but may no longer be in the lagoon and why. I will explain and show some endemic species and some that were newly discovered in our lagoon, as well as the mollusks found at Jewell Cove.

The Lake Worth Lagoon is interestingly situated between the north end of the Caribbean Province and the south end of the Carolinian Province. This means that a great many species that normally would not normally live together will do so here. A few slides of some of the closely related species will be shown.

Site Fidelity, Home Range, and Movement of Mutton Snapper (*Lutjanus analis*) in the Lake Worth Lagoon

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This project seeks to understand the movement, home range, and site fidelity of the mutton snapper (*Lutjanus analis*) in coastal habitats. Although typically associated with tropical waters, the mutton snapper is found throughout the western Atlantic from New England to Brazil where depth separates mature from immature and newly mature individuals. While adult mutton snapper occupy multiple habitat types in depths to 282 feet, immature and subadult fish are found coastally in much shallower waters (<88 ft). Within these regions, immature and subadult fish are habitat generalists that associate with vegetated sand and mud bottoms, hard and coraline bottoms, mangroves, and other natural and manmade structure. As habitat generalists, they likely serve as nutrient movers within the coastal ecosystem as they move among available habitats and as a valuable link in the connectivity of the inshore-offshore nutrient seascape when they move to deeper water as adults. The details of the subadult movement patterns within the coastal habitat are largely unknown, however. Thus, we utilized an array of passive acoustic telemetry receivers and environmental probes within the northern Lake Worth Lagoon to study how immature and subadult mutton snapper utilize coastal space. Twenty-five mutton snapper (10 - 16 inches total length) were implanted with internal acoustic transmitter tags between May 2021 and February 2022. Site fidelity of tagged individuals was calculated with a residency index to understand the frequency of movement within home ranges determined by kernel utilization distributions. Furthermore, linear mixed effects models were used to model movement related to environmental conditions. This study sheds light on the complexity of coastal habitat utilization by mutton snapper and supports their ecological importance by illuminating how they connect coastal habitat with their movement.

Using HOBO Pendant Light Loggers to Determine Water Column Light Attenuation Coefficient (K_d) in the Loxahatchee River Estuary

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A pilot study was conducted in a shallow estuarine seagrass bed in the Loxahatchee River Estuary (LRE) to examine a novel method of measuring continuous light attenuation through the water column to the seagrass bed using HOBO pendant light loggers. The goal of this study is to develop a method to collect high resolution data to characterize long-term light conditions over a variety of water conditions within the estuary.

Phase I of the study provided calibration of the HOBO light loggers to LI-COR Photosynthetically Active Radiation (PAR) quantum sensor following published methodologies. HOBO light loggers measure incident light levels in LUX or lumens m^2, while the quantum sensors measure photon flux (mol photon s^1 m^2) between 400 to 700 nm; wavelength range applicable to plant physiology and ecology. A submerged calibration station was constructed using a series of HOBO loggers and a LI-COR sensor mounted on the same plane at a depth equal to one half of low mean tide, recording data at 15 min intervals during peak light transmittance (9:30am to 3:00pm). Equipment was deployed over 11 consecutive days capturing a range of light data under varying water quality conditions. Data were fitted using an exponential decay equation to develop individual calibrations between each HOBO logger and the LI-COR sensor.

During Phase II, the HOBO loggers were reconfigured to a vertical array in the water column at 20 cm intervals starting from just below mean high tide (approx. 1 m) to just above the sediment surface (approx. 0.1 m). Mean light and depth were measured at 15 min. intervals at each HOBO logger. Linear regression was performed between log-transformed light measurements and depth to determine instantaneous light attenuation coefficient (K_d), which was then used to determine percent of light reaching the seagrass bed at various depths. During 37 days of measurements (May 1 to July 7), on average we calculated 42.3% (sd ± 15.3) of light reached this seagrass bed at a depth of 1.0m (sd ± 0.2).

Deploying light logger arrays as described may prove useful to improve our understanding of water quality conditions at seagrass beds and in determining suitability of sites for potential seagrass restoration.

Status of Seagrasses in the Lake Worth Lagoon: Palm Beach County's Long-Term Monitoring Program

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Seagrass protection and restoration has been a primary objective of the Lake Worth Lagoon (LWL) Management Plan since plan adoption in 1998. In 2000, Palm Beach County Department of Environmental Resources Management (PBCERM) initiated the Fixed Transect Seagrass Monitoring Program. The objective of the fixed transect monitoring program is to determine whether seagrass beds are stable, expanding, or receding over time. The monitoring program initially consisted of five transects; four transects were added in 2001 to provide better spatial resolution on seagrass abundance in the lagoon. Annual monitoring of the fixed transects has been conducted every year except 2006. In 2015, the number of transects increased to ten: two new transects were added and one transect was lost due to development in the north segment. Transect locations were selected by PBCERM staff to serve as indicators of lagoon-wide seagrass health.

The second component of PBCERM's seagrass monitoring program is lagoon-wide mapping every five years to document large-scale trends. In 2001 and 2007, seagrass beds were mapped throughout the lagoon using color aerial photography that was interpreted with an analytical stereoplotter and verified with limited *in situ* groundtruthing. Water clarity in 2012 did not allow for aerial photography of sufficient quality for accurate seagrass mapping. Recognizing the importance of evaluating large-scale trends in seagrass distribution in the management of this important ecological resource, Coastal Eco-Group Inc, in conjunction with PBCERM staff, developed an alternative field mapping protocol for implementation during the 2013 mapping survey.

A total of 1,508 1 m^2 sites were quantitatively sampled during the 2013 mapping survey: 1,000 sites were located along the 2007 bed edges or interior of seagrass beds, and 508 sites were added in the field to document bed expansion or recession from the 2007 bed edges. The central segment experienced a considerable reduction in seagrass areal extent between 2007 and 2013, decreasing from 12% of lagoon bottom to 2%. Water quality data from the 2013 sites suggested that low water clarity had resulted in seagrass bed retreat to shallower water depths in comparison to 2007. Record low seagrass cover had also been documented at the fixed transects in 2013 following massive freshwater releases from Tropical Storm Isaac in 2012. The last large-scale mapping effort was completed by Coastal Eco-Group Inc. in 2018. Field methods were similar to the 2013 mapping survey with additional ground-truthing sites in areas outside of previously mapped seagrass habitats. Despite the addition of 92 acres of seagrass habitat in 2018, overall seagrass extent decreased from 1,582 acres in 2013 to 1,552 acres in 2018.

The fixed transects appear to be accurate indicators of lagoon-wide seagrass cover/health. The annual transect surveys have shown large fluctuations in seagrass cover since 2001 with major decreases associated with-large scale freshwater releases into the LWL in 2004-2005 and 2013-2014. The 2014 through 2020 annual fixed transect surveys documented continued seagrass habitat loss and shifts in species composition throughout the LWL. The 2021 survey results suggest improvement in seagrass habitat conditions in the north end of the central segment of the lagoon.

Spatial and Temporal Trends in Long-term Seagrass Coverage in Palm Beach County, Florida

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Seagrasses provide benefits to marine and human life by acting as a habitat for commercial fisheries, protecting the coastline from erosion, sequestering carbon, and filtering nutrients from the water. In the last 40 years, seagrasses have declined globally at an approximate rate of 1.5% per year. One of the most significant factors contributing to the seagrass reduction is poor water quality. Because of this, the amount of light reaching the seagrasses is insufficient for seagrasses to photosynthesize. In this study, we evaluated whether the amount of light (using photosynthetically active radiation or PAR data) differed across the Lake Worth Lagoon (LWL), which could influence seagrass presence. Preliminary results from a Mixed Effects General Linear Model indicate that light availability across the LWL is significantly different ($F_{1,7} = 7.3$; $p < 0.001$), and specifically, there is not enough light in Whitehall (Transect 8) to support all seagrasses species. Most notably, this transect cannot support *H. wrightii* due to the high light requirements necessary for this species to survive. Additionally, light availability at the bottom transect depths is not correlated to seagrass cover, suggesting that there may be more significant drivers of seagrass decline in the LWL than light availability. These findings provide our partner, the Palm Beach County Environmental Resources Management (PBC ERM), with data that they will use to better regulate water quality standards in the LWL, allowing for seagrass ecosystems to flourish and provide continued ecosystem services in the future.

Microplastics in the Surface Waters and Mangrove Sediments of the Lake Worth Lagoon

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These studies examine microplastics in the surface waters and mangrove sediments of the Lake Worth Lagoon. The surface water microplastic study was conducted in 2020. This study examined the effects tides and location have on the abundance and variation of microplastics in the surface waters of the Lake Worth Lagoon. Three sites were chosen within the lagoon in the north, central, and south. 1-liter water samples had an average of 8.625 microplastic pieces (n=48). Fibers, fragments, and films were present in the samples. No microbeads were found. Fibers were the most common type of microplastic found. High tide samples had a higher average (high tide mean=9.29, low tide mean=7.96, df=23). Edge and center samples were compared the results were statistically significant, edge samples had higher averages of microplastics (edge mean=12.67, center mean=7, p-value= 0.002, df=11).

The results of this study sparked further investigation into microplastic conditions in mangrove and beach sediments. This project aims to quantify the abundance and variation of microplastics in mangrove and beach sediments on Southeast Florida barrier islands. Three public parks, Coral Cove Park, Phipps Ocean Park, and Boynton Inlet Park, located in Palm Beach County will be sampled seasonally in 2022 (i.e., summer, fall, and winter) to quantify the spatiotemporal distribution of microplastics at regionally similar, but geomorphically varied barrier island sub-environments. At each site 10 samples will be collected every 10 meters along 100 meter transects in the mangroves and on the beach at the mean high tide line. Samples will be collected using a metal ruler and shovel within a 25x25cm quad sample area. The top 5 cm will be collected. Sediment and microplastics from the samples will be sieved, dried, floated, digested, filtered, and analyzed under a microscope for identification. This research will be important for coastal managers to gain a better understanding of current microplastic pollution and the geomorphic conditions (e.g., managed/non-managed environments, geotechnical properties) to inform best management and conservation practices.

Providencia Cay Habitat Restoration: The Key West of the West Palm Beaches

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Palm Beach County Environmental Resources Management

The Lake Worth Lagoon (Lagoon) is an estuary that has suffered the extensive loss of estuarine habitats and degraded water quality due to human development activities over the past century. Approximately 70% of the lagoon's shoreline is developed with seawalls associated with private residences and businesses. The Providencia Cay Habitat Restoration Project will fill in a deep dredge hole to restore and enhance critical shallow estuarine subtidal and intertidal habitats (seagrass, mangroves, cordgrass, and oyster reef) through the capping of anoxic, fine-grained organic sediments (i.e., muck). Capping the muck and filling the hole will allow for the natural recruitment of seagrasses. Additionally, the project will result in an intertidal island consisting of forested (mangrove), emergent (tidal marsh), unconsolidated sand (tidal flat), and reef (oyster) habitats. Project construction will result in a footprint of approximately 6 acres, including creation of 2.57 acres of seagrass area, 0.9 acre of mangrove/cordgrass, 1.74-acre benthic habitat enhancement, and 0.19 acre of wave break and oyster reef. This island is expected to support a wide variety of fish and invertebrates found within the Lagoon. The finished island will provide an eco-tourism destination to observe and interact with fish and wildlife in a variety of ways such as fishing, paddle sports, birding, an outdoor classroom, and wildlife viewing. The project is part of an ongoing effort to create a Paddling Blue Trail between the City of West Palm Beach's Currie Park Boat Ramp and downtown's South Cove Natural Area. Other benefits of the project include downstream water-quality improvements, increased protection of shorelines from sea level rise, and increased carbon sequestration capabilities. Methods chosen to achieve this project have been used by Palm Beach County Environmental Resources Management (PBC ERM) to successfully restore over 250 acres of high-quality habitat within the Lake Worth Lagoon.

Identification of Fish Habitat Hotspots and Suitability for Use in Prioritizing Conservation and Restoration Projects in Coastal Rivers

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Coastal rivers of southeastern Florida have been ranked high for restoration by conservationists, because of the potential for projects to benefit human assets and aquatic communities. A fisheries-independent monitoring dataset was analyzed to identify fish habitat using hotspot analysis and habitat suitability. Initial testing for broad seasonal changes (high vs. low flow) in species distributions showed little change suggesting habitat was important for supporting fishes in this system. A river section (23-45 km from the river mouth) comprised of braided river channels and mangrove backwaters was a hotspot for Common Snook and Red Drum. The same low salinity section supported several regionally unique tropical species including Opossum Pipefish, Smallscale Fat Snook, and Bigmouth Sleeper. Restoration efforts can be prioritized by maintaining low salinity (<15 PSU), reconnecting floodplains and riverine backwaters in areas comprised of fish hotspots and exploring strategies to improve fish habitat in other areas currently less used.

Research and Conservation of South Florida's Juvenile Manta Rays

Jessica Pate

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The giant manta ray (*Mobula birostris*) was listed on the U.S. Endangered Species Act as a "Threatened" species in 2018, yet insufficient data exist on the manta population along the eastern U.S. to designate critical habitat. Taxonomic and genetic evidence suggests that manta rays in the Western Atlantic are a separate species (*M. cf. birostris*), and little is understood about the ecology and life history of this putative species. The juvenile life stage of both, *M. birostris* and *M.cf. birostris,* are particularly under-studied. We are the first to describe the manta rays along a highly developed coastline in southeastern Florida using boat-based surveys, aerial surveys and photo identification of individuals. One hundred and twenty-five manta individuals were identified between 2016-2021. All male individuals were sexually immature based on clasper development, and no females were observed with mating scars or visibly pregnant. Sixty-four (51%) individuals were observed more than once during the study period and 26 individuals were sighted over multiple years. The occurrence of juveniles, high site fidelity and extended habitat use of the study area by juvenile manta rays suggests this is a nursery habitat. High rates of fishing line entanglement and vessel strike injury were documented, and rapid wound healing was observed. Occasional sightings of juvenile manta rays in the Lake Worth Lagoon warrants further investigation of the extent and purpose of manta ray use of estuarine habitats. Future research and conservation efforts will focus on identifying the physical and biological features of the nursery habitat and mitigation of anthropogenic impacts.

Using Citizen Science to Investigate Marine Debris Motion in the Lake Worth Lagoon Region

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The Lake Worth Lagoon Drift Card Study, or *Lagoon Drift*, is a long-term citizen science experiment designed to provide observational insights into how localized currents affect the way particles, including marine debris, move in and around the Lake Worth Lagoon (LWL). The study is the first of its kind in the LWL region and began in 2017 as an extension of the Biscayne Bay Drift Card Study led by the University of Miami Consortium for Advanced Research on Transport of Hydrocarbon in the Environment. Study experiments focus on the synchronous release of small wooden degradable drift cards around the LWL and Intracoastal Waterways. Each drift card is stamped with a brief study description and instructions for reporting found cards. During an experiment, 40 cards are deployed from each release site. The cards then travel with surface currents until they are found and reported by community members. Program partners and area citizen scientists play a critical role in all aspects of the study, from drift card creation to decoration, deployment, recovery, and reporting. Over 2000 citizen scientists have participated in the seven *Lagoon Drift* experiments executed to date. On average, 23% of cards deployed are recovered and reported. Recovery rates for the *Lagoon Drift* study are above average relative to drift card studies in general, and those of the Miami *Bay Drift* study which averaged 10% card recovery. The majority of cards reported are found within the LWL, however, a notable number are recovered outside the lagoon on Atlantic beaches. Cards have been reported from New Smyrna Beach in the north, to Hillsboro Inlet in the south. While some of the drift card release sites demonstrate relatively consistent trends in card distribution between experiments, others have far less predictable distribution patterns. Additional study is necessary, however inconsistencies likely result from some combination of surface winds/waves, tides, variable waterway flow tied to regional precipitation, and upstream water control structures. ANGARI Foundation plans to continue to execute two *Lagoon Drift* experiments annually and to facilitate use of the acquired data to help inform cleanup and resource management efforts, while providing a basis for future research. The study further serves as an excellent educational platform for program partners to engage the community in the conversation about human impacts on the environment and marine debris.

SEAHIVE: A Shoreline Protection System That Supports Environmental Restoration

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SEAHIVE is a sustainable estuarine and marine protection system researched and developed at the University of Miami (UM) under the National Cooperative Highway Research Program (NCHRP) in collaboration with the Florida Department of Transportation (FDOT). The system was designed through a morphological investigation that related the shape of the system's elements to aspects such as material efficiency, stability, and ease of manufacture, and physical testing at the UM SUrge STructure Atmosphere INteraction (SUSTAIN) Facility.

The hexagonal SEAHIVE elements can be clustered to reflect the beehive design and used as revetment, breakwater and seawall alternative providing protection from storm surge and wave action in marine and estuarine environments. Considering its adaptive features and potential for habitat creation, the system provides an efficient and cost-effective eco-engineering alternative for the protection of coastal communities that can be tuned for both low and high energy areas. As sea level rise and storms increase, and the effects of vessel wakes are exacerbated by ever increasing boat traffic along Florida's waterways, critical habitat for coastal vegetation (mangroves, seagrasses) is at danger of disappearing due to increased erosion and degradation. Here we describe SEAHIVE and the role it might play in coastal resilience, habitat creation and restoration, as well as a living lab that can support education and outreach. Used alone or in combination with other engineering solutions, SEAHIVE might be critical in the protection of mangroves, an important part of the Indian River lagoon ecosystem. We hope it is viewed as a new tool in the resilience toolbox of managers, property owners of public and private lands in Florida.

Shorebirds, Seabirds, and Management at the Lake Worth Lagoon

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As coastlines are developed, islands within the intracoastal waterway can serve as important habitat for species that rely on this land for roosting, nesting, and foraging. In the otherwise highly urban environment of coastal Palm Beach County, artificially constructed islands in the Lake Worth Lagoon are vital for beach nesting shorebirds and seabirds that are vulnerable to predation and human disturbance. The Florida Fish and Wildlife Conservation Commission (FWC) and the Palm Beach County Department of Environmental Resource Management work in partnership to continually monitor and manage shorebird and seabird nesting at restoration sites within the lagoon and maintain detailed records of brood and fledging success. The State Threatened American oystercatcher first nested on the lagoon's Snook islands in 2005, making this the southernmost limit of their breeding range on Florida's east coast. The development of new habitat has led to the recruitment of additional pairs and successfully fledged chicks that use nearby oyster beds to forage. An FWC banding program of oystercatcher chicks initiated in the last several years will provide additional data on population dynamics, survivorship, and movement of the species. More recently, State Threatened least terns and black skimmers have established nesting colonies on newly constructed islands. FWC's winter shorebird surveys throughout the lagoon also provide information on a variety of migratory birds that use this habitat as overwintering grounds including the Federally Threatened red knot and piping plover. Current management practices involve posting islands to educate boaters and prevent human disturbance, using decoys to attract least terns, and addressing threats from non-native species. FWC law enforcement play a vital role in the conservation of shorebirds and seabirds by patrolling the area regularly throughout the nesting season and conducting public outreach. Biologists also manage nesting habitat with vegetation control methods and substrate placement. As development and environmental pressures increase, islands within the Lake Worth Lagoon will continue to play a central role in the conservation of imperiled beach nesting birds and other species in Palm Beach County.

Soil Denitrification Dynamics in Urban Impacted Riparian Zones throughout Tampa, FL

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Denitrification is the anaerobic, microbial transformation of nitrate (NO_3^-) into inert, atmospheric nitrogen (N) under ideal conditions. It is a critical process in the management of anthropogenic NO_3^- and has been shown to respond to elevated N concentrations within the soil of urban riparian zones. We investigated the relationship between land use / land cover (LULC)classifications on soil denitrification and associated biogeochemistry within coastal, sub-tropical riparian zones. Soil samples were collected from low-order streams throughout Tampa, FL at distances of 0 m, 5 m, and 10 m from the streambank. Results from factorial analysis indicate that LULC classification (p=0.005, F=4.406) was significant in predicting denitrification enzyme activity (DEA) potential, with high density residential sites showing the greatest average DEA potential at 2.439 mg N $kg^{-1}h^{-1}$. Variables showing significant difference based on LULC classifications were pH and soil carbon to N ratio and showing that these factors likely had the most influence over riparian zone soil DEA potential based on LULC classification. These findings suggest that urban riparian zones are responding to elevated soil nitrogen; however, high residential areas showed lower carbon to nitrogen ratios than other sites, suggesting that some of the most urbanized areas could be improved to act as better NO_3^- sinks.

Building an Innovative Resilient Island through a Public-Private-NGO Partnership

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The Palm Beach Resilient Island is not just an innovative concept for intertidal habitat and restoration of a remnant natural island in Lake Worth Lagoon. It's also a model for how a non-governmental organization (NGO) can leverage its expertise and reputation to build collaborations with public and private partners to make a greater impact and demonstrate how nature-based solutions can inform climate adaptation strategies for the region. Coastal communities are vulnerable to flood risk from storm events, high tide flooding, and sea level rise; and nature-based solutions have been proven to simultaneously provide benefits to human well-being – flood risk reduction – and biodiversity. Climate change affects all of us, and it is too big an issue for any one community, government, corporation, or organization to tackle alone. But when we work together, we can multiply our efforts and make a more meaningful impact. With a challenge grant from the Batchelor Foundation, the Nature Conservancy (TNC) began partnering with the Palm Beach County Department of Environmental Resources Management (ERM) to develop a "Resilient Island". ERM is a pioneer in large-scale habitat restoration. TNC is an astute collaborator and endeavored to demonstrate how nature-based solutions arranged in a redundant or layered approach could protect natural and restored habitats as well as developed habitats from erosion and flooding. This concept allowed TNC to secure more funding from the Carrier Corporation which slightly expanded the project footprint to include another layer, some upland bird nesting area. Leveraging the partnership with TNC and its generous private funding from the Batchelor Foundation and the Carrier Corporation as a one-to-one match allowed ERM to follow suit and secure public funding from the Florida Resilient Coastlines Program. These additional funds resulted in another more substantial expansion of the project footprint, increasing the intertidal area by 39% and increasing the upland bird nesting area by 160%. Furthermore, the Lake Worth Lagoon's shoreline is mostly armored with seawalls that limit space for migration of habitats in response to sea level rise, which reduces their future ability to continue providing benefits to coastal communities. But it also presents a significant opportunity to export the Resilient Island approach to protect and enhance natural, restored, and developed habitats – a win-win for people and wildlife – as the region adapts.

A History of Fisheries Monitoring Effort in Lake Worth Lagoon, Palm Beach County, Florida

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The Florida Fish and Wildlife Conservation Commission (FWC) Fish and Wildlife Research Institute's (FWRI) Fisheries-Independent Monitoring (FIM) program is a long-term program designed to monitor the relative abundance of fishery resources in Florida's major estuarine, coastal, and reef systems. The program was developed to; 1) address the critical need for effective assessment techniques for an array of species and sizes of fishes and selected invertebrates; 2) provide timely information for use in management plans; and 3) monitor trends in the relative abundance of taxa in a variety of estuarine and marine systems throughout Florida. In an effort to regain valuable lost estuarine habitats, beginning in 2008 and continuing today, Palm Beach County Department of Environmental Resources Management (PBC ERM) initiated several restoration projects in the Lake Worth Lagoon. While these projects are believed to be providing a benefit to the Lagoon, programs were not initially in place to monitor fisheries utilization of these restoration sites and their restored habitats and only two pre-assessment studies were completed (FWC 2005 and FAU 2015).

In 2014 in an effort to initiate a fisheries monitoring program around the Grassy Flats restoration, the FWC, Division of Habitat & Species Conservation (a project partner) reached out to the FIM program to collaborate with FAU to conduct quarterly sampling around the restoration sites. Initial effort consisted of 21 nets: (4) 21-m seine and (3) 40-m seine hauls) each event between November 2014 – August 2016. Beginning in November 2016 (and continuing through August 2020) sampling in northern Lake Worth (around Munyon and Singer Islands) was added in addition to continued sampling around the Grassy Flats restoration. Effort from the Central Lagoon was shifted to the northern part of Lake Worth Lagoon due to concerns over the continued health of the seagrass beds and associated fisheries dependent on the habitat in the area. In 2021, the Tarpon Cove in north Central Lake Worth was added with restoration effort being split between the new Tarpon Cove site and the combined Grassy Flats/Snook Islands area.

Build it and they will come – new restoration sites do support newly recruited fish and invertebrates. Without impactful changes in the management of freshwater inflows, restoration's effects on nekton diversity and food web structure may be hampered by chronic eutrophication forestalling recovery to its full potential.

Manatee Lagoon: The Importance of Public Education and Outreach during an Unusual Mortality Event

Rachel Shanker
Manatee Lagoon, West Palm Beach, FL

In 2021, manatees along the east coast of Florida began dying in record-breaking numbers, resulting in what is known as an Unusual Mortality Event (UME). This prompted Florida Power and Light Company (FPL) to create its first ever hybrid position: A role titled Conservation Liaison and Educator. This individual works alongside the Florida Fish and Wildlife Conservation Commission (FWC) Manatee Research and Rescue Team in a hands-on role that aids manatee conservation, including helping rescue manatees and participating in the release of those that have been rehabilitated back into the wild. In addition to assisting FWC, the position also guides education initiatives at Manatee Lagoon. Manatee Lagoon - An FPL Eco-Discovery Center® is a free, educational attraction with the mission to educate the public about manatees and the Lake Worth Lagoon, and to inspire communities to conserve and protect Florida's environment and wildlife for future generations. As part of its commitment to community outreach and education, FPL is an active partner with Florida Atlantic University in the establishment and ongoing operation of a docent program that taps emerging scientists and educators for delivering accurate and up-to-date information on manatees and the Lake Worth Lagoon to visitors, students, and special groups. Manatee Masters, ranging from undergraduate to doctorate level, lead the center's daily programming including school field trips, summer camp group visits, center tours, and more. As the unfortunate UME situation for Florida manatees continues, the role of the Conservation Liaison and Educator will further evolve and this individual will continue to lend a helping hand, in so far as rescues and releases, but also in sharing information about what's happening with manatees in our state and what we can all do to help.

Managed Mooring Fields, Reducing Environmental Impacts

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The population growth of Palm Beach County coupled with the increase of the public use of the waterbody's, managed to preserve and protect for continued enjoyment. Creation of managed mooring fields built in locations that will benefit the public and the environment. They prevent chain and anchor damage, which is generally approximately 50 feet in diameter. A helix is engineered for certain sized vessels, based on a load, and require certain diameter fins and shaft diameter and ground penetration. Designed for protection to hold a vessel in winds of a Category 3 Hurricane magnitude. The vertical nylon strap or line is also sized as part of the engineering and fastened to the bottom of a 24inch buoy on the surface preventing any contact with the bottom resource. Vessels in the mooring field have rules and regulations, requirements, and be capable of navigation. Must have law enforcement to assure compliance as well as patrol surrounding waters to ensure vessels are not derelict, do not discharge sewerage and are capable of navigation and are properly registered. The results are that we have created affordable water access, that the vessel does not discharge in our water body, does not do bottom damage with anchor and chain and is affordable. We need a system of managed Mooring Fields of various sizes that meet the demand of that area coupled with responsive law enforcement.

Virtual LIVE Field Trips: Connecting Kids with Nature

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Palm Beach County Environmental Resources Management (ERM) joined with Palm Beach County's School District (PBCSD) to bridge the learning gap created by the Covid-19 pandemic. The idea of the Virtual LIVE Field Trips started in the midst of the COVID-19 pandemic with the closing of schools, youth programs, beaches, parks, natural areas, and official government orders to "stay safe at home". Collectively, we all struggled to navigate through the crisis.

How can ERM staff scientist assist teachers struggling to keep their students learning and engaged through a video screen? How can we inspire students and share with them about our local natural world and its inhabitants as field trips usually do, but virtually? Let us try a Virtual *LIVE* field trip! No permission slips, no fees or transportation issues and you can be up front and personal with scientist in the field – in Lake Worth Lagoon and its diverse, native watershed habitats.

How did it work? Science teachers at Palm Springs Middle School volunteered to allow PBCERM to connect "LIVE" into the Google classroom set up for students and teachers. ERM scientists were out in the field - physically ready to explore LIVE with students and teachers – virtually as we traversed through Lake Worth Lagoon and its diverse watershed habitats. Always getting dirty, sandy, wet, muddy, and sometimes bitten by a harmless creature caught in a minnow trap. A remarkable way to share about our amazing local watershed and urban estuary, Lake Worth Lagoon. It is an interactive journey, bringing scientific concepts learned in the classroom, ALIVE in the field, but safely through the video camera. Students and teachers ask many questions, which makes an enjoyable experience on both sides of the screen!

Since our first adventure, in April 2020, ERM and PBCSD continued the VLFTs into the following school years, now planning for the 2022/23 school year. Field trip topics expanded to prescribed burns, seining in the LWL to capture the productivity of this estuarine habitat, swamp tromps and sea turtle nest excavations. The PBCSD audience grew from one teacher with 20 students to 10+ teachers with sometimes up to 200 students, a handful of PBSD administrative staff and even parents!

Changes in Nitrogen and Phosphorus within a Decade in Waters along a Major Canal and Estuary in South Florida

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The West Palm Beach-C51 canal (WPB-C51) connects Lake Okeechobee with Lake Worth Lagoon (LWL) in South Florida, U.S. This canal receives discharges from Lake Okeechobee, agricultural, and urbanized areas. This research's objectives were to determine spatial and temporal differences and trends of N and P forms along the WPB-C51 canal and LWL for 2009 to 2019. Data were obtained from the DBHYDRO database of the South Florida Water Management District. Average total phosphorus (TP) and total nitrogen (TN) concentrations at studied stations ranged between 55 to 183 µg L^{-1}, and 0.61 to 2.62 mg L^{-1}, respectively. The TP and TN concentrations at LWL inflow were higher than the State of Florida's regulatory criteria (49 µg L^{-1} and 0.66 mg L^{-1}, respectively). The TP and TN concentrations generally declined from Lake Okeechobee to LWL, however, agricultural drainage was highest for soluble reactive phosphorus (SRP) and all N forms. Temporal trends showed predominantly increasing trends for P forms' concentrations. TP and TN load rates increased by 0.005 Mg yr^{-1} and 0.032 Mg yr^{-1}, respectively at LWL inflow. Results suggest nutrient assimilation by plants and P precipitation along the WPB-C51 canal. Possible sources of SRP and N are fertilizers, nitrification, and organic matter mineralization. Increasing trends in P concentration are possibly due to legacy P and urbanization and increases in TP and TN loads can be due to larger Lake Okeechobee discharges and higher nutrient concentrations. Results emphasize the need to implement strategies to minimize nutrient input into LWL to meet its water quality goals.

Establishing an Acoustic Footprint in Lake Worth Lagoon Through Collaboration

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The West Palm Beach Fishing Club (WPBFC) and the FWC-FWRI Tequesta Lab have had a long-standing relationship dating back to when FWC's office was within the fishing club headquarters. Since that time, the WPBFC has been a fundamental partner with FWRI-Tequesta in many of the studies conducted over the years including the acoustic tagging of various sportfish species such as sailfish, tripletail, cubera snapper, mutton snapper, amberjack, cobia, snowy grouper, kingfish, and snook. In 2020, the fishing club deployed artificial structures offshore called "reef darts" and acquired acoustic receivers for FWRI-Tequesta to maintain. The establishment of these receiver stations has unveiled several highly migratory species utilizing these structures within the first year of their deployment, including the endangered smalltooth sawfish, as well as several great white sharks. Inshore, through collaboration with Florida Atlantic University (FAU), Palm Beach County Environmental Resource Management (PBCERM), Inwater Research Group, the FACT Network, WPBFC, and FRWI-Tequesta, an acoustic footprint was established from the inlet and northern areas of interest within the Lake Worth Lagoon. After a successful year, plans have been made to expand the array southward in other areas of restoration interest. With 7 acoustic receivers offshore and 12 within the northern Lake Worth restoration areas, the additional 10 receivers in the southern portion of the lagoon will enhance the acoustic footprint and open the doors to further collaborative efforts in tracking various marine species of interest. These monitoring efforts will aid in the overall management of restoration areas and identify key areas of use by species of interest and lead restoration efforts in a sustainable direction. Moving forward, it is important to recognize and maintain these important collaborative relationships for the future of our fisheries, habitats, and water quality management.

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