Abstracts of Presentations

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ONE LAGOON

Key Note Address

Fish in the Indian River Lagoon – More Than Just an Entrée

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The State of Florida's long-term fisheries-independent monitoring program has been actively monitoring fish communities in the Indian River Lagoon (IRL) since 1990. During that time there have been many changes in the fish communities and their associated habitats as a result of man-made (hardened shorelines, sewage spills) and natural (e.g., hurricanes, algal blooms, winter freezes) disturbances. Despite all the changes in the system, there are some positives, as monitoring efforts conducted within the IRL have indicated that fish communities can be extremely resilient to disturbances. This resilience potentially makes them a good tool for investigating how restoration efforts may affect future communities. Fish habitat use has also been shown to be useful in helping to guide restoration and can function as a metric for gauging restoration success.

Short Bio

My academic experience began at New York Institute of Technology where I received a B.S. in Biology/Environmental Science in 1981. With little motivation to find a real job, I enrolled in graduate school at Adelphi University. There I worked on a taxonomic question related to the Rock Gunnel, *Pholis gunnellus* and received my M.S. in Biology in 1984. I began my doctoral work at Rutgers University which turned into a lesson in politics and survival and after two years I transferred to the University of Delaware's College of Marine Studies to work on the early life history of Weakfish, *Cynoscion regalis*, receiving my Ph.D. in 1991.

I have over 40 years of research experience in estuarine and marine systems. I have been at the Florida Fish and Wildlife Research Institute since 1989 serving as Research Administrator of the Indian River Field Laboratory since its inception in 1990 until handing off the leadership in December 2023 prior to my retirement on February 1, 2024. My work has focused on Florida's Fisheries-Independent Monitoring Program in the Indian River Lagoon. The program, which operates state-wide, was developed, in part, to provide timely information for use in management plans and monitor trends in the relative abundance of taxa in a variety of estuarine and marine systems throughout Florida. My specific areas of research include a wide range of fisheries ecology studies from population and community studies to harmful algal blooms and contaminants in marine and estuarine fishes throughout Florida's estuarine and nearshore waters. I have authored or coauthored over 35 peer-reviewed papers and have served on graduate student committees at universities around the state (FAU, FIT, UCF, UNF, JU, and Bethune-Cookman), including two as Chair.

Contributed Oral and Poster Presentations

(The presenting author is the first author, unless indicated by underlining.)

Fishers Know More Than You: Using Recreational Fishers' Knowledge to Assess IRL Health and Guide Restoration

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The ecological decline of the Indian River Lagoon (IRL) due to the urbanization of the watershed is well known. Numerous programs to collect relevant data (e.g., seagrass coverage, water quality) have been ongoing for decades, and though they provide important information on IRL status, they are expensive and time consuming to conduct. Fishers spend extensive time on the water, and 'fish where the fish are' to maximize their catch per unit effort. The fish they target are appropriate proxies for IRL health in space and time because these fish integrate the many factors that reflect overall IRL ecological health. Here we show that fishers' knowledge and fisheries landings are valid indicators of IRL estuary health, and should be incorporated into a multi-metric framework to assess the ecological decline, track the ecological status, monitor recovery, and guide restoration and mitigation of the IRL.

Spatial Responses of Two Elasmobranch Species to a 2018 Cold Event in the IRL

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Temperature plays an important role in the spatial ecology of elasmobranchs (sharks, skates and rays) and other fishes, with individuals often seeking out and/or remaining within a preferred set of thermal conditions. In January-February 2018, two major cold weather events reduced inshore temperatures of the Indian River Lagoon to considerably low levels (~12°C). During this time period, our team had a substantial number of both bull sharks (*Carcharhinus leucas*; n=14) and whitespotted eagle rays (*Aetobatus narinari*; n=17) fitted with acoustic transmitters and tracked via the collaborative FACT Network of acoustic receivers. This infrastructure facilitated an investigation into species-specific spatial responses to these events at a relatively large scale, including tracking of positions at offshore locales where a majority of these individuals migrated to. Here, we report on the synchronicity of these thermal migrations and discuss the potential drivers of the interspecific differences we observed.

Listening to the Lagoon: An Overview of the Lake Worth Lagoon Acoustic Receiver Array

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The Lake Worth Lagoon (LWL) is a twenty-mile-long estuary situated south of the Indian River Lagoon. To monitor habitat restoration efforts and the overall health of the lagoon, the Florida Fish and Wildlife Conservation Commission, Palm Beach County Environmental Resource Management and the West Palm Beach Fishing Club have deployed an array of 24 acoustic receivers throughout the LWL. Since the establishment of this array, collaborative tagging efforts focused on multiple marine fishes have been conducted by these groups. Additionally, several species from outside groups have been detected within the array, demonstrating use of the LWL. To date, a total of 15 different species tagged by 19 partner organizations have been detected. We highlight the significance of the LWL array and its connectivity to

arrays in adjacent water bodies. Understanding this connection can contribute to the success of fisheries management and fish habitat restoration in the southeastern region of Florida.

Assessment of Fish Spawning Aggregations in Southeast Florida: Residency and Movement Patterns of Gray Snapper off Southeast Florida

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Identifying and managing fish spawning aggregations (FSAs) is a top priority for fisheries and ecosystem management in southeast Florida. This project builds upon previous research assessing FSAs which identified Gray Snapper (*Lutjanus griseus*) as a species of interest. Using an already established acoustic receiver array, the objectives are to examine residency, movement patterns and behaviors of Gray Snapper that are suggestive of spawning aggregations. We acoustically tagged 75 Gray Snapper between the months of April and July in 2022 and 2023 at pre-determined locations near acoustic receiver stations. Preliminary analysis revealed 63 of 75 individuals have been accounted for, with detections occurring across 21 acoustic receiver stations. On average, tagged individuals visited between one and three receiver stations with a range of movement varying between 0 and 17.64 km. Findings suggest a relationship between site fidelity, home range and the capture/release location.

Can You Hear Me Now: A Look at The Use of Passive Acoustic Telemetry within and around the Southern Indian River Lagoon to Monitor Fish Movement

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The use of passive acoustic telemetry to track the movement of aquatic animals has become more prevalent in recent years. For many marine fish species, this technology can provide detailed information regarding residency, home range, and habitat usage. Additionally, with the emergence of collaborative acoustic research groups such as the FACT Network (Atlantic Coast) and iTAG (Gulf Coast), the ability to share data and expand acoustic coverage areas has never been greater. Currently, FWC Tequesta staff manage an array of 121 acoustic receivers within the Indian River Lagoon (IRL) and surrounding areas (offshore and in an adjacent river system). This array supports a variety of projects that involve many different agencies and research groups. The use of acoustic telemetry, coupled with ongoing research efforts, can help to increase our knowledge and understanding of how the IRL supports healthy fisheries.

Microplastic and Cellulose Fiber Ingestion by Juvenile Estuarine Invertebrates from Restored Oyster Reefs in the Indian River Lagoon

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Microplastics (MP) are a marine pollutant that pose a threat to the resilience of the Indian River Lagoon (IRL) on the east coast of Florida. This is particularly true for small organisms like juvenile Eastern oysters (*Crassostrea virginica,* size range: 0.5-25 mm). Man-made cellulose fibers are another widespread pollutant in estuaries. We investigated MP and cellulose fiber presence in oysters, ivory barnacles (*Amphibalanus eburneus),* and slipper shells *(Crepidula fornicata)* from the IRL. Other species examined include *Crepidula aculeata, Geukensia demissa,* and *Anomia simplex.* Individuals were collected from intertidal oyster reefs using natural recruitment on biodegradable oyster mats. Only 4.31% of oysters,

4.92% of slipper shells, and 4.00% of barnacles ingested pollutants. Of 37 pollutants analyzed via Fourier-transform infrared spectroscopy, 19 were cellulose fibers and 16 were plastic. The most common MP analyzed was polyethylene terephthalate. These findings are important to understanding human impacts on newly recruited invertebrates in the IRL.

Potential for Recovery of Seagrass from Seeds in the Indian River Lagoon

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The distribution and abundance of seagrasses in the Indian River Lagoon (IRL) decreased substantially after 2011, especially in the northern and central regions. Optimistic estimates predict natural recovery could take 12-17 years, which has led to calls for planting seagrasses to accelerate this process. Planting is costly, time-consuming, and risky; therefore, information that helps optimize site selection is valuable. Fragments of seagrasses have been shown to colonize areas in the IRL, but there is little information on colonization via seeds in the system. This study begins to assess the presence of seeds in locations with historically persistent seagrass. Documenting the spatial distribution of seeds would help guide the selection of sites for restoration and better predict potential for recovery.

Examining the Interaction Between Nearshore Seagrass Beds, Shoreline Morphology, and Living Shorelines

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Nearshore seagrass beds represent an important component of coastal ecotones. Using GIS methodologies, this study examined the association between shoreline morphology, shoreline erosion, and nearshore seagrass persistence in Mosquito Lagoon between 2011 and 2021. A field study compared the effect of living shorelines on nearshore seagrass beds. Three sites were identified, each containing four shoreline segments. Three segments were stabilized with one of three different breakwater types and the fourth was an un-stabilized, low-erosion, positive control. Sites were then monitored between March and November of 2023. The GIS analysis found that seagrass persistence was correlated with lower shoreline slopes, and lower erosion rates. Field-monitoring found seagrass (primarily *Halodule wrightii*), growing adjacent to all living shoreline designs, though shoot density was significantly greater at positive control shoreline segments and varied between sites. Significantly lower shoreline slopes were observed at positive control shorelines, and at the site with the greatest shoot density.

Mercury Concentrations in Key IRL Fishery Species: Individual, Temporal, and Spatial Patterns

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Information on mercury (Hg) levels in fish is important to inform healthy choices by consumers. The FWC Fisheries-Independent Monitoring program has collected Hg concentration data on key fishery and forage species in the Indian River Lagoon (IRL) and elsewhere in Florida since 1990. Mercury concentrations in individuals of fishery species such as Sheepshead, Red Drum, Spotted Seatrout, and Common Snook can be highly variable but generally increase with size and age. Long-term data also indicated considerable variability within and among species over both temporal and spatial scales. Despite this variability, mean mercury levels of legally harvestable IRL individuals for these common fishery species fall within USEPA safe consumption guidelines.

First Flash Kinetics of *Mnemiopsis leidyi* Cydippid Larvae

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The Indian River Lagoon is home to the bioluminescent ctenophore *Mnemiopsis leidyi,* whose luminescent response will be characterized with mechanical stimuli from the Underwater Bioluminescent Assessment Tool (UBAT) and stirring within an integrating sphere. The light intensity and temporal kinetics of the flash responses are determined. This study will provide a well-defined baseline of cydippid flash responses and shear stress thresholds, which can be used for interpreting field measurements, identifying key species in the Indian River Lagoon, and predicting potential changes in water quality. The first flash kinetics can be relevant to sustainable ecosystem-based management practices.

Response of Fish through Ontogeny in MPA and Adjacent Waters of the IRL

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Along with supporting one of the most ecologically diverse and economically valuable estuarine fish communities in the world, the NIRL also contains a highly enforced functional marine protected area surrounding the Kennedy Space Center. We hypothesized that the protection afforded by this secured area would significantly impact resident fishes, potentially spilling over harvestable adults into recreational areas. Here, we develop spatiotemporal models of density for three key fishes of interest (Spotted Seatrout, Mangrove Snapper, and Pinfish) at three life history stages (larvae, juveniles, and adults), inside and outside of the protected area demonstrating ontogenetically variable impacts of this protected area, and the value of such spaces.

Fish Ecological Modeling Informs Restoration Efforts in the IRL

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The Restore Lagoon Inflow project has sought to evaluate the potential efficacy of increased oceanic inflow into the NIRL to improve water quality. Here, we will discuss the steps taken to assess potential consequences for the NIRL fish community, and highlight critical needs for moving forward, should funding be resumed.

Using Wildlife Trail Cameras to Monitor Faunal Responses to Biodegradable Oyster Reef Restoration Materials

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Biodegradable oyster reef restoration materials have been introduced in Mosquito Lagoon to avoid potential plastic pollution from traditional restoration materials. Studies have shown success regarding oyster recruitment rates to these materials, however, their impacts on non-target species are unknown. This project aims to determine if these biodegradable materials alter vertebrate counts and foraging behaviors. Wildlife trail cameras were deployed to observe vertebrates on intertidal oyster reefs for 126 days. Treatments included Biodegradable EcoSystem Engineering (BESE)-shell mats, cement-jute tiles, and cement-jute rings. Unrestored, live reefs were used as positive controls, and unrestored, dead reefs as negative controls with three replicates of each treatment. To date, 2,811 vertebrates have been observed, and 31,333 video

clips have been processed. Results suggest that biodegradable materials do not cause any positive or negative changes in vertebrate counts or foraging behaviors, and thus provide a good alternative for plastic oyster restoration materials.

Does Mangrove Encroachment on Oyster Reefs in The Indian River Lagoon Enhance Blue Carbon Storage?
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Mangroves and oyster reefs are two common coastal habitats in Indian River Lagoon; both provide diverse ecosystem services, including carbon sequestration and storage. Decreasing freeze events and increasing sea levels are leading to mangrove habitat expansion, including encroachment onto live oyster reefs. This study will investigate how mangrove encroachment on oyster reefs impacts the abundance and stability of soil carbon, relative to each habitat alone. Soil (0-10cm) was collected from 3 locations in Mosquito Lagoon, each containing a mangrove-only, oyster-only, and mangrove-encroached oyster reef site. Total and active carbon were quantified, and stable carbon was determined through physical and density fractionation that isolates persistent mineral-associated organic matter (MAOM). It is hypothesized that total and active carbon will be greatest in the mangrove soil, but MAOM-carbon will be greatest where mangroves encroach on oyster reefs. This research will identify changes in coastal carbon storage due to mangrove encroachment on oyster reefs.

Iron's Influence on Water Clarity and Sediment Carbon Storage in the Indian River Lagoon
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Lower water clarity in the IRL, a function of turbidity and CDOM, indicates increasing carbon and transfer within the estuary. However, most carbon storage in the IRL is within underlying sediments, making sediment-water interactions central to the IRL carbon cycle. Our work estimated 100.1 tons of carbon is stored in IRL sediments, with 8.07 tons in St. Lucie sediments alone. Inflow areas like the St. Lucie have high terrestrial inputs of iron and carbon that may interact increasing CDOM absorption, making dissolved iron (dFe) optically important in darkening the IRL. Unlike CDOM in many terrestrially influenced marine sediments i.e., Lake Okeechobee, IRL dFe doesn't appear to regulate CDOM. Potentially, sediment pore water dFe doesn't accumulate to appreciable levels because of preferential binding with hydrogen sulfide and precipitation. While geochemical processes like pyritization drive sediment-water interactions and optical decoupling, IRL regions comprehend diverse drivers with variable impacts on sediment carbon storage.

Water Quality Drivers of Bottlenose Dolphin (*Tursiops truncatus*) Occurrence in the Indian River Lagoon
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In the Indian River Lagoon (IRL), salinity and dissolved oxygen (DO) are important drivers of common bottlenose dolphin (*Tursiops truncatus*) density spatial patterns. DO and salinity are often correlated with other water quality parameters. Florida Atlantic University Harbor Branch Oceanographic Institute's Stranding and Population Assessment team has a dolphin photo identification (ID) program (NMFS Letter of Confirmation #23069-01) spanning 2021-present with a survey range within the IRL of Sebastian Inlet to Jupiter Inlet. To enhance our understanding of what specific water quality parameters are related to dolphin occurrence, environmental parameters (Kd, DO, salinity, temperature, pH,) were measured and

water samples were collected to determine concentrations of dissolved nutrients, chlorophyll-*a*, and a human waste tracer, the artificial sweetener, sucralose. These data were compared to dolphin occurrence in the IRL to facilitate informed management recommendations. In addition, our outreach efforts include exhibitions and hands-on activities for all ages.

Fisheries Studies from a Mosquito Control Perspective

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Mosquito Control impoundments, which were constructed in the 1950s-60s to prevent oviposition by salt marsh mosquitoes, also provide nursery habitat for juvenile fish. The District has been collaborating with the Indian River Land Trust on research projects directed by Dr. Jon Shenker and performed by graduate students from Florida Atlantic University's Harbor Branch Oceanographic Institute, to better understand how juvenile snook and tarpon use mosquito control impoundments. Studies have focused on the effects of temporary drawdowns of the Water Tower Impoundment on emigration of snook and tarpon during peak mosquito season. The presentation will address fisheries studies from the mosquito control perspective.

The Seagrass Isn't Always Greener at the Other Site: Variability in Seagrass Benthic Communities Across the Indian River Lagoon

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In collaboration with the Florida Oceanographic Society, the Smithsonian Marine Station is conducting a study on benthic infaunal communities throughout the Indian River Lagoon's (IRL) seagrass beds. Seagrass ecosystems, critical for their high productivity and provision of habitat, have undergone significant coverage losses in the IRL over the past decade. Our study, spanning 27 historic seagrass sites, aims to broaden our understanding of seagrass ecosystem health by analyzing infaunal invertebrate communities in relation to seagrass density and sediment characteristics. Recognized globally as indicators of benthic condition, infauna perform crucial services in seagrass beds, such as stabilizing and oxygenating sediments, and cycling nutrients. Preliminary results indicate that infaunal abundance and diversity varies widely across sites. Taxa from several phyla have been identified, including foraminiferans, echinoderms, polychaetes, crustaceans, and bivalves. Our research addresses some gaps in traditional seagrass monitoring, which focuses on aboveground parameters, to inform more effective monitoring and restoration strategies.

Evaluating the Unintended Consequences of Non-Plastic Restoration Materials

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Recent studies have documented microplastic pollution in aquatic environments. In response, coastal restoration practitioners have rapidly replaced plastic-based restoration materials with non-plastic alternatives perceived to be more 'eco-friendly.' However, most alternative materials have not been evaluated for potential ecological risks. This study quantified nutrient or metal leaching under laboratory conditions for five types of alternative materials, including pre- and post-deployment in Mosquito Lagoon, compared to traditional plastic materials. Results indicated high dissolved inorganic nitrogen (DIN) and soluble reactive phosphorus (SRP) release from biodegradable materials. Fresh Jute released 2.6 ± 0.4 mg DIN L^{-1} and 2.1 ± 0.7 mg SRP L^{-1}, followed by fresh BESE® material (0.2 ± 0.07 and 0.5 ± 0.04 mg L^{-1}, respectively). Galvanized steel gabion baskets released significant Zinc (2.1 ± 0.6 mg L^{-1}) after 2 years of

field deployment. This data will help restoration practitioners make informed decisions about the best materials to utilize for restoration.

Leveraging Mosquito Impoundments to Treat Eutrophic Waters in the Indian River Lagoon, FL

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Littoral wetlands throughout the Indian River Lagoon have been impounded to control mosquitoes, which has reduced their ability to buffer nutrient loading. The unique structure of mosquito impoundments can be potentially leveraged to provide an effective estuarine treatment wetland. Herein, we are conducting a pilot study to determine the nutrient removing potential of varying hydrologic regimes within a mosquito impoundment. The initial phase of this project characterizes seasonal biogeochemical conditions throughout a selected mosquito impoundment. Samples were tested for total nitrogen, ammonium, and total dissolved phosphorus. Furthermore, YSI EXO2 multiparameter water quality sondes were placed in-situ at the inflow and outflow sites to measure dissolved oxygen, pH, turbidity, temperature, salinity, chlorophyll-a, and fluorescent dissolved organic matter at 15-minute intervals. This preliminary data will guide subsequent project phases to understand the overall ability for these systems to mitigate the nutrient loading situation occurring in the IRL.

Quantification of Secondary Microplastics Produced by Plastic Restoration Materials

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Plastic meshes have previously been widely utilized in oyster reef restoration and living shoreline stabilization projects in the Indian River Lagoon. Concerns regarding the potential for these materials to release microplastics into coastal ecosystems drove a switch to alternative materials, but an examination and quantification of microplastic releases had not been conducted. In this study, two previously common plastic meshes for restoration, Vexar® and Naltex®, were gently shaken in filtered water from Mosquito Lagoon for one year in a temperature-controlled environment. The meshes were then removed and the water filtered through a 0.45µm filter. Microplastics (0.025-5mm) remaining on the filters were visualized and counted under a 45x dissecting microscope. Preliminary data indicates significantly more microplastics in water incubated with both plastic meshes relative to the control water. This data will assist in decision making as restoration practitioners weigh the advantages and disadvantages of plastic and non-plastic restoration materials.

Something's Fishy: Bottlenose Dolphin (*Tursiops truncatus*) Feeding in the Indian River Lagoon, Florida

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Bottlenose dolphins (*Tursiops truncatus*) consume commercially and recreationally important fish species in the Indian River Lagoon, Florida, and as apex predators are sentinels of ecosystem health. Data from vessel-based photo-identification surveys (NOAA NMFS LOC. 23069-1) conducted from June 2021-June 2023 were used to identify fish species consumed by dolphins in the Indian River Lagoon from Sebastian to Jupiter. Fish were identified as close to species level as possible and grouped by taxonomic order. Seasonal comparisons of feeding were also conducted. Of the 42 documented sightings with feeding behavior, fish were identified in 17 sightings, consisting of 5 orders (Perciformes, Clupeiformes, Mugiliformes, Beloniformes, and Tetraodontiformes) and 10 species. This study establishes baseline data

for future research and contributes to the understanding of dolphin diet and health. Shifts in dolphin diet can potentially reflect ecosystem wide impacts such as changes in prey abundance and distribution, water quality, and presence of environmental contaminants.

Benthic Infaunal Responses to Mangrove Restoration

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Benthic infauna are small-sized animals that live within the substrates beneath a body of water and include groups such as polychaetes, nematodes, arthropods, and mollusks. These organisms provide ecosystem services such as water filtration, bioturbation, nutrient cycling, and act as the base for many benthic food webs. This living shoreline restoration project seeks to use the community dynamics of infauna to monitor the progress of a hybrid shoreline installation in Palm Bay, Florida. This project, to be deployed in March 2024, will feature experimental groups of differently sized mangroves and MRC's newly designed Modular Breakwaters for Living Shorelines (MBLS). The goals of this deployment are to curb coastal erosional issues along the 440 feet of restored shoreline, assess biotic responses to restoration, monitor local changes in sedimentology, and provide a cost-benefit analysis of living shorelines against other forms of shoreline hardening.

The Response of Benthic Infauna to Environmental Muck Dredging at Sykes Creek (Indian River Lagoon, Merritt Island, Florida)

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Fine-grained, organic-rich polluted sediments ("muck") in estuaries result from coastal development and human activities and are a global phenomenon in estuaries. Runoff in the Indian River Lagoon ("IRL") carries yard debris, eroded soils, and surface pollutants into the estuary, where they contribute directly and indirectly to the organic load in sediments. The IRL's benthic habitat is smothered with approximately 15,900 acres of muck in Brevard County alone. Sykes Creek is in the northern IRL within the Banana River Basin (Merritt Island). This project monitors and enumerates Sykes Creek benthic infauna before, during, and after environmental muck dredging. Infaunal communities are an essential component of estuarine ecosystems. They filter the boundary water column, speed benthic decomposition, oxygenate surface sediments through bioturbation, and are prey for benthic foragers. By monitoring the benthic infaunal communities during environmental dredging, we can observe the success of muck removal and its impact on the ecosystem**.**

"Plastic Rain" in the Indian River Lagoon

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The Indian River Lagoon (IRL) has high concentrations of microplastics (MP) in surface waters (mean density: 1.47 MP/L), with an estimated 1.4 trillion total MP lagoon-wide. Most are microfibers. Efforts are underway to determine why the IRL is a MP hotspot. Busch et al. (*Environments* 2023) documented that stormwater outfalls are a significant source of MP throughout the IRL. Our next avenue of inquiry is to look at MP entrained in wind and rainfall following the research of Brahney et al. (*Science* 2020). They found deposition rates in protected lands to be 132 plastic pieces/sq m/d. We collected replicate samples during heavy and light rainfall events as well as during clear skies to determine if there were different MP

signatures for rain vs wind deposition. Standard field and laboratory protocols were used to process all MP samples, and results were analyzed to quantify "plastic rain" in Florida estuaries.

Assessing Ecological Impacts of the Indian River Lagoon-South Restoration Project
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As part of the Comprehensive Everglades Restoration Plan, the Indian River Lagoon-South Restoration Project will work to restore habitat within the watershed by: (1) attenuating and treating local basin runoff via new reservoirs and stormwater treatment areas; (2) restoring functional quality of surrounding natural lands; and (3) enhancing estuarine habitat. As project components come into operation, ecological monitoring assesses the impact of the project on restoring these diverse and ecologically vital ecosystems and provides support for an adaptive management approach. Monitoring plan methodologies and targets are currently being refined to best inform restoration progress and will leverage existing efforts and subject matter expertise.

The Occurrence of Seagrass Adjacent to Environmental Dredging for Polluted Organic Sediment Removal in a Sub-tropical Lagoon
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Globally, estuaries and other coastal habitats are increasingly eutrophic due to anthropogenic activities. Eutrophication negatively impacts ecosystems, decreases sediment quality, enhances harmful algal blooms, and degrades seagrass habitat. Seagrasses are an important component of coastal systems, providing ecosystem services including fish nursery habitat and sediment stabilization. Florida's Indian River Lagoon is one such eutrophic estuary that has experienced significant seagrass losses. To combat ongoing environmental degradation, Brevard County has implemented environmental dredging, aiming to remove fine-grained organic-rich sediments and improve sediment and water quality. While not used for navigation, environmental dredging is intended to be a temporally discrete removal of polluted legacy sediments. In this study, seagrasses adjacent to the Sykes Creek (IRL, Merritt Island, Florida) environmental dredging site have increased in cover in 2023. However, more post-dredging sampling and comparisons with other locations are necessary to determine whether there is a correlation between nearby environmental dredging and seagrass occurrence.

Oyster Spat Monitoring in the Southern Indian Lagoon and St. Lucie Estuary: 2020-2024
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Since 2020, oyster spat recruitment in the southern Indian River Lagoon (IRL) and St. Lucie Estuary (SLE) has been monitored to assess temporal and spatial trends along a salinity gradient. Salinity, a critical factor for oyster survival and recruitment, is generally higher and more stable in the IRL versus the SLE, with potential implications for oyster health and reproduction. To quantify spat recruitment, oysters were strung in pairs onto PVC T-bars, and positioned at the same elevation as adjacent live oyster reefs for monthly monitoring. We hypothesized that the SLE would have higher spat numbers than the IRL due to historically optimal salinity conditions. The variability of salinity, due to freshwater runoff, likely impacted recruitment, with the SLE recruiting fewer spat than the IRL. This assessment underscores the relevance of long-term oyster monitoring as an indicator of estuarine health and possible deleterious effects of freshwater runoff on spat recruitment.

Investigating the Relationship Between Sediment Characteristics and Populations of Seagrass at the Coastal Oaks Preserve

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The Indian River Land Trust and FAU Harbor Branch Junior Scientists Program partnered to investigate seagrass and sediment relationship in the Indian River Lagoon (IRL). Seagrass serves as a natural water filter, sediment stabilizer, and an important food source for many organisms. Scientists collected data on seagrass populations at eight transects along the Coastal Oaks Preserve and analyzed sediment at the respective sites. *Halodule wrightii* was the most prevalent species of seagrass with a grand mean percent coverage of 44.28 ± 15.68%. *Thalassia testudinium* was also present, with a grand mean percent coverage of 1.26±0.45%. Averaged sediment samples were mainly composed of coarse sand and fine sand regardless of distance from shore. This data will benefit restoration efforts for the IRL by identifying ideal environments where seagrass populations thrive.

***Syngnathus louisianae* Distribution and Habitat Associations in the Indian River Lagoon**

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Syngnathus louisianae (Chain Pipefish) is a species of fish belonging to the Syngnathidae family. *Syngnathus louisianae* can be observed throughout the lagoon, but there is little research that addresses the densities of these fish's distribution in the estuary, and their habitat associations. This study aims to identify the population density of these fish throughout the Indian River Lagoon, and the habitats they associate themselves with. The Florida Fish and Wildlife Commission (FWC), Fisheries Independent Monitoring (FIM) data was used to analyze the presence of *Syngnathus louisianae* in ArcGIS Pro through point density and pair-wise buffer analyses.

Evaluating the Antifouling Efficacy of Ultraviolet Light on the Barnacle *Amphibalanus amphitrite*

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Biofouling, the accumulation of aquatic organisms on surfaces, is a pressing economic and environmental issue. Antifouling solutions to control the recruitment and establishment of tenacious species are often costly, environmentally harmful, and inadequate. However, ultraviolet (UV) light has been documented as an environmentally friendly antifoulant with promising results under certain conditions. This study utilized UVA and UVC, two wavelength ranges of UV light commonly used in antifouling studies, to control fouling by the widespread and locally invasive barnacle *Amphibalanus amphitrite*. Barnacle larvae reared from Indian River Lagoon (IRL) broodstock were exposed to varying doses of UVA and UVC, and were then assessed for settlement success, growth, and survival to adulthood. Results from this study will inform the effectiveness, appropriate wavelength, and dose of UV light needed to deter barnacle fouling in marine environments.

Native Plant Species Dominate a Restored Tidal Marsh in the Coastal Oaks Preserve

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The Coastal Oaks Preserve, located on the Indian River Lagoon, has a tidal marsh restoration site that was previously dominated by exotic Brazilian Pepper trees. The 7-acre site was mulched by the Indian River Land Trust in 2021 to remove the invasive non-native species. This site has been monitored annually to assess the abundance of native and non-native plant species. In Fall 2023, 10 50-meter transects were established and 1-m^2 quadrats were used to monitor the abundance and distribution of plant species. Since 2022, there has been substantial growth of native species throughout the entire site, namely salt marsh sedges and members of the Asteraceae family. The site has displayed a great increase of native species each year, and we conclude that annual monitoring of the species composition of the Coastal Oaks restoration site is not necessary. However, from 2021-2023 the Oak tree population decreased by 19.7%, and we recommend that the oak trees should continue to be monitored in future restoration site projects.

Evaluating the Impacts of Marine Science Programming on Students in Underserved Communities

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Florida is on the frontline of environmental change, and therefore it is critical to inspire the next generation of stewards, scientists, and resource managers. This need is even greater in underserved communities where students lack educational opportunities and have the most to gain from influential teachers, special programs, and STEM initiatives. This project analyzed the impact of two FAU Harbor Branch outreach programs- the "Ocean Discovery Experience" (hosted afterschool at Boys & Girls Clubs) and "Explore the Indian River Lagoon" boat field trips (hosted on the *Discovery* floating laboratory), which reached roughly 835 socially disadvantaged students over the eight-month study period. Pre- and post- assessments were used to measure the impact on participants, as well as differences between the classroom and field-based experiences. While both programs increased participants' interest in STEM and understanding of the topics covered, the outdoor educational experience had the greatest impact on learning and knowledge retention.

Assessing Nutritional Condition in Common Bottlenose Dolphins (*Tursiops truncatus truncatus*) Inhabiting the Northern Indian River Lagoon

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Assessing common bottlenose dolphin (*Tursiops truncatus truncatus*) health in the Indian River Lagoon (IRL) is critical as dolphins are subjected to high levels of anthropogenic mortality, starvation has been attributed to large-scale mortality, and the population has experienced numerous Unusual Mortality Events. The evaluation of nutritional condition can provide valuable data to better assess dolphin health. Vessel-based photo-identification surveys were conducted in the northern IRL (summer 2023), and nutritional condition was assessed for 155 marked adult dolphins utilizing a standardized body condition index. The overwhelming majority (93%) presented in compromised nutritional condition (68% underweight, 25% emaciated). Emaciation was most common in females with dependent calves. The results are concerning, as the dolphin community appears to be increasingly nutritionally stressed. Future studies will utilize UAS overflights and photogrammetry to better quantify the degree of nutritional compromise.

Insights into Indian River Lagoon Fish Population Genetics and Implications for Lagoon Biodiversity and Management

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I review current understanding of fish population genetics in the Indian River Lagoon, with a focus on the implications for lagoon biodiversity and management. Key points include (1) advances in genetic research that have significantly enhanced understanding of species' population genetic structure; (2) how genetic connectivity, influenced by larval transport and migratory patterns, varies considerably among species, including instances of genetic isolation over surprisingly short distances, even between neighboring estuaries; and (3) how population genetic data can inform effective management strategies to conserve genetic diversity and enhance population viability. Taken together, these findings shed new light on the complexity of the IRL ecosystem to help guide future conservation efforts.

Range Expansion and Population Shifts of Estuarine Fishes in a Changing Subtropical Estuary

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Catastrophic losses of seagrass and increased environmental degradation have been occurring during the past decade in the Indian River Lagoon. Changes were observed in the abundance of two closely related sparid fishes based on fishery-independent monitoring efforts over 22 years, with a significant increase of sea bream *Archosargus rhomboidalis* and a simultaneous decline of sheepshead *A. probatocephalus*. A prominent northward expansion of tropical sea bream was recently evident (2015–2019). These abundance trends and the northward expansion of sea bream into previously undocumented areas were associated with an annual minimum water temperature increase of approximately 1.5°C and an overall mean water temperature increase of 0.9°C. If environmental degradation persists or expands, negative effects on seagrass-dependent fish populations, including sheepshead, will likely continue. Direct competitive interactions with expanding sea bream populations may negatively affect the potential recovery of sheepshead in the estuary.

Changes in the Phosphorus Sorption Capacities of Sediments in Response to Hypoxia in the Indian River Lagoon

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Since 2010, the Indian River Lagoon has experienced a regime shift characterized by increased harmful algal blooms, phosphorus concentrations, and hypoxic events. When oxygen is depleted within the sediments, sulfide can irreversibly bind iron and release phosphorus back into the water column, potentially contributing to higher phosphorus concentrations. To determine the long-term effects of chronic short-term hypoxic events, sediments were tested in aerobic and anaerobic conditions to determine the maximum capacity for phosphorus sorption. Comparing this data to data published in 2001, aerobic sediments exhibited a decrease in sorption capacity from 2001 to 2023. Further research is required to determine the influence of iron and grain size on this process, but a diminishing ability to bury phosphorus within sediments implies that the rate of phosphorus sequestration from the IRL may be decreasing.

Managing Mosquitoes with Blood, Fish and Weirs in Brevard County: Striking a Balance in and around the Indian River Lagoon

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Brevard County Mosquito Control employs an integrated environmental approach of managing mosquito populations in and around the Indian River Lagoon while fulfilling a State public health mandate to protect residents from mosquitoes and associated diseases. Every week the Department conducts extensive trapping and microscopic identification of mosquitoes while monitoring for mosquito-borne diseases. There are over 40 known mosquito species in Brevard County, each with unique habitat and disease potential. The Department utilizes these data to manage mosquitoes via native fish stocking, water level management in salt marsh breeding areas (i.e., mosquito impoundments), surveillance and elimination of water-holding containers (e.g., waste tires), targeted applications of Environmental Protection Agency (EPA) approved materials, and even public education to encourage residents to reduce mosquito breeding and disease transmission potential. Additionally, project partnerships are key to the Department's success in increasing IRL fish passage, living shoreline, seagrass, and water quality opportunities while protecting public health.

Assessment of Coastal Stormwater Systems for Improved Urban Habitat and Estuarine Ecosystem Management

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The research goal is to understand the role and impacts of the coastal urban stormwater systems on the broader estuarine watershed and its community. The three objectives are: (1) to analyze historical water quality, and meteorological data within Halifax River to determine if there are spatial and temporal trends within the past 10 years, particularly regarding the nutrient parameters; (2) to collect and analyze water quality data and habitat description from the three outfall canals that drain to the Halifax River to relate them to the conditions in the river; and (3) to compile a GIS map of the adjacent cities within the Halifax River stormwater drainage to depict the flow through the stormwater system, flood areas, census data, and critical infrastructure. The research outputs will be shared with local governments to help decision-making.

Diurnal and Episodic Hypoxic Events Contribute to Fish Kills Plus Diminished Removal of Nitrogen and Phosphorus from IRL

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Over the past decade, IRL algae blooms have become less predictable based on external nutrient loading. Higher dissolved phosphorus concentrations since 2010 and altered nitrogen speciation point towards a significant internal source of N and P that could result from a change in the redox state of sediments. As oxygen declines, sandy sediments can switch from a sink to a source of dissolved nutrients, contributing to a series of positive feedback loops helping to sustain algae blooms, hypoxia, and an alternate stable state. Using our network of bottom water dissolved oxygen sensors, diurnal hypoxia was observed throughout the Banana River Lagoon during warm summer months. These preliminary data reinforce the need to better understand the spatial extent and duration of hypoxia plus impacts to nutrient cycling. These data will allow for more accurately modeled internal nutrient loading and help to select restoration sites where the local redox environment will promote successful outcomes.

Determining Hydrodynamic Habitat Thresholds for Seagrass in a Microtidal, Estuarine Environment
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Coastal seagrass meadows are a crucial part of many estuarine ecosystems, providing habitat, food and shelter for fish and other lagoon organisms in addition to attenuating incoming waves and stabilizing sediment. Recent disturbances including algal blooms and shoreline modification have reduced the distribution of seagrasses like *Halodule wrightii*, driving the need for more robust restoration practices. The objective of this research is to describe hydrodynamic habitat preferences that may shape *H. wrightii* distribution. Mapped seagrass distributions and modeled wave distributions (height, frequency) were compared throughout IRL to determine if there is a hydrodynamic threshold at which seagrass absence is more likely than presence. Preliminary results suggest preference for an 80th percentile wave height below 9-10 cm along shorelines and below 11 cm in open water. Investigation of shoreline type revealed that seagrasses were prevalent adjacent to natural, wetland shores and not often found adjacent to hardened shorelines.

Stormwater Monitoring as a Crucial Contribution of Citizen Science on Behalf of IRL Restoration
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Long overdue: The SWIRL (StormWaterIRL) pilot project began January 2024 to directly determine what hazardous contaminants are sent from mainland sources into the IRL in northern Brevard County. All previous analytical monitoring occurred within the Lagoon but failed to establish a) which organic compounds (herbicides, pesticides, pharmaceuticals, PFAS, etc.) degrade ecological health, and b) what are real-time water-quality data monitored at stormwater outfall points. These needed data include the actual volumes of fresh water that are diluting life-supporting salinity in the IRL. SWIRL is conducted by a team of volunteer professionals and local students, as a year's effort to gain vital understanding in support of the growing movement for Lagoon restoration. It is hoped that awareness of the new initiative will cause other organizations to seek cooperative ventures, leading to expanded, effective monitoring programs.

Coastal Acidification: An Emerging Issue in the Indian River Lagoon
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Coastal acidification (CA) is increasingly recognized as a serious threat to estuaries. The Indian River Lagoon Observatory Network of Environmental Sensors (IRLON) has been monitoring pH and pCO2 levels at 13 stations in the Indian River Lagoon (IRL) and St. Lucie Estuary (SLE) since 2022. Over the annual cycle (2022), pCO2 levels at IRL sites near three inlets were lower than the much more elevated levels upstream in the IRL and SLE. CA in the IRL was exacerbated by storms and freshwater runoff. Over short (i.e., daily, weekly) temporal periods, diel and tidal patterns on pH, pCO2, and aragonite saturation values (ΩAr), were readily discerned, most strongly near an inlet (Station IRL-SLE) where pH could fluctuate by one full unit during one tidal cycle. Based on ΩAr estimates, calcifying organisms in the IRL are likely at risk of CA (ΩAr <1), at least in certain locations, at certain times.

Exploring Oyster Reefs through Virtual Reality: Comparing Methods of Science Outreach

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Virtual reality (VR) uses immersive, virtual environments to simulates realistic experiences that can provide people with first-hand perspectives of new spaces. Recently, VR has gained popularity as an approach to increase access to threatened, inaccessible habitats to help garner support for conservation. However, the effectiveness of VR compared to more traditional outreach methods, such as live animal touch tanks, has not been determined. Oyster reefs in Mosquito Lagoon were used as a case study, filmed in 360 degrees, and displayed through immersive VR headsets. High school students participated in both the VR experience and an oyster habitat touch tank activity. Student learning and environmental attitude were compared between the two outreach methods. Preliminary results show that environmental attitude was not impacted. However, the VR experience and touch tank activity equally improved student learning, indicating VR can be an effective method of outreach in situations where live animals are not available.

An Elementary School Teacher's View: Best Practices for Engaging Students in Mangrove Conservation

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As a STEM resource educator in Florida, I strive to engage my students with regional natural habitats to provide a deeper and more meaningful experience that centers around the Next Generation Science Standards. Toward this goal, for the past decade I have collaborated with the University of Central Florida faculty to grow red mangroves from propagules in a nursery environment on our school campus. These plants are later used in shoreline stabilization. This poster will showcase how my students use mangroves in 3D Learning that supports sensemaking and challenging engagement. These investigations foster curiosity, inquiry, problem solving, and creative thinking utilizing a driving question board consisting of plant needs, life cycles, structure and function, seed dispersal, reproduction, ecosystems, and pollination. The roles of conservation, restoration, data collection, interdependence, and shoreline stabilization of mangroves are embedded in their learning. Lessons support Disciplinary Core Ideas, Crosscutting Concepts, and Science and Engineering Practices.

IRLON: It's Not Plug and Play!

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The Indian River Lagoon Observatory Network of Environmental Sensors (IRLON) is a real-time estuarine observation network with 13 stations in the Indian River Lagoon and St. Lucie Estuary. With the 24/7/365 mission of continuous monitoring of 20 water quality and 8 meteorological parameters, Team IRLON faces daunting challenges to keep the network running and generating high-quality data. We battle the high-fouling IRL environment, sensor drift, storms, and boat and lightning strikes on our stations. We have developed rigorous procedures for maintenance and quality control, strong logistics planning and teamwork, and have become innovators of estuarine observations. For example, we have developed the UNDI (UNderwater DIstribution box) and begun to design improved biofouling components using 3-D printing. Our efforts make important environmental data freely available to many different types of users so that we can all better understand, manage, and improve the health and value of the Indian River Lagoon.

Seagrass Census: Assessing Viable Seagrass Fragments Abundance in the Wrack Line

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Seagrass restoration of *Halodule wrightii,* has become crucial as seagrass coverage in the Indian River Lagoon (IRL) declined 58% between 2011 and 2019. To understand the abundance of seagrass fragments available for natural recruitment and restoration, we tracked the abundance of viable fragments found in wrack in Mosquito Lagoon. Wrack is plant material, including seagrass fragments, mangrove propagules, and other detritus. Replicate samples were collected from 5 locations every 2 weeks for 1 year and processed in the laboratory. To date, *H. wrightii* was the most common species and was most abundant during the fall season. Among the total *H. wrightii* fragments collected, 43.5% had apical meristems, the growth tips needed to produce leaf-bearing shoots. Annually, on average, 31 fragments with apical meristems per/m^2 meter squared a month were recorded. This study will assist restoration practitioners in understanding the availability of viable *H. wrightii* fragments for natural and active restoration efforts.

Development of a Coupled Physical-Biogeochemical Model for C44 Canal and Linking Lake Okeechobee with St. Lucie Estuary

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Waters periodically released from Lake Okeechobee to the St. Lucie and Caloosahatchee estuaries often contain significant nutrients and toxin-producing blue-green algae *Microcystis aeruginosa*. Understanding the impacts on water quality and phytoplankton blooms in the estuaries, however, is challenging because, in part, the water properties including nutrients and phytoplankton abundances may change significantly during the transport through the canals (C-43 & C-44). Yet observations are highly limited to characterize these changes. To address this issue, a coupled hydrodynamic-biogeochemical model has been developed for C-44 canal to simulate the transport and biogeochemical processes in the canal. The biogeochemical model simulates both nitrogen and phosphorus cycles and includes five phytoplankton groups. A three-year (2018-2020) simulation has been completed and validated with available data, which results will be presented. In the future, this model will be linked to companion models for the lake and St. Lucie estuary being developed as an inter-connected modeling system.

Shoreline Defense Force! Novel Design of an Educational Wave Flume Illustrates the Impact of Shoreline Habitat on Coastal Erosion Processes

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Experimental hydraulic flumes are important research instruments used to test hydrodynamic and sediment transport processes in research laboratories. However, flumes can also be powerful tools to visualize erosion, which can be effectively leveraged towards environmental education and community engagement. Students from the Ecohydraulics Laboratory at UCF have designed a novel educational flume to engage nonscientific communities in the topic of shoreline erosion. The mobile flume is designed to go almost anywhere, is affordable to build, simple to operate, and flexible to engage diverse audiences (e.g., from very young to adult), yet preserves the rigor of critical scientific processes. The dual-chamber design with erodible bed allows for comparison of different habitat types side-by-side. For instance, observers can watch different erosion rates progress in real time along a hardened slope vs. within a structurally complex, biodiverse shoreline. Come see the Shoreline Defense Force in action and learn how to build your own!

Baitfishes Priceless Contribution to the IRL Economy, Culture, and Environment

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Live bait sales are valued at $275 million per year in Florida alone, but the impacts of baitfish fisheries are far reaching, from tourism to commercial and recreational fishing to estuarine health. Located on the IRL, Live Advantage Bait LLC (LAB) was the first and only commercial marine baitfish hatchery producer in the U.S. LAB pioneered commercial marine baitfish aquaculture techniques and over the past decade has commercially produced numerous species of baitfish for research, restoration, and commercial sale. Working directly with researchers, the commercial supply chain and conservation groups has allowed LAB to learn and contribute data demonstrating the importance of these bait fish species to our local economy, cultural heritage, and environment. This presentation will dive deeper into the priceless impact baitfish retail, fishing, and ecology has on the greater IRL. As well as what we can each to preserve and positively impact their populations into the future.

Environmental Hypoxia in Ecologically Important Estuaries and Its Effects on Native Fish Species during Early Development

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Estuaries like those in the Gulf of Mexico and the Indian River Lagoon (IRL) host some of the most species-diverse ecosystems in North America, but is facing an increased intensity of hypoxic zones. This project aims to reveal potential consequences from hypoxia in the larval stages of Florida Pompano (*Trachinotus carolinus)* and Red Drum (*Sciaenops ocellatus*). To test the effects of hypoxia, fertilized eggs were incubated in two treatments of severe and moderate hypoxia and one treatment of normoxia in a recirculating aquaculture system. Larval development, survival, and fatty acid lipids use were assessed. Lipids were extracted and separated into neutral and polar fatty acids to understand the potential effects of severe hypoxia on energy demand and membrane permeability. This project enhances the understanding of marine ecosystem function to optimize conservation and management strategies where hypoxic zones are prevalent in areas like in the IRL and the Gulf of Mexico.

A Preliminary Characterization of Microcystin Exposure in Estuarine Sentinels in the Indian River Lagoon, Florida

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The Indian River Lagoon (IRL) is a diverse estuarine ecosystem experiencing declining water quality in conjunction with increasing vulnerability to harmful algal blooms (HABs). Aquatic mammals inhabiting the IRL can serve as sentinels of One Health threats by demonstrating the presence and deleterious effects of HAB toxins. Microcystin (MC), a potent hepatotoxin produced by blue-green algae, is an emerging concern in the IRL. Initially introduced to the lagoon by freshwater outflows from Lake Okeechobee, MC persistence is due to eutrophication, toxin sedimentation, and climatic factors. Microcystin has been detected in IRL residents, domestic animals, free-ranging fauna, and water samples. Yet, there is no routine testing for MC exposure, severely limiting our knowledge of toxin occurrence and health consequences. Thus, we are prospectively and retrospectively screening estuarine indicator species, common bottlenose

dolphins (*Tursiops truncatus*) and North American river otters (*Lontra canadensis*), for MC exposure and are correlating findings to health markers.

Assessing a Decade of Unprecedented Change in the IRL Using Macroalgal Bio-Observatories to Understand Nutrient Sources

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Eutrophication is a global issue. The Indian River Lagoon (IRL), FL, is a eutrophic estuary where harmful algal blooms, seagrass losses, and wildlife mortalities have occurred. In 2011-2012 macroalgae collected from 20 sites spanning the IRL revealed that nitrogen (N) from human waste was a primary N source supporting algal blooms. Limited point-source inputs of sewage to the IRL implicated septic systems. Water quality has continued to deteriorate in northern segments of the IRL. In 2022-2023, the previous study was repeated to assess decadal changes in water quality and nutrient sources. Throughout the IRL, water column N to phosphorus (P) ratios (N:P) increased, while macroalgal tissue N:P decreased. Stable N isotopes ($\delta^{15}N$) of macroalgae increased, suggesting septic systems remain a primary nutrient source in the IRL, which was confirmed by the high concentrations of the artificial sweetener sucralose. The results from this project will help better understand the nutrient sources driving of eutrophication in the IRL.

Education and Advocacy toward Marine Debris Prevention and Reduction

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This NOAA Planet Stewards initiative in Daytona Beach employs MDMAP data analysis to reduce marine debris in a connected coastal ecosystem encompassing oceanfront beaches, lagoon shores, and the urban watershed. Bethune-Cookman University collaborates with local colleges and high schools, advocating for marine life and implementing community-level strategies. Focused on micro- and macro-plastics, derelict fishing gear, and non-natural materials in shoreline projects, the project integrates human dimensions for sustainable coastal and marine practices. Aligned with NOAA's Marine Debris Program, it strives to realize a vision of oceans and coasts free from debris impacts and investigates prevention methods.

Examining How Environmental, Physical, and Pathological Factors Impact the Reproduction and Distribution of *Crassostrea virginica* in the Northern Indian River Lagoon

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Since 2021, Brevard Zoo has monitored spatial and temporal patterns in oyster spat settlement in the Brevard County portion of the Indian River Lagoon. Current data suggests oyster spat becomes limited at sites further north in the IRL. To examine how environmental, physical, and pathological factors impact oyster reproduction, Brevard Zoo will expand their oyster spat settlement monitoring program in 2024 with funds from Restore America's Estuaries. Monthly oyster spat monitoring will occur at 15 sites in the IRL and Banana River lagoon. Additionally, live oysters will be collected from four oyster reef sites monthly to be processed for condition index, hemolymph, and histology analysis. Continuous water quality monitoring sensors will be used to evaluate environmental conditions at the four reef sites. Findings will help guide future oyster restoration site selection in Brevard County.

Habitat Utilization and Distribution of two Sympatric Dasyatid Stingrays in the Indian River Lagoon

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Bluntnose (*Hypanus say*) and Atlantic Stingrays (*Hypanus sabina*) are understudied sympatric species that act as meso-predators within the Indian River Lagoon (IRL). Fisheries scientists with Florida Fish and Wildlife (FWC) have been regularly sampling within the IRL using a variety of sample gears since 1998. Historical data from this program can help characterize habitat utilization and track population changes. Factors such as latitudinal distribution, environmental influence, and behavior, such as mating, may also affect their distribution. Results from this study can help better inform decision makers about the changing ecological state and conservation of the IRL.

Dead Dolphins Dated by Stranding Domain along Florida's Coastline

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The bottlenose dolphin (*Tursiops truncatus*) is an indicator species of ocean water quality. This project examined available NOAA *Tursiops* strandings records from 2000-2020 along Florida's coast with corresponding water quality and environmental drivers. This includes coastal sea surface temperature (SST), chlorophyll a concentration, river flow data, the El Niño index, and harmful algal species' cell count. Timing of stranding locations and algal blooms were designated into corresponding NOAA *Tursiops* stocks to find correlations with unusual mortality events (UMEs). Statistical analyses showed the IRL stock had disproportionately higher strandings than any other east coast stock by average and by total strandings. Preliminary analyses suggest there may be no relationship between UMEs and cell counts. This study will help inform future management decisions by understanding the environmental factors that correlate with stranding patterns.

Freshwater Discharge Disrupts Linkages between the Environment and Estuarine Fish Community

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Freshwater diversions have altered coastal ecosystems greatly, resulting in fundamental shifts in hydrology and ecological communities. In recent years, efforts to restore hydrology have increased. To explore the impacts of altered freshwater discharge to St Lucie Estuary, here Bayesian structural equation models are used to quantify the relationships among water quality properties, nutrients, and components of the fish community. During periods of relatively low freshwater input, predatory sport fish and lower trophic level forage fish guild dynamics were tightly coupled with water quality and one another. Conversely, during periods of high-water discharge, there was virtually no link between water quality and fish guilds. As restoration of estuaries and rivers continues globally, freshwater delivery to downstream ecosystems will be altered. Following the approach presented here, Bayesian structural equation models can generate insight regarding potential system-wide shifts following alteration of freshwater delivery, thereby providing a critically important tool for evaluating management strategies.

Growth and Survival of Manatee Grass at Different Salinities in the Indian River Lagoon: A Mesocosm Experiment to Assess Restoration Potential

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Indian River Lagoon (IRL) seagrass restoration has largely focused on *Halodule wrightii*; however, there are opportunities to address the viability of other historically present seagrass species. Identifying additional native seagrasses for restoration could help increase habitat and species diversity. This study evaluates the growth and survival of Manatee Grass, *Syringodium filiforme*, in response to varied salinities found throughout the IRL. Twelve mesocosms were established, each planted with 9-13 shoots of manatee grass in quarry sand. Mesocosms were illuminated with full spectrum 1000W grow lights matched to sunrise and sunset. Seagrass growth and survival is being monitored using blade count, shoot count, chlorophyll concentrations, and canopy height. Salinity levels are maintained at 10, 15, 20, and 26 ppt, to test the hypothesis: *S. filiforme* experiences decreased growth and survival at salinities <20 ppt in the IRL.

Five Year Overview of Fish Disease and Mortality Reports in the Indian River Lagoon

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The Florida Fish and Wildlife Conservation Commission's (FWC) Fish Kill Hotline allows everyone to report fish kills, diseased or abnormal fishes, discolored water, or other marine issues via phone, online, or the FWC Reporter App. Fish kills and disease are recorded in a statewide database. FWC Fish and Wildlife Health staff (FWH) collaborate with the public, researchers, and agencies to collect samples, obtain data, and determine causes of mortality and disease events. Since 2019, FWH received 421 mortality reports throughout the IRL. In conjunction, fish health is assessed by FWC's Fisheries-Independent Monitoring (FIM) program. In 2022, 219,533 fish ≥75 millimeters were collected during FIM sampling and 615 (0.3%, 37 taxa) had a gross external abnormality (GEA). Statewide, northern IRL specimens had the highest incidence of GEA's (1.2%). The most common GEA was parasitic infestation. Reporting fish health issues supports FWC in effective assessment of fish and ecosystem health in Florida.

Maximizing Nitrogen Removal in a Bioreactor by Adjusting C:N Ratios and Residence Times

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Coupled nitrification-denitrification is limited when the depletion of oxygen decreases the ability of aerobic bacteria to oxidize nitrogen. In a bioreactor system developed at Florida Tech, nitrification was promoted through the addition of oxygen plus a supplemental carbon source. Building upon previous efforts, both C:N ratios and various residence times were tested to find the best combination of decreased nutrient concentrations and throughput to achieve maximum N removal. The range of carbon-nitrogen molar ratios showed effective removals of dissolved inorganic nitrogen at ratios as low as 3. To date, residence times <2 hours achieved >95% removal of dissolved inorganic nitrogen (DIN). By increasing the efficiency of nitrogen removal, bioreactors can be a more effective tool in combating eutrophication in the IRL.

Investigating the Impacts of Transplantation Techniques and Hard Clam (*Mercenaria mercenaria*) Presence on Subtropical Seagrass Restoration

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Seagrass restoration has historically been relatively unsuccessful compared to other coastal ecosystems. Recently, there has been interest in restoring seagrasses alongside hard clams (*Mercenaria mercenaria*), which can improve plant growth through nutrient enrichment. To examine the interactive effects of clams (presence/absence) and seagrass transplantation techniques (non-anchored, staples, burlap, and jute) on shoal grass (*Halodule wrightii*) growth, a randomized block experiment was conducted in Palm Bay, FL, from May until November 2023, within an herbivory exclusion fence. Clams had no significant effect on seagrass growth, and disappeared after two months, likely due to predation. Planting technique was significant, with burlap having significantly higher cover and shoots versus the staples and un-anchored plots. In October, the fencing was removed, and after one month plots experienced > 95% seagrass loss. The results of this study revealed challenges in co-restoration and determined an optimal technique for seagrass restoration in the middle Indian River Lagoon.

Hydrodynamic Habitat Threshold Model for Oyster Restoration in Microtidal Estuarine Environments

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Oyster reefs play a significant role in sediment transport processes by attenuating incoming wave energy, helping to reverse shoreline erosion. Unlike hardened structures, oysters provide sustainable, long-term shoreline protection through dynamic adaptation to changing environments. Urbanization and overharvesting have contributed to a decline in oyster populations, sparking a need for restoration. Though salinity, temperature, and other habitat suitability factors are known, there is limited knowledge on preferred hydrodynamic climate. This study aims to establish hydrodynamic habitat thresholds for Eastern Oyster *(Crassostrea virginica*) through a comparison of oyster distributions across Florida estuaries and modeled wave climate (magnitude and frequency). Preliminary results from the Indian River Lagoon and Lake Worth Lagoon indicate that oysters prefer wave climates where the 80th percentile wave heights are below 7-8 cm. These research findings provide essential insights for correctly targeting sites for oyster reef creation or restoration, thus contributing to the resilience of the coastal environment.

Investigating the Molecular Mechanisms Driving Super Clam Resilience

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Selection for resilient variants can facilitate rapid adaptation that prevents extinctions via a process called evolutionary rescue. 'Evolutionarily enlightened' conservation planning can capitalize on these adapted variants and accelerate ecosystem recovery. We take an important first step toward evolutionarily enlightened conservation for hard clams in the IRL. Hard clams provide important ecosystem services to coastal communities, but environmental degradation decimated IRL populations. However, a small population of resident "super clams" persisted through the environmental changes and have proven to be more resilient to contemporary challenges than other stocks. We compare the genotypes of super clams to hard clam populations collected from the Matanzas River and Sapelo Island GA using 2b-RADseq to determine if the super clams represent a distinct genotypic variant and to identify suites of genes associated

with these differences. We will determine the molecular mechanisms for IRL super clam resilience, which will help improve restoration strategies.

Examining the Plasticity of the Syngnathids spp. in the Northern IRL

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The Indian River Lagoon is a vital estuarine system on the east coast of Florida. It has been experiencing a concerning decline in its seagrass habitats. Seagrasses play a pivotal role in maintaining the ecological balance of the lagoon, providing essential habitats for many marine species. Seagrass decline in the IRL is primarily attributed to a combination of anthropogenic factors, including nutrient loading, pollution, and coastal development. Data and field surveys conducted over a multi-year period reveal a substantial reduction in seagrass coverage, particularly in key Syngnathid habitats. Concurrently, there has been a notable decrease in the abundance and diversity of Syngnathid species, including seahorses and pipefish, which are known to rely heavily on seagrass ecosystems for shelter and food. This study aims to determine how syngnathid species changed over time in the Northern IRL and how these changes can provide insight into the recovery of syngnathid species.

Parasite Diversity of Cryptobenthic Fishes in the IRL

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We quantified parasite diversity in small cryptobenthic fishes as part of a project assessing the health of dolphin food webs in the Indian River Lagoon. Cryptobenthic fish taxa (e.g., Gobidae, Blennidae) represent an important trophic link between benthic and pelagic food webs, and they are often infected with metazoan parasites that rely on other hosts at higher trophic levels for life cycle completion. Over a 1-year period, we collected a total of 258 individuals representing 15 species from multiple locations in the IRL. Individual gobies (n=110), blennies (n=34), oyster toadfish (n=26), and skilletfish (n=12) were dissected for parasites. Infection prevalence was approximately 12% for these cryptobenthic fishes, and there are likely new host records for some parasite taxa. Project data are currently being used for a meta-analysis assessing how parasite diversity and trophic complexity in the IRL compares to urbanized estuaries worldwide.

Goliaths Growing in the IRL: Local Significance and Management Implications

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The Atlantic goliath grouper (*Epinephelus itajara)* is the largest bony reef fish in the Atlantic Ocean and is found in subtropical coastal regions, primarily on the southern coasts of Florida. Adults inhabit inlets to mid-shelf areas, favoring artificial structures where recreational fishing is often concentrated. Juvenile goliath grouper use inshore mangroves as nurseries for up to six years, making the Indian River Lagoon critical to their life cycle. After historical overexploitation in the 1950s through 1980s, protected status implemented in 1990 has facilitated a substantial recovery of populations in Florida. As a result, a catch-and-release sport fishery for adults has emerged, as well as a recent limited harvest of juveniles. This presentation will detail our efforts to improve management of goliath grouper by developing optimal release

strategies relevant to recreational fisheries (e.g., barotrauma mitigation) and using animal-borne biologgers to study ultra-fine scale behavioral ecology, especially spawning dynamics.

What's So Different about Mosquito Lagoon?

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The Indian River Lagoon (IRL) system is comprised of 3 sublagoons, Mosquito Lagoon (ML), Banana River Lagoon (BRL), and the Indian River Lagoon proper. Of the 3 sublagoons, ML is considered the most natural and underdeveloped. Merritt Island National Wildlife Refuge and Canaveral National Seashore protect the uplands from development and the vast complex of mangroves, oysters, and saltmarshes contribute to the uniqueness by filtering nutrients and providing shoreline buffers. In 2022, after seven consecutive years of loss in ML, the seagrass beds began to show small increases in cover. By summer 2023, there were continuous beds of *Halodule wrightii* extending hundreds of acres with over 50% cover. Why ML and nowhere else in the IRL system? Which came first, improved water clarity or seagrasses? How can we explain this fortunate turn of events?

Accessing Blue Carbon Finance from Habitat Restoration in the Indian River Lagoon: Results from a Feasibility Study on Seagrass Restoration

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Nature-based climate solutions (NCS) involve **conserving, restoring, or better managing ecosystems to reduce greenhouse gases and store carbon.** Restoration of "blue carbon" ecosystems, including seagrass meadows and emergent tidal wetlands, is an important NCS strategy in coastal systems such as the Indian River Lagoon (IRL). Since restoration can increase removal of atmospheric carbon dioxide and reduce emissions of other greenhouse gases, many NCS projects can be developed to generate funding through the sale of carbon offsets on the voluntary carbon market. A feasibility study assessed the opportunity to develop a blue carbon offset project in the IRL to help finance future restoration, monitoring, and management of seagrass habitats. Estimates of emissions reductions and carbon revenues were generated along with a risk assessment of major threats to restoration success, including harmful algal blooms and sea-level rise. Opportunities, challenges, and next steps towards accessing blue carbon finance will be discussed.

NASA DEAP Institute: A Three-University Consortium toward Improving Satellite Data-based Flash Flood Segmentation using Machine Learning

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The NASA MUREP DEAP Institute is a consortium of three universities: Bethune-Cookman University, Alabama A&M University, and Embry-Riddle Aeronautical University. The overarching research theme is to improve scientific understanding and projection of multiple spatial/temporal scale impacts of water level changes on coastal resources and communities using NASA's satellite data, models, and suborbital and field data. The DEAP research focuses on creating a constellation of sensors to capture changing water levels from a single storm event to decadal (sea level rise) time scales. Our proposed collaborative research using ML and DL architectures will also improve the performance of flash flood segmentation from satellite

images. The primary research setting/test areas for the team are the Indian River Lagoon and the northern coastal region on the Florida Atlantic Ocean. The DEAP research also helps enhance community resilience by providing early warnings and flood/resource management orders.

Impacts of Glyphosate on Algae Blooms in the Indian River Lagoon

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Concerns regarding the use of herbicides are often focused on potential toxicological impacts; however, varied tolerances among photosynthesizers can contribute to a change in the aquatic community. When broken down, glyphosate itself produces NH_4^+, PO_4^{3-}, and CO_2 contributing to algae blooms that can cause decrease light availability for seagrasses. Glyphosate was dosed into water from the IRL to achieve eight concentrations, from 0 ppm to 500 ppm glyphosate. Mesocosms were maintained under natural daylight photon flux for six weeks. The time for the glyphosate to break down and produce visibly detectable algae was concentration dependent. Chlorophyll (µg/L) and cyanobacteria (cells/mL) levels increased initially at low glyphosate concentrations; however, over time chlorophyll spiked in mesocosms that were initially dosed with higher concentrations of glyphosate over the six weeks. In glyphosate dosed water, cyanobacteria became more abundant with lower chl/PE ratios.

***Rhizophora mangle* (Red Mangrove) Growth and Survival in Different Habitats in Mosquito Lagoon, Florida**

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Mangroves provide many ecosystem services in coastal environments around the world. In Mosquito Lagoon, the red mangrove *Rhizophora mangle* is a common species in coastal wetlands, and recently, the number of individuals successfully recruiting to intertidal oyster reefs has greatly increased. To understand how well *R. mangle* responded in terms of survival and growth to the suite of variables associated within these two habitats, 300 approximately 1-year old seedlings were tracked (n = 30 per site on 5 oyster reefs and 5 shoreline sites) for one year. Monthly data collection included above-ground measurements for each seedling, while below-ground measurements quantified biogeochemical properties of the soil adjacent to mangroves at each site. After one year, greater stem circumference and ammonium concentrations were observed on oyster reef sites. Survivorship declined over time for both habitat types, however, survivorship was greater on oyster reefs after one year ($p= 0.002$).

Biodiversity Associated with the Salt Marsh Shoreline at Jones' Pier Conservation Area

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Saint Edward's ecology students partnered with the Indian River County Conservation Lands Division and Inwater Research Group as part of an Indian River Lagoon National Estuary Program funded grant to sample the spatiotemporal shoreline biodiversity associated with the newly formed salt marsh of the Jones' Pier Conservation Area. Opened in May of 2023, the 4-acre salt marsh connects to the Indian River Lagoon with a screw pump and series of culverts, providing improved water quality, aquatic and terrestrial wildlife habitat, and stormwater management. Cast and seine nets were utilized to collect aquatic fishes and invertebrates during the Fall of 2023. Initial sampling demonstrated a dominance of juvenile common snook

Centropomus undecimalis within the shoreline areas of the salt marsh. Collections will continue to potentially describe spatial and temporal changes in species inhabiting the salt marsh.

The Relations between Water Quality and Fish in the Impoundments of the Coastal Oaks Preserve

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The Indian River Lagoon is a vital water source and provides nursery grounds for a variety of fish species. In the last century, mosquito impoundments were built along the Indian River Lagoon to control salt marsh mosquito populations and to replace the use of harmful chemicals. However, the impoundments became segregated from tidal exchange. Rotational impoundment management (RIM) was implemented in the 1970s, which involved adding water exchange culverts to previously established impoundments. In this study, we analyzed four of those culverts and looked at how water quality varies among culverts inside the Coastal Oaks Preserve (COP) and its effect on fish. We measured water quality parameters including temperature, salinity, dissolved oxygen, and pH. We also utilized culvert traps to catch fish traveling within culverts. We concluded that the addition of culverts to the COP will positively influence water quality and fish diversity and abundance.

Using Environmental and Prey Characteristics to Describe Sport Fish Abundance in an Estuarine Environment

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The local abundance of estuarine fish is influenced by multiple environmental factors, including dissolved oxygen concentration, salinity, and temperature. Higher trophic level sport fish are influenced by these abiotic factors, as well as biotic factors including the abundance of their prey and local habitat types. In this research project, the relative importance of these abiotic and biotic factors is examined to increase our fundamental understanding of the drivers of sport fish abundance. Using empirical abundance data collected between 2017 - 2022 in combination with Bayesian Linear Regression analyses, a predictive model has been developed that best explains variation in sport fish abundance in the Mosquito Lagoon and Mantanzas River. This tool provides insight regarding the primary influences on sport fish species in Florida's estuaries. In the future, this knowledge can be used to develop more effective management strategies for increasing sport fish abundance, and ultimately moving coastal ecosystems toward sustainability.

Four Years of Clam Restoration: Lessons Learned and New Directions

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The Indian River Lagoon Clam Restoration Initiative began in 2019 with repatriation of 2.3 million native *Mercenaria mercenaria* clams at three sites spanning Mosquito and Northern Indian River Lagoons. Four years and 27+ million clams later, the Initiative has established 18 high density and 79 low density sites spanning waters from New Smyrna to Stuart. Proximity to inlets and stormwater outlets has proven to exert more control over clam growth and survival due to salinity fluctuations than predation and algal blooms. Survival rates over the first three years ranged from 62-84%, however, the high rainfall and excessive heat of the summer of 2023 reduced the average survival rate to 53.7%. To increase overall project success, new approaches such as aerial distribution following an R strategy are being explored.

IRL Biodiversity: Review and Gap Analysis of Northern Indian River Lagoon Biodiversity
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The Indian River Lagoon (IRL) has an abundance of scientific studies on charismatic fauna and keystone habitats. However, there exists a knowledge gap on less prioritized yet vulnerable species and regions. With the ecological connectivity of the IRL, this lack of attention needs to be addressed to better understand conservation, research, and management opportunities. Therefore, this study aims to identify species of concern within the geographical area from Haulover Canal, to NASA Bridge Causeway, to Playalinda Beach. From the Smithsonian Institute and iNaturalist, we compiled a database of approximately 3,000 species within our study area. Species will be grouped by taxonomic class and order, and threat level according to IUCN Red List parameters. Species at levels of vulnerable and beyond, will be further analyzed via a literature review to determine research gaps and conservation opportunities.

Dynamic Nature of Hydrology and Benthic Vegetation of Mosquito Control Impoundments
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Mosquito control impoundments within the Indian River Lagoon are hydrologically separated from the lagoon from approximately May through October and managed by the Mosquito Control District of the respective county. The impoundment water level naturally fluctuates with tide and precipitation and is also artificially flooded during the mosquito breeding season (May-October) using pumps. Occurrence of benthic vegetation such as the seagrass *Ruppia maritima*, macroalgae *Chara* sp. and other mat-forming algae were documented in a mosquito control impoundment (North Siphon impoundment) for a two-year period. In situ measurements of water quality and publicly available data of precipitation and tide were related to the vegetation survey data. The managed impoundment section of the Indian River Lagoon has great potential to serve as natural seagrass nursery habitat when restoration strategy is linked to the hydrology of the impoundment.

Advancing Coral Restoration on St. Lucie Reef
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Found just outside the Indian River Lagoon near St. Lucie Inlet, St. Lucie Reef (SLR) comprises the northernmost portion of Florida's Coral Reef (FCR) tract. This area provides key habitat for diverse assemblages of organisms and ecosystems that support both recreational and commercial fisheries. Unfortunately, coral cover at SLR has declined as a result of hurricane impacts and stony coral tissue loss disease (SCTLD). Natural recruitment of new corals appears limited, warranting coral restoration efforts. Our recent study demonstrated that SCTLD-susceptible species could be successfully outplanted on SLR with negligible disease impacts. To further investigate the efficacy of coral restoration at SLR, this study aims to evaluate the impacts of outplant size and environmental factors, other than disease, on coral outplant survival and growth. Ultimately, our results will help inform and direct ongoing coral restoration planning for St. Lucie Inlet State Park and the Kristin Jacobs Coral Ecosystem Conservation Area.

Save the Seed: Sexual reproduction of *Halodule wrightii* in Mosquito Lagoon, FL

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Halodule wrightii flowers and seeds were observed for the first time attached to vegetative fragments collected in the shoreline wrack in Mosquito Lagoon (ML), Florida during the fall of 2023. Fragmented reproductive shoots with fruits may aid long-range dispersal, colonization of disturbed sediments, and contribute to genetic diversity of the population. We recorded and assessed flowering, fruiting, and seed production collected from the wrack. The presence of reproductive fragments suggests that flowering and seed dispersal plays a larger role than previously thought in the establishment and maintenance of *H. wrightii* in ML. Our future research plan is to determine the extent of the *H. wrightii* seed bank in ML to inform seed-based restoration potential. Understanding reproductive phenology and output helps resource managers to develop management and conservation plans that sustain seagrass and associated biodiversity.

Keep Calling Us: The U.S. Sawfish Recovery Hotline is a Key Tool that Promotes Recovery of the Endangered Smalltooth Sawfish in the Indian River Lagoon

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Historically, the endangered smalltooth sawfish, *Pristis pectinata*, ranged in U.S. waters from Texas to the Carolinas. Over the last century, substantial reductions in range and population size have occurred and the core range is now in southwest Florida. In the late 1990s, scientists began collecting encounter reports from public sources such as anglers, boaters, and charter captains. These reports laid the groundwork for the current U.S. Sawfish Recovery Hotline (1-844-4SAWFISH) and the associated U.S. Sawfish Recovery Database, which helps researchers and managers collect information on when and where sawfish are encountered throughout the southeastern U.S., including the Indian River Lagoon. Encounter data have played, and will continue to play, important roles in the success of research and management decisions that foster recovery. This talk will discuss successful collaborations that have come from reporting that has occurred in the IRL in recent years.

Seed Bank, Viability, and Germination of *Ruppia maritima* within Seagrass Beds and Mosquito Control Impoundments of Indian River Lagoon

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Seeds of *Ruppia maritima* were retrieved from sediment samples and reproductive shoots within the seagrass beds of the Indian River Lagoon and two impoundments (Merritt Island T-10-F and North Siphon at the Indian River Lagoon Preserve State Park). The mean seed bank count was 433/L in Merritt Island and 8.4/L in North Siphon. The mean viability for control, cold-stratified, and dry-stratified seeds were 85% ± 5.27, 60.5% ± 11.89, and 53.5% ± 15.47, respectively. The mean germination percentages (post storage for each stratification technique were 19.7 ± 11.6% for control non-stratified, 15.7 ± 10.0% for cold, and 44 ± 19.4% for dry. The results developed from this research can provide practical restoration knowledge such as handling and transplanting protocols for seagrass restoration initiatives.

Decade of Subtidal Oyster Restoration in Brevard County

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Oyster restoration varies naturally by system, and the IRL is no exception. Brevard Zoo has constructed over 80 subtidal oyster reefs in partnership with Brevard County Natural Resources. Identifying and understanding the specific challenges and adaptations needed for the IRL is essential to improve restoration impact. Comparisons of materials including oyster bags, gabions, and corrals show the latter two methods to have greater oyster establishment. Faster oyster growth rates and on average 2.5 times more oyster recruitment was observed in gabion reefs than neighboring bag reefs. Improved monitoring of restoration projects and understanding spatial limitations of natural oyster recruitment have fostered more successful restoration methodologies. After working with five material types, two miles of constructed projects, thousands of volunteer hours, ten oyster gardening seasons, and eight million pounds of oyster shell recycled, we hope to inform other restoration practitioners and highlight the value of subtidal oyster restoration in Brevard County.

Using Unmanned Aircraft Systems (UAS) to Assess Body Condition of Common Bottlenose Dolphins (*Tursiops truncatus truncatus*) in the Indian River Lagoon, Florida

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Common bottlenose dolphins (*Tursiops truncatus truncatus*) in the Indian River Lagoon (IRL) have experienced four Unusual Mortality Events (UMEs) with the most recent mortality event being attributed to starvation. The stock is considered immunocompromised and is routinely subjected to persistent anthropogenic stressors such as fishing gear entanglement, vessel strikes, contaminants, and harmful algal blooms. These factors necessitate monitoring nutritional status to evaluate health trends in IRL dolphins. Previous body condition assessments of this stock have involved invasive capture-release examinations or subjective methods using lateral images of the body. To improve precision, we are investigating the use of photogrammetry data collected from noninvasive unmanned aircraft systems (UAS) combined with models developed from capture-release data to estimate morphometric parameters and subsequently determine the body condition of these free-swimming ecosystem sentinels.

Utilizing Python™ to Analyze Sonar Recordings for Tracking and Counting Fish Targets

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Obtaining video imagery of fish is difficult in low light and highly turbid water. An alternative for observing fish in low light conditions is sonar technology. A Lowrance Elite FS-7 sonar and transponder were deployed to capture data on fish abundance and behavior around culvert mouths within mosquito control impoundments. The recorded sonar imagery often contained high amounts of noise due to the relatively low resolution of this commercial sonar operated at short distances and to debris in the water column. Obtaining accurate count data from the recordings proved to be time consuming and difficult. An analytical procedure in Python™ was developed to automatically analyze fish counts while reducing false counts due to noise. Additionally, code was created to continuously track fish as they moved across frames in the recordings. This new procedure can readily be used to automate count data from sonar recordings and assist with observing fish behavior.

Mosquito Impoundments as Fish Nurseries: Variability in Habitat Structure, Fish Species Composition and Emigration into the Indian River Lagoon

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Juvenile tarpon and snook were tagged in four mosquito control impoundments in Indian River County. Their association with culvert openings that control connectivity between impoundments and the IRL, and emigration through culverts, were tracked over a 20-month period. Fish species composition and size structure varied among the impoundments, with deeper habitats supporting larger fishes. Snook were not found in impoundments that experienced very low dissolved oxygen episodes. Tagging success for YOY tarpon and snook was lower than an earlier study in two impoundments, perhaps indicating variable recruitment levels. Emigration was minimal, even during experimental summertime culvert openings of the impoundments to encourage the expected seasonal emigration. The persistence of larger juvenile tarpon inside impoundments, especially near the mouths of culverts, may act as a predatory barrier that reduces survivorship of new recruits into the habitats. Increasing habitat connectivity may thus encourage emigration of these larger juveniles and restore nursery productivity.

Ichthyoplankton Recruitment within Mangrove-dominated Mosquito Control Impoundments

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Coastal wetlands across the IRL have been impounded for mosquito control purposes, which have been known to have adverse effects on overall fish populations. The objective of this project was to assess the use of culverts by larval fish at three impounded mangrove sites in the IRL. A total of 3,926 fish were collected using light traps (both inside the basins and in the surrounding IRL) from 24 taxa in 576 samples over the year-long study. Inside the impoundments were dominated by species known to spawn in and around mangroves. Larvae of the main sportfishery species that have juveniles known to utilize the studied impoundments (the Atlantic tarpon, and the common snook), were rarely caught inside the impoundments or in the surrounding IRL. The low numbers of IRL and offshore spawning larvae that enter the impoundments may be hindered by conditions inside the impoundments, especially during the summer.

Detection of Multiple Algal Toxins in Whitespotted Eagle Rays from Florida Coastal Waters

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Coastal areas of Florida experience recurrent harmful algal blooms (HABs), which could potentially affect the survival and health of large mobile species such as whitespotted eagle rays. Eagle rays may contact HAB toxins directly through ventilation or skin exposure or indirectly via shellfish consumption. They also serve as important wildlife indicators for potential public health concerns as their shellfish diet represents a shared exposure routes with humans. However, toxin uptake in this species is largely unknown, with most data to date coming from a single red tide study following exposure to a major bloom. To fulfill this knowledge gap, we initiated a biomonitoring program of whitespotted eagle rays in the IRL and Sarasota Bay to collect tissue samples (blood, muscle biopsy, liver and stomach contents) and evaluated toxin concentrations using UHPLC-MS/MS. Our results indicate that various biotoxins are transferred to this species, with evidence of regional differences in toxin composition.

Comparison of Results of Different Oyster Reef Construction Strategies in the Indian River Lagoon

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To increase natural filtration of lagoon waters, the construction of oyster reefs to increase oyster habitat has been funded by Brevard County's Save Our Indian River Lagoon (SOIRL) initiative. Initially, most of the reefs were constructed of traditional Naltex plastic mesh shell bags filled with oyster cultch. To improve the reef enhancement, new construction strategies, including gabions and corrals, are being tested. For example, the Wexford oyster project in Melbourne Beach, built in 2021, was constructed with 2 modules of metal gabions and 3 modules of plastic mesh shell bags. After 2 years of natural recruitment, there were significantly more oysters ($p = 0.004$) in gabions ($696/m^2$) than in shell bags ($535/m^2$). The oysters also grew to larger sizes in the gabions compared to the shell bags. These performance metrics support utilizing gabions in place of Naltex plastic mesh shell bags for oyster restoration.

Results of Pilot Seagrass Transplanting Efforts in the Indian River Lagoon Using Nursery-Reared *Halodule wrightii*

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The Brevard Zoo initiated a pilot seagrass planting project in 2023 in an attempt to refine site selection criteria and planting methodologies for future community-based seagrass restoration efforts in the Indian River Lagoon (IRL). *Halodule wrightii* was planted at 16 locations across the Brevard County portion of the IRL and Banana River Lagoon in May of 2023. The plantings were monitored within the first two weeks of installment and monthly thereafter for the first six months. Although success varied across locations, herbivore exclusion devices aided the growth and establishment of seagrass in most cases. Additionally, heavy loads of drift algae and *Caulerpa prolifera* negatively impacted the seagrass plantings. Monitoring of transplants will continue up to one-year post-planting. Results of this project have influenced site selection and experimental design for 2024 planting efforts in hopes of answering new questions.

Parasite Surveys of *Hypanus sabina* and *H. say* Hosts in the Indian River Lagoon Estuary

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Parasites' specific host-parasite associations coupled with their complex life cycles and transmission modes make them integral components in shaping community structure. Despite the wide abundance, accessibility, and distribution of sympatric stingrays *Hypanus sabinus* and *H. say* in the Indian River Lagoon (IRL) estuary, their parasite-host interactions remain undescribed. Beginning in July 2023, the FWC Fisheries Independent Monitoring (FIM) program and Nova Southeastern University have taken monthly specimen collections from differing IRL regions during FIM surveys. Preliminary species examinations have focused primarily on the spiral valve (intestine), gills, and stomach of stingrays using standardized parasitological necropsy procedures. Parasites to date include species primarily from the class Cestoda and also include Digeneans and Monogeneans. Descriptions of parasite communities and better understanding will provide unique insights into the community ecology of the IRL system.

Autecology of Dasyatid Stingrays within the Indian River Lagoon, Florida

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Within the Indian River Lagoon, the life history, diet, population diversity, and ecological influence of two stingray species, *Dasyatis sabina* and *Dasyatis say*, are limited despite frequent catches by the Fisheries Independent Monitoring (FIM) program within the Florida Fish and Wildlife Research Institute. Collaborations between FIM and Nova Southeastern University have started a conventional tag-recapture study and monthly specimen collection to fill in knowledge gaps about the autecology of these species. Data collected from this study can provide valuable insight into management decisions for prey items, related species, or those that inhabit similar habitat regimes.

Fish Use of Habitat Restoration Sites in Lake Worth Lagoon – A Model for IRL Restoration Efforts

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To regain valuable lost estuarine habitats, the Palm Beach County Department of Environmental Resources Management (PBC ERM) initiated several restoration projects in the Lake Worth Lagoon. These projects utilized different methods including sand capping mud deposits to create shallow water areas for the placement of oyster bars, riprap breakwaters, and intermittently flooded mangrove islands for potential habitats. The Fisheries Independent Monitoring program (FIM) has been monitoring fish use of these sites since 2014, and results indicate that restored habitats are supporting newly recruited fish and invertebrate species, including species with commercial or recreational importance. These sites could serve as models for future restoration projects and effective monitoring efforts in the Indian River Lagoon.

Niche Partitioning in Benthic Fish Predators in the Indian River Lagoon

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Fish are theorized to have complex competitive interactions and niche partitioning. Testing these assumptions at the scale of individual fish species feeding in a lagoon habitat provides an opportunity to understand space and resource use in the Indian River Lagoon. Gut contents of the four most common predator taxa—*Bairdiella chrysoura*, *Lagodon rhomboides*, *Menticirrhus americanus*, and *Micropogonias undulatus*—were analyzed and compared statistically. The results suggest that the four fish taxa are opportunistic on the most abundant categories of prey, but exhibit significant differentiation in feeding selectivity. Feeding niche partitioning in these generalist fish can therefore be viewed as the universal consumption of abundant prey resources plus a specialized resource not consumed by competitors.

The Opossum Pipefish (*Microphis lineatus*) – an Anadromous Fish?

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The rare Opossum Pipefish (*Microphis lineatus*) is a marine fish that spawns in freshwater river systems (Gilmore 1977). Permanent breeding populations in the U.S. were reported from only three river systems in east Florida (Gilmore and Hastings 1983). The definitive reproductive study by Frias-Torres (2002) confirmed earlier presumptions that larvae spawned in freshwater water bodies are carried downstream and

develop in high salinities (often in Sargassum rafts) before recruiting back to coastal rivers as juveniles. The capture of larval Opossum Pipefish from the Kissimmee River and northwest Lake Okeechobee in the spring of 2023 has substantially altered this paradigm. The Opossum Pipefish joins other marine invaders such as Atlantic Needlefish (*Strongylura marina*), Clown Goby (*Microgobius gulosus*), and Naked Goby (*Gobiosoma bosc*) reproducing successfully in Lake Okeechobee.

Genomic Assessment of Spotted Seatrout Management Stocks along Florida's Atlantic Coast

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The spotted seatrout (*Cynoscion nebulosus*) estuarine fishery is one of the most valuable in Florida. Currently, spotted seatrout management units are delineated based on traditional metrics of demography and population genetic structure using markers that are evolutionarily neutral, which may not fully demarcate locally adapted stocks. Coupling specific management actions to locally adapted stocks is imperative as these reflect the unique biological and ecological conditions in which they have evolved. This study used whole-genome genotyping to evaluate how well current stock identities reflect the true population structure. Fish collected from 2019-2022 during FWC-FWRI's Fisheries-Independent Monitoring program were genotyped using a 2bRAD sequencing approach to assess the fine-scale population structure along the Florida Atlantic coast. Our results will demarcate genetic stocks that reflect local ecological conditions. These results will contribute to conventional fishery data towards improving management strategies facilitating spotted seatrout population growth and ensuring fishery resilience and productivity.

Assessing Wrack Biodiversity in the Indian River Lagoon Amid Changing Shoreline Conditions

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Climate change threatens estuarine biodiversity through tropicalization, rising water levels, and more frequent storms that results in shoreline erosion. We monitored the biodiversity of shoreline wrack in the Indian River Lagoon (IRL). Wrack is accumulated vegetation along shorelines, and it plays a critical role in nutrient cycling. Every two weeks for one year, 5 replicate quadrats (0.25 X 0.25 m) were collected from 5 Mosquito Lagoon shoreline locations and processed in the laboratory. Overall, 35 unique, identifiable wrack species were cataloged. Red mangroves were the most abundant species of mangrove propagules observed. We observed that the mean annual wrack composition by season for red mangrove (*Rhizophora mangle*) propagules (131.3 g/m^2) has increased compared to a previous 2018 study (60.0 g/m^2). This increase is a possible result of tropicalization that has allowed for mangrove expansion. Understanding changes in wrack biodiversity can highlight the effects that climate change has on estuarine systems.

Evaluating Ecological Community Structure over Long Time Scales in the Northern Indian River Lagoon, FL

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To restore and maintain coastal ecosystems for future generations, resource managers must have a clear understanding of ecosystem baselines when the system was in its healthiest condition. However, studies in marine ecology suffer from 'shifting baseline syndrome' because we are solely reliant on present-day data (< 50 years) for evaluating ecosystem change that has occurred over millennia. In this study, we leverage interdisciplinary collaborations to evaluate how fish communities have changed over the last 1,500 years

in the northern Indian River Lagoon (IRL). Our objectives were to reconstruct historic fish communities using shell midden zooarchaeological data, compare historic and present-day fish communities using multivariate analyses, and identify key species driving differences between these communities. Preliminary results suggest significant temporal differences in fish community structure. With these findings, IRL resource managers can better specify ecosystem baselines within the system and use this information to help inform management strategies in the IRL.

Hardhead and Gafftopsail Catfish in the Indian River Lagoon: Abundance, Distribution and Diet, Including Egg Predation in Horseshoe Crab Spawning Aggregations

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Hardhead catfish (*Ariopsis felis*) and Gafftopsail catfish (*Bagre marinus*) are common inhabitants of the Indian River Lagoon, often caught by anglers and frequent inhabitants of restaurant docks where they are fed by restaurant patrons. Their sharp spines provide protection from many predators, and their carnivorous feeding habits may impact the populations of other species. Intense FWCC seine surveys from 1999-2020 shows a general increase in population sizes, perhaps in response to the loss of protective seagrass habitats used by prey species. Stomach content analysis of 80 hardhead catfish collected by FWCC indicate catfish fed primarily on fish and crabs. Abundant hardhead catfish aggressively fed amidst large masses of horseshoe crabs spawning at the water's edge in Titusville. Stomach content analysis indicated that fish consumed up to 1556 eggs prior to capture. The overall impact of catfish as predators on IRL fauna and on horseshoe crab reproduction merit further assessment

Larval Recruitment Patterns Can Structure Indian River Lagoon Fish Communities: Implications for Habitat Restoration and Management Programs

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The great diversity of fish species in the Indian River Lagoon employ a variety of reproductive strategies, including nest-building demersal spawning, estuarine pelagic spawning and offshore spawning with pelagic larvae that enter the IRL through inlets. Although many studies have examined the distribution and abundance of juvenile fishes in the IRL, relatively little effort has focused on the larval supply that influences the initial distributions of juveniles and subsequent fish community structure in different IRL regions. Data from the one major ichthyoplankton survey in the northern IRL and Banana River Lagoon, studies of larval recruitment in the Sebastian Inlet, and a single survey from Port Canaveral are summarized to illustrate how larval recruitment can influence the fish communities in the northern IRL. The potential impacts of these larval recruitment patterns on fish community responses to habitat management projects and other anthropogenic and natural changes to the IRL are discussed.

To Cage or Not to Cage Seagrass: Is There Even a Question?

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Diminished water quality has led to the decline of seagrasses and their associated ecosystem services in the Banana River Lagoon (BRL), resulting in increased restoration initiatives. Restoration success may be hindered by herbivory and the addition of herbivore exclusion devices may limit grazing stress on newly established seagrasses. These structures may alter sediment dynamics, influencing seagrass productivity.

To test whether herbivore exclusion devices impact restoration success and sediment dynamics, we caged half of our seagrass restoration plots in the BRL. Treatments were monitored monthly for seagrass growth, and at three months for porewater nutrients, sediment bulk density, and CN. On average, caged plots had 87% more seagrass cover and 81% taller blades than control plots, highlighting the importance of caging newly transplanted seagrasses. There was no significant difference in porewater or sediment characteristics between treatments, suggesting that pedogensis and nutrient cycling need extended monitoring to capture changes in temporal scales.

Atlantic Mole Crab (*Emerita talpoida)* Abundance and Distribution on the Space Coast

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Mole crabs, known by fishermen as sand fleas, are a foundational species of sandy beach ecosystems. Shorebirds and fish depend on these burrowing crustaceans for food and fishermen rely on them as bait to catch various species such as whiting and pompano. This pilot study surveys the abundance and distribution of Atlantic mole crabs along twenty-six 50-meter transects of beach in Canaveral National Seashore and Cocoa Beach using stainless steel sand flea rakes. Our research indicates that Atlantic mole crabs are more abundant in Cocoa Beach than in Canaveral National Seashore. Further research will include analysis of sand grain size, specimen size, and tidal cycle, in relation to both location and mole crab abundance.

Exchange of Juvenile Tarpon (*Megalops atlanticus*) between a Mosquito Impoundment and the Indian River Lagoon Estuary

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Juvenile tarpon (*Megalops atlanticus*) depend on coastal wetlands for nursery habitat. The larvae remain in these protected areas until they reach approximately 250 mm total length, then emigrate to the main estuary, often during flood events. In the Indian River Lagoon, development has changed habitat availability. Wetlands located within mosquito impoundments are connected to the main estuary by culverts which are opened periodically. Our study site is an impoundment in Jensen Beach that is known to contain juvenile tarpon. The culverts at this site are left open year-round as managers explore the best option for mangrove restoration. The objectives of this study are to determine 1) residency of juvenile tarpon since they can move freely through culverts, and 2) conditions under which emigration occurs. To meet these objectives, 13 juvenile tarpon were tagged with acoustic transmitters and tracked via an array of acoustic receivers.

Assessing the Net Advantage of Living Shoreline Stabilization on the Ecological Success of a Restoration Method for *Halodule wrightii*

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Current seagrass restoration may not be considering the ecological interactions between seagrass and adjacent shorelines. This research intended to determine the suitability of Mosquito Lagoon for *Halodule wrightii* restoration in combination with living shoreline stabilization. Three site types with three replicate locations, a total of nine locations, were labeled as ‘eroded shoreline’, ‘not eroded’, and ‘newly stabilized’. At each location, a soil sample was taken and a ‘natural-recruitment’ plot was marked adjacent to plots where seagrass was planted. Results showed the planted treatment had a significant effect on seagrass density at eroded and newly stabilized shorelines ($p<0.001$). To compare seagrass density at different site

types, abiotic measures were considered. This model showed shoreline stabilization had an insignificant effect on seagrass density after planting (p=0.9345). Soil analysis showed that homogenous soil compositions produced higher seagrass counts. Discussion from these results enhances habitat suitability models for *H. wrightii.*

Hydro-morphologic Regime in Black Mangrove Pneumatophores

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Mangrove fringe serves a crucial role in dissipating tidal hydrodynamics and mitigating wave energy along the coast. This unique coastal ecosystem acts as a natural defense structure, with interactions between mangroves, hydrodynamics, and sediment mechanics. The present study aims to investigate hydrodynamics and sediment transport to address the effect of vegetation-generated turbulence within natural pneumatophore canopies of varying density-low and high and in bare sediment bed. In this investigation, we present an in-situ dataset collected from the Indian River Lagoon, specifically in a wave-exposed mangrove fringe forest. Turbulence statistics, including turbulent kinetic energy, dissipation rate and Reynolds shear stress, are examined to elucidate how mangrove pneumatophores modify the flow field under natural conditions.

Micro-Scale Hydrodynamics within Eastern Oyster Reefs in the Indian River Lagoon, Florida

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Oyster reefs provide valuable services as fish habitat and natural infrastructure. Past research of reef flow regimes has treated oyster canopies as a single system with uniform density. However, recent studies have found significant variation in oyster cluster density across the reef. The objective of this study is to understand flow dynamics in multiple areas of canopy density within the same reef. An experimental field study was conducted on an Eastern Oyster (Crassostrea virginica) reef located in Mosquito Lagoon, Florida. Data collected on various hydrodynamic parameters, such as mean velocity, turbulence dissipation, and production, suggest that 91% flow attenuation occurs in moderately dense canopy layers during high water levels. Additionally, dense canopy layers exhibit the highest turbulent activity. The ultimate goal of this research is to develop a comprehensive methodology that can be applied to entire reef systems, while also accounting for the spatial heterogeneity of oyster reefs.

Do Temporal Trends in Common Snook Mercury Levels in the Indian River Lagoon Evidence the Ecological Costs of Mercury Exposure?

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The toxicological significance of ecologically realistic mercury (Hg) concentrations in natural fish populations are difficult to identify and remain largely undetermined. The FWC Fisheries-Independent Monitoring program has collected Hg data on Common Snook – a tropical species susceptible to cold stress – in the Indian River Lagoon (IRL) since 1990. Reduced Hg levels in IRL snook populations were observed following a severe cold event in Florida in 2010. This decrease could be explained by several mechanisms, including one in which individuals with elevated Hg concentrations experienced higher mortality. Long-term FWC population abundance data and Hg concentration data were examined to support or refute each

of the potential mechanisms. The results suggested that the neurotoxicological impacts associated with Hg contamination in Common Snook may have reduced the ability of some individuals to respond successfully to severe cold stress. These results may provide direct evidence of the cost of elevated Hg exposure in natural ecosystems.

Aquatic Plants in Coastal Urban Stormwater Structures as Potential Habitats for *Mansonia* Mosquitoes

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In Florida's Atlantic coastal counties, extensive canal networks divert urban stormwater runoff to estuaries, alleviating potential flooding. While native aquatic plants in stormwater ditches provide fisheries and wildlife habitats, the overgrowth of floating, non-native species like *Salvinia minima, Pistia stratiotes*, and *Eichhornia crassipes*, can impede water flow and serve as hosts for *Mansonia* mosquitoes. Our research in Volusia County assesses urban stormwater systems as potential *Mansonia* habitats, studying native and non-native plant phenology and anatomy. Surveys of retention ponds, ditches, and canals, coupled with laboratory observations, anatomical studies, and documentation of egg masses and larvae, contribute to regional stormwater management and long-term coastal watershed resilience planning. Research outputs contribute to regional stormwater management and long-term coastal watershed resilience planning.

How Oyster Reefs Influence Hydrodynamic Conditions in the Indian River Lagoon

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The University of Central Florida's Ecohydraulics Lab is simultaneously conducting several studies to investigate oyster reefs' characteristics and their influence on the shallow water in the Indian River Lagoon. This study is a part of that overall effort and focuses on how oyster reefs affect the hydrodynamic conditions in the vicinity of reef clusters, from the channel to in front of and behind the reefs. Measurement of the water velocity at various locations of oyster reefs, wave heights, seabed elevation, reefs' sizes and heights, and wind velocity were collected over several hours during rising tides in several days at seasonal low and high-water conditions. The findings will help in recommending more suitable designing and placing created oyster reefs which will be a part of the living shoreline to protect or minimize coastal erosion.

Can a Fish Be Worth Thousands of Dollars?

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Suppose Guy and his buddy come to the Lagoon for a 3-day fishing trip. They rent a motel. They hire a fishing guide. They eat at restaurants. They buy beer. They buy some bait and new tackle. They spend over three thousand dollars. And Guy and his buddy each catch one trophy redfish or snook and go home happy because of their catches. But, … without seagrass and a healthy Lagoon, those fish would be scarce or absent. So, did each of those fish contribute over a thousand dollars to the local economy? We will do some tiny math to estimate a potential value of the fish and seagrass.

Fishes in the Northern Estuaries Monitoring (FNEMO)

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The St. Lucie Estuary (SLE) is a diverse and productive portion of the larger Indian River Lagoon (IRL) in southeast Florida. Runoff and excessive freshwater discharges into the estuary have negatively affected this essential ecosystem. Efforts are underway to restore these estuarine systems as part of the Comprehensive Everglades Restoration Plan. We identify how recreational fish species respond to changes in environmental variables that occur between seasons and across years, and whether disturbances (e.g., storm events) cause abrupt shifts in habitat use as well as identify high use areas or hotspots. Since September 2022, acoustic transmitter tags have been deployed in common snook (*Centropomus undecimalis*) (n=75) and sheepshead (*Archosargus probatocephalus*) (n=75), in the SLE where established acoustic arrays are located. Snook have been detected outside of the system around the time of storm events (e.g., Hurricane Nicole), while sheepshead have remained within the system.

Evaluating Movement and Distribution Patterns of the Endangered Smalltooth Sawfish in a Recovering Nursery

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The smalltooth sawfish (*Pristis pectinata*) is a Critically Endangered species that has been protected in Florida waters since 1992 and federally listed since 2003. Until recently, this species was rarely seen on the east coast of Florida. An increase in reports to the U.S. Sawfish Recovery Hotline and the successful tagging (n=9) of small juveniles has prompted special attention to this area as a reemerging nursery. Research on Florida's west coast has provided substantial information about the biology and ecology of this species, including the importance of perennial high-use areas within nurseries. We aim to identify how this estuary may benefit this reemerging population and identify key habitats that may need special conservation attention (e.g., high-use areas). The unique opportunity to study recovery of this iconic species in a degraded estuary will improve our understanding of how resilient this species is and what recovery may look like in the future.

A Brief Overview of Fisheries-Independent Monitoring in the Southern IRL and Surrounding Areas

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Florida Fish and Wildlife Conservation Commission's Fisheries Independent Monitoring (FIM) program uses a variety of sampling gear and techniques to monitor inshore fisheries throughout Florida. The Tequesta field lab began sampling the Southern Indian River Lagoon (IRL) in 1997. Each month, Tequesta pulls twelve 183-m haul seines that target large-bodied fishes in the IRL and St. Lucie River. The FIM sampling allows researchers to track species composition, distributions, and population trends over time.

In addition to identifying, measuring, and counting all fish caught in the net, life history information is collected from select individuals using otoliths, fin clips, reproductive organs, and tissue samples. This access to great numbers of fish provides opportunities for collaboration using laboratory-based methods or field-based study (e.g., acoustic tagging). Collaborative research is being conducted on a variety of species in the study region including work on common snook, sheepshead, and smalltooth sawfish.

Effects of *Halodule wrightii* Shoot-Density on Restorative Transplantation and Sediment Organic Matter

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In the last decade, the Indian River Lagoon (IRL) has experienced drastic loss of seagrass coverage, threatening the stability of the ecosystem. Seagrass restoration projects are being implemented in the IRL to increase coverage and restore ecosystem services. To test the efficacy of our restoration matting technique and the subsequent return of sediment health, we examined if *Halodule wrightii* shoot density influences transplant success rate and sediment characteristics. Our approach was to (1) transplant and monitor growth of seagrass mats with different shoot densities (16 vs 24) and (2) examine sediment bulk density and organic matter in each plot. Results indicate that seagrass arrays planted with 16 shoots show 42% greater success than those planted with 24 shoots. Furthermore, there was no significant difference across treatments for sediment characteristics. Overall, this study provides evidence that shoot density of seagrass transplants should be considered for successful restoration.

Big Sawfish in the Southern Indian River Lagoon: What Are They Doing?!

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Historical data show that the Indian River Lagoon (IRL) once acted as a nursery for the endangered smalltooth sawfish, *Pristis pectinata*, and supported large numbers of individuals from multiple life stages. In recent years, adults have been known to frequent nearshore ocean waters off the southern IRL, but until recently there have not been any tagging studies to answer questions about their movement patterns, residency, and association with the estuary. To date, 29 large juveniles and adults (2.3–4.6 m stretch total length; mean = 3.8 m) have been acoustically tagged in the lower St. Lucie River and St. Lucie Inlet. The goal of this talk is to present preliminary data on movements of these size classes in the region and relate the patterns to what we know from previous work. In addition, this research is highly collaborative, and this aspect of the project will be a theme.

Martin County Seagrass Restoration Project: Taking a Comprehensive Approach to Restoring Seagrass Habitat in the Indian River Lagoon (IRL)

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Over the last 10 years seagrass populations have declined throughout the IRL due to poor water quality and algal blooms. To reverse this decline resource managers have been working to restore seagrass throughout the estuary. However, plantings alone do not address the primary drivers of seagrass mortality. To restore seagrass habitat, it is critical to understand underlying conditions that caused their decline. Martin County has been working with Tetra Tech Inc. on a restoration project that incorporates water quality and pore water monitoring, seedbank analysis, seasonal mapping and monitoring of seagrass and the cyanobacteria

Lyngbya, experimental removal of the cyanobacteria, spawning and introduction of lucinid clams that research indicates improves seagrass survival and plantings at different time of the year. This presentation will provide findings from data collection conducted within the last year and will discuss seagrass plantings and other restoration activities that will be completed within the coming year.

The Joy of Permitting: Fish Attractors & Artificial Reefs

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Since 2011, the Indian River Lagoon has been subject to algae blooms of unprecedented scale, frequency, and duration. This led to severe declines in seagrass acreage and density with little recovery documented in the intervening years. Seagrass beds are important nursery habitat for many species within the lagoon. In this short presentation, we discuss the U.S. Army Corps' Regulatory process for fish attractors, habitat restoration, and artificial reefs. The presentation will cover regulated and unregulated activities, design elements to include in the permit application, and complications that can delay review and issuance of a permit.