Abstracts of Presentations

Johnson Education Center
HBOI-FAU, Fort Pierce, Florida

February 7-8, 2013

Key Note Address

Regime Shift? Shifting Baselines? What is the State of the Lagoon?

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The Indian River Lagoon system experienced over a decade of positive trends in trophic status, including an expansion of seagrass coverage, before suffering massive algal blooms in 2011 leading to an equally massive loss of seagrasses. SJRWMD scientists, in collaboration with a score of outside Lagoon scientists, are uncovering clues indicating a cascade effect of multiple factors that set up conditions favorable for two geographically distinct, yet concurrent blooms of unusually high magnitude and long duration. The underlying drivers and immediate triggers instigating the primary "superbloom" in the north of the system and the secondary bloom in the south will be discussed, followed by further conjecture about the state of the Lagoon and its recovery. Concluding remarks will cover what further investigations are planned and thoughts on long-term management, with particular emphasis on nutrient loading reduction.

Contributed Papers (Oral and Poster Presentations)

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

Age and Growth of the Bull Shark in the Indian River Lagoon, FL

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The Indian River Lagoon (IRL) is one of the most important nursery areas on the U.S. Atlantic coast for the bull shark, *Carcharhinus leucas*, and represents the northern limit of functional nursery habitat in the northwest Atlantic for this species. Vertebral samples from 71 bull sharks in this area were analyzed to estimate ages and growth. The mean size-at-birth of bull sharks in this region was found to be 61.7 cm fork length (FL) and ages ranged from 0-6 years old (mean = 1.4 years old). On average, IRL juveniles grow 35.7 cm FL between birth and age 3. The year-round bull shark population within this system is dominated by neonates and juveniles and based on age structure and tagging data for juveniles, the residency period within this nursery area can be up to 6 years although few remain after 3 years of age. After this residency period in estuarine waters, juveniles move to the core offshore population.

Linking Mercury to Health Effects with Laser Ablation: Will It Work for Marine Fishes?

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Mercury can negatively influence the health of marine biota, but directly linking mercury to health effects can be difficult. Recent studies focusing on freshwater species have been successful in this regard, but toxicity pathways may be significantly different for marine fish species. Elevated incidences of macrophage centers (MC), an inflammatory response, in liver of fish can occur with high concentrations of Hg. Laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS), has been used to co-localize MC and Hg deposits within tissues of a number of freshwater species including gar, perch, and others. We present efforts to use this innovative approach to link mercury exposure to health effects in marine fishes from Florida waters. Preliminary results suggest that differences in the organization of MC between marine and freshwater species present technical challenges. Although numerous MC were found, the small size of these centers in marine fishes made it difficult to obtain enough sample for MS analysis. Differences in immune organization between marine and freshwater fishes should be an important consideration when making risk assessments of mercury in marine biota.

A Brown Tide Event in the Indian River Lagoon: Microscopic Description and Bloom Concentrations

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A major brown tide event was observed in the Mosquito and Indian River Lagoons (Florida, USA) in the summer of 2012. Densities of the brown tide species were high for a period of two months (>0.5 x 10^6 cells ml^{-1}), and exceeded $3x10^6$ cells ml^{-1} during the peak of the bloom in August. The bloom was dominated by a small 2-4 µ diameter non-flagellated golden brown alga with non-uniform spherical shape. SEM showed extracellular polysaccharide material covering the surface of the cell wall. Transmission electron microscopy revealed the presence of basal bodies and a pyrenoid connected to the chloroplast via a stalk. The aforementioned characteristics are consistent with the pelagophyte species *Aureoumbra lagunensis*, the same species responsible for harmful algae blooms in Texas during the 1990's.

Preparing to Update TMDLs for the IRL

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In order to implement the Federal Clean Water Act locally, the Florida Department of Environmental Protection adopted Nitrogen and Phosphorus Total Maximum Daily Loads (TMDLs) for most of the Indian River Lagoon (IRL). Basin Management Action Plans (BMAPs) to implement TMDLs for the Banana River, North IRL and Central IRL are scheduled for adoption in early 2013. During TMDL and BMAP development, local governments shared concerns regarding the age, quality, robusticity, spatial and temporal resolution of data used to develop TMDLs for the IRL. A consortium of 18 local, state and federal interests jointly funded preparation of an update of IRL TMDLs using data sets and computational power that were not available during initial TMDL development. Available data were analyzed and a new geo-spatial load-estimating model was built for the IRL. Updated targets, thresholds and nutrient load reductions will be based on hybridizing the reference condition approach with stressor-response relationships.

Laying a Baseline: Retrospective Multivariate Analyses of Native/Non-Native Species Associations

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The impact of non-native fishes on native fishes is something that many have attempted to study and understand with varied success. Today, through retrospective analyses of historical data, we can begin to lay baselines from which to address this topic. Toward that end we addressed the questions of which native fishes' densities, in a freshwater tributary to the Indian River Lagoon (IRL), have historically been driven by a model non-native family, Cichlidae, and whether these patterns vary seasonally, spatially, or ontogenetically. Multivariate analyses have revealed that densities of several economically important IRL fishes have historically been influenced by the presence of cichlids and this influence varied seasonally, through ontogeny, and with substrate type. Using this information we can now focus our research efforts on describing the mechanisms behind these associations with the ultimate goal of more effective management and preservation of our natural resources.

Simulation and Forecasting Potential Responses of *Syringodium filiforme* with Freshwater Inflow to the Southern Indian River Lagoon over a Range of Time Scales

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Syringodium filiforme (manatee grass) provides essential habitat in the Indian River Lagoon (IRL). Manatee grass is sensitive to fluctuations in submarine light and salinity with variable freshwater inflows on time scales of months-decades. This study developed a simulation framework to forecast changes in shoot density with changes in environmental drivers. The framework was developed by linking salinity response experiments, water column variables, and field monitoring of seagrass characteristics from 2002-2007. Simulations were driven by a 41 y (1965-2005) daily time series of salinity derived from base inflows to the St. Lucie Estuary. Results from the base simulations were used to prescribe optimal freshwater discharge for the survival of *Syringodium filiforme* in the IRL. The framework is being

adapted to quantify potential responses of manatee grass to different inflow scenarios derived from alternative solutions to the management of watershed resources. These scenarios are intended to benefit both freshwater supplies and valuable coastal habitats for the Northern Everglades aquatic landscape.

Changes in Biomass of Submerged Macrophytes in the Northern Indian River Lagoon Related to the 2011 "Superbloom"

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During 2011, a phytoplankton bloom of unprecedented concentration persisted from spring into fall within the Banana River and northern Indian River Lagoon. Secchi disk readings of ≤0.5 meters lasted 6 - 7 months in most of the area north of the Pineda Causeways. In association with this *"Superbloom,"* seagrass coverage drastically declined, with many areas suffering >50% reduction, including a complete loss at some District transect sites. To expand the understanding of the superbloom impacts to the larger submerged plant community, information from four monitoring programs were combined to provide seasonal estimates of seagrass, epiphytes, and macroalgae biomass. These macrophyte components and their combined total biomass during 2011were compared to changes during the previous decade to evaluate the superbloom impacts with a more inclusive, total SAV perspective. In addition, a preliminary evaluation will be presented that explores relationships between the biomass changes and trends in available light.

Trends in Fibropapilloma Rates of Juvenile Green Turtles (*Chelonia mydas*) in South Hutchinson Island and the Indian River Lagoon

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Green turtles (*Chelonia mydas*) inhabiting the Indian River Lagoon (IRL) have a higher prevalence of fibropapillomatosis (FP) than turtles inhabiting nearby nearshore reef habitat. FP is a potentially deadly disease characterized by tumors that can adversely affect sea turtle health. We used data from the sea turtle research program at the St. Lucie Nuclear Power Plant, and from a study of marine turtles in the IRL near Fort Pierce, to assess trends in the prevalence of FP among juvenile green turtles. No significant annual trends in FP rates were observed; however, significant seasonal trends in FP rates were observed in turtles found on the nearshore reefs. We hypothesize that these differences were caused by turtles moving from the IRL onto the nearshore reefs when water temperatures in the IRL dropped, which caused the rate of FP among green turtles found on the nearshore reefs to increase dramatically during the winter.

Mapping of Seagrass and Chlorophyll Using the Satellite Hyperspectral HICO Data

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The Hyperspectral Imager for the Coastal Ocean (HICO) is the first spaceborne imaging spectrometer designed to sample the coastal ocean. HICO images that cover the Indian River Lagoon will be collected in order to develop a HICO based mapping protocol for submerged aquatic vegetation (SAV). The specific objectives are to: (1) develop a novel algorithm to decompose the HICO remote sensing reflectance from optically shallow productive coastal waters in order to separate the signals of water

column chlorophyll (phytoplankton) and SAV (seagrass and macroalgae); (2) calibrate and validate the algorithm using atmospherically corrected HICO data and *in situ* data; (3) develop and implement mapping protocols to separately map seagrass and phytoplankton using a single HICO dataset. The algorithm will then be implemented into the image processing program, ENVI using the IDL programming language, in order to provide a user friendly application.

Phylogenetic Diversity of *Pyrodinium bahamense* (Dinophyceae) from the Indian River Lagoon (Florida) Based on Single-Cell PCR and Sequencing of the 18S rRNA and Luciferase Genes

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Pyrodinium bahamense is a bioluminescent dinoflagellate with a record of intense bloom formation in the Indian River Lagoon (IRL), as well as numerous locations throughout the Indo-Pacific. It is currently classified as a single species, with two varietal forms, *bahamense* and *compressum*, defined by morphological and biochemical characteristics. Limited genetic information exists for *P. bahamense* var. *compressum*, while none exists for *P. bahamense* var. *bahamense*. This study utilized single-cell PCR to explore the phylogenetic diversity of *P. bahamense* within the IRL using *Pyrodinium*-specific primers targeting the 18S rRNA gene and degenerate primers targeting the conserved catalytic domain of the luciferase gene. Sequences for 18S rRNA gene amplicons identified *P. bahamense* as genetically identical to existing var. *compressum*, while luciferase gene sequences clustered into two distinct groups defined by a set of core amino acid differences. This study provides the first genetic evidence for *P. bahamense* in the IRL, and underscores the value of single-cell PCR for diversity analysis from environmental samples.

Investigation of Lionfish (*Pterois volitans*) Amongst Florida's Critical Estuarine Mangroves: A Case Study of the Indian River Lagoon, Florida, USA

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The recent invasion of the Pacific lionfish (*Pterois volitans*/*miles*) has the potential to devastate coastal marine communities and has been identified as one of the top fifteen threats to global biodiversity. This invasive marine predator has been found in the Indian River Lagoon since 2010; thus, early baseline data on this invasion are essential. Details on lionfish habitat selection, especially in critical fisheries habitats such as mangroves, are lacking. This study aims to examine both the extent and the nature of mangrove use by lionfish through analysis of density distribution and possible correlations with microhabitat features to aid management and removal efforts. Diet, reproductive capacity and size structure of the population will also be examined

A 3-Minute Tour of Microzooplankton in the Indian River Lagoon

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Microzooplankton (<200 µm) are an important component of estuarine ecology because they direct energy flow through pelagic food webs. They consume phytoplankton and provide energy to higher trophic levels. They also reroute organic material from the waste and decay of other organisms back through the food web by consuming bacteria. This 3-minute talk will highlight what we know about microzooplankton in the Indian River Lagoon, including an introduction to the main groups of organisms and a consideration of how they may affect the health of the estuary.

Living Shoreline Successes and Pitfalls in Mosquito Lagoon

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Shoreline erosion from natural and anthropogenic events has caused extensive damage at Native American archaeological sites, known as shell middens, within Mosquito Lagoon and Canaveral National Seashore. For three years, we have tested combinations of native species for use in living shoreline stabilization to retain sediment, increase habitat, and reduce wave energy to protect these archeological sites. In spring/summer 2012, living shoreline stabilization occurred at four shell middens using a multi-species approach: *Crassostrea virginica* in lower intertidal zone, *Spartina alterniflora* in middle intertidal zone, and *Rhizophora mangle* and *Avicennia germinans* in upper intertidal zone. After 8 months, plant percent cover increased by 30% at two sites and accretion (~2 cm) occurred at three shell middens. However, variations in plant survival, oyster recruitment, and erosion were observed and one shell midden, adjacent to the ICW with a steep slope and extensive anthropogenic alterations, is currently being re-evaluated.

Recognition of Novel Cyanobacterial Biodiversity for Monitoring and Predictions of Harmful Cyanobacterial Blooms in the IRL

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Cyanobacteria of the genus *Lyngbya* seasonally form extensive blooms in the IRL and Southern Florida. The prolific production of bioactive secondary metabolites of many of these bloom-forming *Lyngbya* can be hazardous for humans and the natural environment. In our efforts to provide taxonomic clarity, we show phylogenetically that two of the most prevalent *Lyngbya* specimens in the IRL, in fact, represent two novel cyanobacterial genera. Here we characterize and compare the ecology, morphology, evolutionary history, and secondary metabolism of these two new taxonomic groups. These taxonomic descriptions are important for monitoring or predictions of potentially harmful cyanobacterial blooms in the IRL.

Creating Water Pollution Gradient Maps as a Tool for Educating Community Stakeholders about Sources of Pollution in the Indian River Lagoon

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ORCA is mapping pollution and tracking its sources in the Indian River Lagoon using an innovative combination of (1) a broad spectrum bioassay for testing sediment toxicity (Fast Assessment of Sediment Toxicity) and (2) a wireless array of low-cost water quality monitoring sensors (Kilroys). Working with volunteers, interns and high school students ORCA has generated critically needed scientific data to raise community awareness of marine pollution and sidestep the need for funding by government agencies. Recently generated pollution gradient maps using data collected by Indian River Charter High School students will be presented along with a live demonstration of data available to the public from the Kilroy array at www.teamorca.org

Genetic Variation and Immune Response in Dolphins; Part 2: Variation in MHC Coding Regions

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The Major Histocompatibility Complex (MHC) is the system of antigen recognition and presentation that initiates the cascade of the immune response in vertebrates. Characterizing MHC diversity is a genetic tool used to measure the health of vertebrate populations. Using direct sequencing and cloning verification methods, we isolated exon 2, including the Peptide Binding Region (PBR), of the Class II DQA locus for the first time in *Tursiops truncatus* for 47 IRL dolphins and 20 Atlantic dolphins (n=67). Allelic variation was detected, despite the little variation seen in neutral markers (discussed in part 1), and a high proportion of nonsynonymous mutations indicates evidence for positive selection. Surprisingly, very few to no synonymous mutations were detected, possibly suggesting that silent mutations are not neutral and may affect splicing and/or mRNA stability. This study provided the baseline data for part 3, looking at whole gene and promoter region variation using next generation sequencing.

Identity of the Brown Tide Organism *Aureoumbra lagunensis* Verified with a Polyclonal Antibody

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Between July and September 2012, a brown tide threatened the health of the Mosquito and Indian River Lagoons. To our knowledge, this was the first brown tide bloom in Florida. The culprit – a 2-4 µm spherical cell – could not be identified to the species level using light microscopy. Candidate taxa included *Aureoumbra lagunensis* (the Texas brown tide) and *Aureococcus anophagefferens* (present throughout the northeastern and mid-Atlantic US). We used immunofluorescence to determine if the organism was *A. lagunensis*, *A. anophagefferens*, or another species. Preserved samples were labeled with polyclonal antibodies specific to the cell walls of the candidate species, followed by fluorescently-labeled secondary antibody. Cells were then examined using an epifluorescence microscope. We found fluorescence in cells labeled with the *A. lagunensis* antibody, but not the *A. anophagefferens* antibody or controls – suggesting the species was *A. lagunensis*. This finding was consistent with subsequent identification using electron microscopy and molecular techniques.

Do Trends in Waterbird Nest Effort at Pelican Island National Wildlife Refuge Foretell an Ecosystem in Decline?

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Waterbirds are widely used as indicators of wetland ecosystem health because they are often limited by food, and therefore have a direct connection to lower trophic levels and ecosystem processes. Nesting surveys of the historic colony at Pelican Island National Wildlife Refuge show dramatic and consistent declines for most species of waterbirds. For example, the Brown Pelican declined from 5,000 nesting pairs in 1910 to a mere 30 pairs in 2012. Species of herons and egrets went from hundreds of nesting pairs each in the 1940s to less than a dozen each in 2012. The consistent response by birds leaves little doubt that the conservation goal of our nation's first National Wildlife Refuge is in jeopardy. We are less certain that the strong declines in nesting signal a degradation of the Indian River Lagoon system because so little is known about the feeding areas on which the colony depends.

Which Seagrass Species Provides Better Foraging Habitat for Wading Birds?

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The Indian River Lagoon Surface Water Improvement and Management plan (S.W.I.M.) identified the conservation and restoration of seagrasses as a key goal in maintaining water quality and biodiversity. There has been little comprehensive research to identify which species of seagrass or a mixture of *Thalassia testudinum*, *Syringodium filiforme*, and *Halodule wrightii* are better foraging habitat for wading birds including Great Blue Herons (*Ardea herodias*) and Great Egrets (*Ardea alba*). A pilot study along one tidal flat in the Indian River Lagoon that varied with respect to *T. testudinum, S. filiforme, H. wrightii* and a mixture of the three species showed that the abundance and prey capture success of foraging Great Blue Herons and Great Egrets did not differ among seagrass beds. Previous research showed that a mixture of seagrass species had highest fish abundances. If supported by additional data it would suggest that conservation of wading birds will be most successful when seagrass diversity is maintained.

Comparison of Estimated, External, Nutrient Loading to Chlorophyll *a* Preceding and during the 2011 Super Bloom

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In the spring of 2011, a phytoplankton bloom of unprecedented magnitude and duration encompassed most of the Banana River and Northern Indian River Lagoon. The watershed of the affected area is ungauged; therefore, a modified version of the Pollutant Load Screening Model (PLSM) was used to simulate nitrogen and phosphorus loading from the watershed to the affected receiving waters. Estimations of N-loading from atmospheric deposition and N- and P-loading from point sources were combined with the watershed load and compared to measured chlorophyll *a* concentrations on a monthly time-step from January 2000 to December 2011. Results of statistical analyses indicate that external nutrient loads have a significant effect on phytoplankton productivity, but explain only a small portion of the variance in chlorophyll *a* concentration. Other factors such as internal nutrient loads, nutrient recycling, competition for nutrient resources and top-down effects are equally important in regulating phytoplankton productivity.

Indian River Lagoon Observatory: Real-time Water Quality Data Network for Research, Education, and Outreach

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The Indian River Lagoon Observatory (IRLO) was initiated to investigate ecological relationships in the Indian River Lagoon (IRL) and how they are impacted by natural and human-induced stressors. IRLO research and education activities will be enhanced by deployment of Land/Ocean Biogeochemical Observatory (LOBO) units and weather sensors that will provide real-time, high-accuracy and high-resolution water quality/weather data through a dedicated interactive website. Initially two LOBOs will be deployed in and near the Harbor Branch Channel adjacent to long-term research sites, with additional units added based on funding. Researchers and students will be able to observe long-term ecosystem changes and those driven by events such as freshwater water discharges, algal blooms, storms, and drought conditions. Introducing this LOBO network into the IRL will provide scientists of various

disciplines from many organizations reliable, continuous observatory data to better quantify and model relationships between environmental factors and biological processes in the IRL.

"The Most Diverse Estuary in North America" – Really??

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The "health" of an estuary or any other ecosystem, according to the Intermediate Disturbance Hypothesis, is in part based on high biodiversity. The IRL is repeatedly tagged as the most diverse estuary in North America. What is the validity of this claim? The answer: it depends.

Don't Cough on Me, Bro! Spatial Analysis of the Dolphin Social Network in the IRL

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Spatial distribution and social associations are key elements in understanding fitness, including assessing the risk of disease exposure/infection and determining the source of illness. Due to a lack of systematic analysis on the above, we investigated the relationship between home range and association patterns in bottlenose dolphins in the Indian River Lagoon as a precursor to developing models that assess risk in relation to ranging and associative behavior. Using social network and space use methods, we found some dolphins ranged widely; however, it was rare to find an animal in another community's core area (median PHR = 0.004). Within communities, core area overlap ranged from 22%-48% (median PHR = 0.22 - 0.48). The limited spatial overlap between dolphin communities suggests that disease transmission among such social units may be restricted, while strong association patterns within communities as well as the use of common areas may result in localized health risks.

Here Today, Gone Tomorrow: Patterns in Bottlenose Dolphin Calf Mortality May Explain Bimodal Birthing Peaks

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While difficult and challenging, an accurate estimate of fecundity rate and infant survival is critical to assessing the health and status of cetacean populations. From 2000-2007, 79 identifiable bottlenose dolphins birthed 146 calves, with a primary summer peak and a secondary spring peak. The disappearance of dependent calves (<24 mo old) was used to estimate infant mortality and fecundity rate in the IRL. Thirty-nine calves (39/146; 27%) disappeared before age two. Many calves vanished between 1-3 mo of age (18/39; 46%), with 11/18 in the summer, when predation pressure is highest. Carcass recovery was low (11/39; 28%), suggesting fatal predator attacks and scavenging may occur at higher rates. Early calf loss coupled with a 12 mo gestation may explain bimodal birth cycles and implies that cows become pregnant soon after calf loss. These findings are significant in that more calf births/deaths go undetected, therefore underestimating fecundity rate and population recruitment.

Changes in the Fish Assemblage of the Indian River Lagoon, Concurrent with Extended Algal Blooms and a Resultant Loss of Seagrass Habitat

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In early 2011, massive blooms of phytoplankton affected most of the Indian River Lagoon (IRL) system. Two concurrent blooms extended from southern Mosquito Lagoon to just north of Ft. Pierce Inlet. Shading led to widespread loss of seagrass, with up to 100% loss along some transects near Cocoa, Melbourne and Palm Bay. During the bloom, fish species richness and diversity were lower than recorded in pre-bloom years. The effects of the bloom and loss of seagrasses on fish abundances varied. Abundance of several sciaenids and most small-bodied/cryptic species declined dramatically. Abundances of other sub-adult and adult sciaenids fish were similar to those from good to average years, and a mixed response also was observed for several planktivorous taxa. Long-term effects on fish stocks will depend on interactions between recruitment success and seagrass recovery.

Searching for Top-Down Effects Associated with the 2011 Superbloom

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Nutrient supply from changes in external loadings or internal cycling represent potential contributors to the 2011 superbloom. In addition to these bottom-up influences, another change that could have fostered accumulation of phytoplankton standing stocks is a reduction in grazing – a release from top-down pressure. Available data were explored to identify support for or against the hypothesis that grazing pressure was altered at a time that could have influenced the 2011 superbloom.
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Seasonal Variation in Bacterial Load in Waters of the Indian River Lagoon

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While both waste water input and runoff from the local environment have been shown to be a major source of microbial contamination in areas such as the Florida Keys, Tampa Bay and other locations around the Florida coastline, there has been no such long-term study of microbial indicator species in the Indian River Lagoon. In order to address this issue we established standardized assays to monitor the levels of enterococci, coliforms, and total heterotrophs in water samples. Six study sites were selected and monitored over the course of a year. The data generated show a high degree of correlation between the study site and the level of bacterial contamination. In addition, we observed distinct seasonal changes in the level of bacterial contamination and an increase in total bacterial load following a major rainfall event.

Monitoring of the 2011 Super Algal Bloom in Indian River Lagoon, FL Using Satellite Data

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During the summer of 2011 an unprecedented super algal bloom formed in Indian River Lagoon (IRL), with Chlorophyll *a* (Chl *a*) concentrations over eight times the historical mean in some areas, which lasted for seven months and spanned the IRL. The spaceborne MERIS data provided high resolution spectral bands in the red and Near Infrared, making it possible to quantify Chl *a* by fluorescence while minimizing interference from the water. The study goals were to: (1) validate Chl *a* algorithms using satellite data of the IRL (2) determine the accuracy of the algorithms in estimation of Chl *a* before, during, and after the 2011 super blooms, and (3) map the 2011 algal bloom using the most effective algorithm. The maps generated by the Normalized Difference Chlorophyll Index (NDCI) allowed better understanding of when and how the bloom began and ended, which would not have been observed by conventional means.

Distribution of Lymphosarcoma in Redfin Needlefish, *Strongylura notata*, in the Indian River Lagoon (IRL)

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The redfin needlefish, *Strongylura notata*, occurs along Florida's coastline but exhibits a neoplastic lesion (lymphosarcoma), primarily in the Indian River Lagoon (IRL, northern region). Here several other tumor types such as fibropapillomatosis in green turtles (*Chelonia mydas*) and gonadal neoplasia in hard clams (*Mercenaria* spp.) have also been reported. Lesioned needlefish were collected from one Florida Atlantic (IRL, 0.3%, n = 5,614) and two Gulf of Mexico estuaries (Tampa Bay, 0.02%, n = 10,762; Charlotte Harbor, 0.02%, n = 6,140) over an 11-year period (1999-2009) during routine fisheries independent monitoring surveys. Within the IRL, the Banana (n = 13) and Saint Sebastian Rivers (n = 3) had the highest lymphosarcoma prevalence. Although the etiology of this tumor is unknown, benthic contaminants should be considered as potential environmental cofactors. Needlefish prey on diverse benthic and epibenthic invertebrates and fishes, and circumstantially these areas are potential hot spots for contaminant exposure.

Effect of Seagrass Density on Population Demographics and Feeding Ecology of the Gulf Pipefish, *Syngnathus scovelli*, in the Indian River Lagoon

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Field collections of *S. scovelli* in three 100% and three 50% density seagrass coverage areas were conducted during the summer of 2011 in the Banana River region of the IRL. *S. scovelli* collected from 50% density seagrass beds were significantly smaller than pipefish in the 100% density seagrass. Despite a direct relationship between size and seagrass density, no differences in fecundity were found between seagrass densities. A change from a benthic to pelagic diet for mid-sized pipefish was observed. Pipefish from 5-7.9 cm consumed a larger volume of harpacticoids in 100% seagrass when compared with the same fish size class in 50% density seagrass. Pipefish in the 50% seagrass density consumed calanoid copepods, not harpacticoids. Although *S. scovelli* demonstrated a preference for 50% density seagrass in laboratory mesocosms, field observations of population demographics and feeding ecology suggest that 50% density seagrass may not be an ideal habitat for this species.

Effect of Submerged Aquatic Vegetation (SAV) Type and Density on Habitat Preference of Two Pipefish Species

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Loss or degradation of seagrass may negatively impact seahorses and pipefish (family Syngnathidae) that have strong associations with these habitats. Mesocosm experiments were established to determine if two pipefish species, *Syngnathus louisianae* and *S. scovelli,* have a preference for a specific species or density of SAV. Equal biomass of *Halodule wrightii*, *Caulerpa prolifera,* and *Gracilaria* sp. were added to mesocosms with prepared lagoon sand, filtered flow through seawater, and red LED lights for nocturnal observations. In general, *S. scovelli* males and females were generalists, occurring in the sand and seagrass and avoiding *C. prolifera. S. louisianae* were specialists, with a strong preference for seagrass. In density experiments, *S. scovelli* demonstrated a preference for 100% and 50% seagrass coverage, while *S. louisianae* preferred 100% density seagrass coverage. The extreme specialism observed with *S. louisiane* may place their populations at risk in the IRL, due to the recent declines in seagrass density.

IRLscience.com: Bringing Together Scientists, Teachers, Students, Legislators, and the Public to Be Better Informed about Issues Affecting Our Indian River Lagoon

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During the 2012 Indian River Lagoon symposium, attendees expressed a common concern regarding the lack of communication about research and activities occurring within the IRL among user groups. Several websites for the lagoon already exist, which highlight species information and specific agency activities. Irlscience.com seeks to condense information about active research and activities occurring in the lagoon from multiple groups into a single site. Current research activities and findings will be synthesized into language easily understood by nonscientists. The site also includes a community calendar where lectures and events around Florida that have a lagoon focus can easily be viewed by the public. The current status and format of the website will be introduced as well as discussion of future plans.

Effects of Hurricanes, Land Use, and Water Management on Nutrient and Microbial Pollution in the St. Lucie Estuary, Southeast Florida

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Multiple hurricanes impacted southeast Florida in 2004 and 2005, producing record rainfall and stormwater runoff into the urbanized St. Lucie Estuary (SLE). To assess effects on water quality, samples were collected in 2005 and 2006. Salinities were < 1 ‰ throughout the SLE in 2005, but returned to near-normal levels by March 2006 in all but the South Fork. Low salinities in 2005 correlated with low DO and elevated turbidity, nutrients, and bacterial counts. Highest turbidity (84.4 NTU), nitrate (37.9 µM), and TDN (130.8 µM) concentrations occurred in the South Fork, whereas the highest ammonium (15.4 µM), SRP (10.5 µM), and TDP (13.8 µM) concentrations occurred in the North Fork. High bacterial counts occurred in tidal creeks adjacent to residential areas relying on on-site sewage disposal systems. Improved water management practices and enhanced treatment of stormwater and sewage are needed to mitigate future stormwater-driven water quality perturbations in the SLE.

Nitrogen Versus Phosphorus Limitation in the Indian River Lagoon: Spatial and Temporal Trends

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The classic view that marine waters are nitrogen-limited does not apply throughout the Indian River Lagoon (IRL). Results from a system-wide study indicated that mean dissolved TDN and TDN:TDP ratios and macroalgal tissue N:P and C:P ratios all increased from south to north during the wet and dry seasons of 2011 and 2012. This suggests a shift from N-limitation in the southern IRL to P-limitation in the northern IRL. TDN pools in the northern IRL were dominated by DON, which is known to support brown tides similar to the 2012 diatom bloom in Mosquito Lagoon. Chlorophyll *a* was also higher in the northern IRL, with the highest mean concentrations (>100 µg/l) reflecting the 2011 "super bloom". Mean $\delta^{15}N$ in macroalgae was consistently higher in all IRL segments during the wet season (+6.8±2.3 o/oo) compared to the dry season (+5.9±1.9 o/oo), indicating the importance of stormwater-driven wastewater inputs during heavy rains.

Investigating the Causes and Consequences of the IRL 2011 Superbloom – A Water Quality Analysis

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We analyzed spatial and temporal patterns and relationships in water quality in order to investigate causes and short-term consequences of a historically unprecedented phytoplankton bloom that afflicted the Indian River Lagoon (IRL) system during 2011. The 2011 'superbloom' was unprecedented, not only for its magnitude (chlorophyll *a* >130 µg/L) and geographic scale (Banana, north Indian River and southern Mosquito sub-lagoons), but also for its long duration and its distinctive floral composition. We used a combination of statistical approaches to compare water quality during 2011 to that of antecedent periods, and to explore relationships between chlorophyll *a* and other water quality constituents before and during the bloom. Bottom-up effects (nutrients) and other physical-chemical factors (e.g., salinity and water temperature) are explored as 'drivers' or 'triggers' of the bloom. The consequences of the bloom on water-column clarity, and the implications to submersed aquatic vegetation are also discussed.

Shoreline Restoration along the Indian River Lagoon: Past, Present, and Future of the Shoreline Restoration Project

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The Indian River Lagoon (IRL) Shoreline Restoration Project (SRP) was created in 1995 in order to re-establish and maintain the mangrove fringe along shorelines of the IRL while also promoting community involvement and environmental awareness. Within the first ten years of the SRP, 11,719 *Rhizophora mangle* propagules were planted along shorelines of the IRL using the PVC encasement method. Over the course of seventeen years, planting techniques have shifted into what is now the saltmarsh vegetation based method. The SRP focuses on planting saltmarsh vegetation because of their ability to establish and spread more quickly than mangroves. Saltmarsh grasses naturally recruit all three species of mangroves found in Florida, transforming the area into a mangrove dominated shoreline. The IRL Shoreline Restoration Project's goal remains the same but the method with which restoration is carried out is evolving to examine the whole ecological system.

TMDLs and Basin Management Action Plans: How They Can Help Restore Seagrasses in the Indian River Lagoon Basin

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Total Maximum Daily Loads (TMDLs) were adopted for the Mainstem Indian River Lagoon in 2009 and Basin Management Action Plans (BMAPs) designed to implement them were adopted in 2013 for the North Indian River Lagoon, Banana River Lagoon, and Central Indian River Lagoon. Ten additional TMDLs are being adopted this year to address water quality impairments identified in contributing watersheds. The Department has partnered with multiple government entities, agricultural producers, water control districts, and other interested parties to develop these TMDLs and restoration plans. The BMAPs have as their goal the restoration of deeper-water seagrass habitat through the reduction of watershed loadings of total nitrogen and total phosphorus (nutrients) into the Lagoon. While TMDLs specify the pollutant reductions needed, it is the BMAPs that identify beneficial projects and activities that will reduce loadings of nutrients, as well as water quality issues or concerns that need further investigation.

Threats and Anthropogenic Stressors Facing Bottlenose Dolphins in the Indian River Lagoon, FL

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The Indian River Lagoon (IRL) is a unique shallow water ecosystem located along 40% of Florida's eastern seaboard. The IRL is an aggregate of three estuarine water bodies, the Indian River, Banana River and Mosquito Lagoon. This geographic setting contributes to the exceptional biological diversity of the system. In 1990, the IRL was identified as an 'Estuary of National Significance' (IRLNEP 1996). Dolphins are long-lived marine mammals that have been identified as sentinels of human and environmental health. Since 1996, HBOI-FAU researchers have initiated investigations on the population of resident bottlenose dolphins inhabiting this vital region, including population and behavioral ecology, disease surveillance, health assessments, stranding response, pathology and life history. During this time, numerous and increasing threats to this IRL sentinel species have been identified. This report will serve to highlight threats facing the IRL dolphin population, and the environment we share with them.

The Bloomin' Lagoon – Bloom and Bust of Indian River Lagoon Seagrasses

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The Indian River Lagoon (IRL) has been hit by two years of consecutive "super blooms." The first bloom began in the Banana River (BR) Lagoon in March 2011 and consisted of a marine chlorophyte species from the Pedinophyte family, *Resultor*. The bloom traveled from BR into the IRL and then northward into Mosquito Lagoon (ML) by August. Chlorophyll *a* concentrations reached 120 µg/L … categorizing it as a "super bloom." The second bloom began in July 2012 and was composed of a pelagophyte species, *Aureoumbra*, commonly called brown tide. This time chlorophyll *a* concentrations reached 200 µg/L and cell counts approached 3 billion cells/L…making it a super-super bloom. Since both of these blooms occurred during the peak growing season for seagrasses, there has been large reductions in total seagrass coverage. Average losses lagoon-wide, exceed 33,000 acres, approximately 42%. However, a 99% loss has been observed in some segments of the central IRL!

Satellite Telemetry of Bottlenose Dolphins, *Tursiops truncatus*, in the Indian River Lagoon

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Understanding movement patterns and habitat use of marine apex predators is central to effective management and the development of models of ecosystem function. Bottlenose dolphins have been studied in the Indian River Lagoon (IRL) since 1996 where sighting histories has revealed a resident population of several discrete communities with limited individual home ranges. In June 2012, we fitted 4 adult dolphins in the IRL with satellite transmitters to collect detailed information on movement patterns. The tags transmitted for an average of 136 days, spanning the entire summer and part of the fall. Dolphins remained within the IRL and their maximal ranging patterns were consistent with prior photo-ID based utilization distributions. Tag data revealed non-uniform use of habitat, rapid transit between habitat patches and tortuosity in movement paths that suggest responses to change in environmental conditions. Fractal analysis and random-walk models will be used to determine how movement decisions are made.

Environmental Humanities and the IRL

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Multidisciplinary studies which integrate the humanities with the "hard" sciences offer a framework to uncover new insights into human-environment interaction within the IRL. There has been no period when the liminal IRL ecosystem was not without shifting barrier islands and dramatically varying salinity levels due primarily to the oceanic interchange following the opening and closing of natural inlets. An historical survey of the lagoon suggests that attempts to "restore" the IRL will necessarily declare an arbitrary historical form to be normative for the system. Nineteenth century settlers in Florida's Indian River Lagoon (IRL) region created an isolated fringe culture wholly dependent on the instable hydrological forces of the shallow lagoon system. These settlers were among the first to construct a built environment marked by the dredging and filling that would define much of the twentieth century Sunshine State.

Genetic Variation and Immune Response in Dolphins; Part 3: Variation in MHC Promoter Regions

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Apex predators can have far-reaching impacts via trophic cascades. Likewise, changes at any lower trophic level can extend to top species such as *Tursiops truncatus*, making them powerful indicators of ecosystem health. Traditional methods for monitoring population disease susceptibility focused on genetic variation for the peptide binding region of antigen receptors encoded by major histocompatibility complex (MHC) genes. While this approach is currently being implemented, we are also incorporating the aspect of variable regulation by analyzing the 200 bp promoter region for several MHC Class II genes. We identified key regulatory motifs which had not previously been described in cetaceans and contain polymorphic sites. Comparative analyses also revealed duplication of a tumor necrosis factor-α response element which is absent in beluga whales. These findings emphasize the value of genotyping complete alleles with promoter regions, for which we are developing a novel method using next generation sequencing.

Community Outreach, Restoration and Monitoring of Intertidal Oyster Reefs in Mosquito Lagoon, Florida

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Research has shown that boat wakes causes extensive oyster shell movement which results in formation of dead margins, piles of disarticulated oyster shells. The restoration involves removing the dead margins and covering areas with a stabilized recruitment substrate for oysters. This increases available oyster habitat and thus the number of live oysters, and associated oyster reef organisms. The goal of the oyster restoration project is to increase live intertidal oyster reef acreage in the Mosquito Lagoon by continuing the successful oyster reef restoration model established by UCF, Brevard Zoo and TNC, which couples science-based restoration with community engagement. Over 30,000 volunteers through education and participation have worked to construct and deploy oyster restoration mats since beginning in 2007. After only twelve months post-deployment, an average of 93 live oysters recorded per mat. If extrapolated, our deployment of 25,978 mats x 93 live oysters/mat = 2,415,954 live oysters filtering water.

Seagrass and Dolphins: What Can They Tell Us about the Health of the Indian River Lagoon?

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Seagrasses are a vital part of the IRL ecosystem due to their productivity level, and a primary food source for many invertebrates and vertebrates. The biodiversity and sensitivity to changes in water quality intrinsic to seagrass communities makes seagrass an important habitat to understand, both in its function and health. Seagrass ecosystems support a multi-trophic food web and provide critical habitat for the survival of pigfish, which are a preferred prey of spotted seatrout. Spotted seatrout are the preferred food of the apex predator, the bottlenose dolphin. In 2011, a superbloom of nutrient-fed algae decimated 32,000 acres of seagrass, affecting 1.4 billion fish (mean of 44,000 fish/acre). The goals of this study are to investigate the spatial/temporal trends of seagrass coverage and dolphin density, and impacts of keystone species loss in marine ecosystems. This work will fulfill accreditation criteria for *STARS*, a national entry level geospatial technician certification program.

Hands on Conservation: The Indian River Lagoon Shoreline Restoration Project, a Partnership between Florida Department of Environmental Protection and Brevard Zoo

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Brevard Zoo and Florida Department of Environmental Protection Indian River Lagoon Shoreline Restoration Project created the Adopt-A-Mangrove program to educate community members about the importance and benefits of mangroves and shoreline restoration. Participants also take home a mangrove to "foster," further engaging community members in hands-on conservation. Program evaluation results show Adopt-a-Mangrove program participants' knowledge increased from pre-participation to post-participation in the following areas: ecology of the Indian River Lagoon, economic value of the Indian River Lagoon to the local economy, ecological value of mangroves to the Indian River Lagoon, and economic value of mangroves to the Indian River Lagoon area. Another exciting response from the post-

participation surveys show most participants have a greater interest in the Indian River Lagoon and felt that they actively participated in conservation after being a part of the Adopt-a-Mangrove program.

Genetic Variation and Immune Response in Dolphins; Part 1: Population Structure of IRL and Atlantic Dolphins

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Bottlenose dolphins (*Tursiops truncatus*) have been observed over the past decade within the Indian River Lagoon (IRL) and along Florida's Atlantic coast (ATL). Localized mortality events and point-source health threats highlight the need to estimate patterns of genetic exchange. Current observations suggest (1) minimal mixing between IRL and Atlantic dolphin stocks and (2) fine-scale community structure within the IRL population. To investigate population structure, we examined genetic variation within mtDNA and ten microsatellite loci in 244 dolphins and found significant differences between IRL vs. ATL dolphins ($F_{st\text{-}mtDNA}$=0.09, $F_{st\text{-}micros}$=0.06: P<0.0001). Bayesian clustering analysis also supported two distinct populations (K=2). However, one community within the IRL, Mosquito Lagoon, appears to be a mix of IRL and ATL genes. These findings emphasize the need for understanding community structure in relation to genetic aspects of health, and lay the ground work for Parts 2 and 3: Immune response at the genetic level.

Climate Change Issues for Clam Aquaculture in the Indian River Lagoon

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Clam aquaculture has a farm-gate value of ~$19 million annually in Florida. Gulf of Mexico and Atlantic Ocean coastal water temperatures of Florida have increased by 0.3 to 2.0°C in the last 20-30 years and are expected to continue to rise with climate change. The hard clam species cultured in Florida, *Mercenaria mercenaria*, is at its southernmost distribution. In light of recurring summer clam mortality events and increasing water temperatures, it is clear that the Florida hard clam aquaculture industry needs a heat-tolerant clam strain to reduce summer mortalities, adapt to future climate change, and continue to contribute to global food security. Previous studies found that clam families differed considerably in their response to thermal stress. Therefore, our objective is to develop a hard clam strain through biomarker assisted selection with increased heat tolerance for culture in the Southeastern U.S. Project support from USDA-NIFA and NOAA-Sea Grant (R/LR-A-47).

The Comparison of Tumor Severity and Numbers to the Straight Standard Carapace Length of Juvenile *Chelonia mydas* Infected with Fibrpapilomatosis

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Fibropapillomatosis (FP) is a viral disease that affects the green sea turtle (*Chelonia mydas)* and includes the formation of tumors on not only the outside of the turtle but also the inside which can be detrimental to the organism's health. In our research, data from the Indian River Lagoon (Jennings cove area) and Lake Worth Lagoon (near Munyon Island) were used and each sea turtle with FP had their tumors mapped and scored using the Balazs tumor score methodology. This score will be compared against the green turtle straight standard carapace length. All recaptured green sea turtles will be used to compare the difference in both the Balazs score and the individual tumor sizes to determine tumor change (i.e.

regressing or increasing). Our hypothesis is that as a juvenile turtle becomes older their tumors will increase in size. This analysis will allow us to better understand how tumor size and numbers are related to juvenile green sea turtles and their time spent in the Indian River and Lake Worth Lagoons.

Ecological Disturbances in the St. Lucie Estuary and the Southern Indian River Lagoon, Elucidated through Macrobenthic Monitoring

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Benthic infauna are important indicators of water quality and are used in a variety of monitoring programs to assess overall estuarine health and to follow long-term trends in estuarine communities related to anthropogenic impacts. The infaunal communities in the St. Lucie Estuary (SLE) and southern Indian River Lagoon (IRL) offer several positive attributes: they are relatively sedentary and long-lived, they occupy an important intermediate trophic position, and they respond differently to varying environmental conditions. Fauna and environmental variables have been quantitatively monitored quarterly since February 2005 from 15 sites in the SLE and the IRL. Monitoring data indicate the SLE is ecologically degraded. Considerable negative conditions exist in the South Fork and SLE, which receive frequent freshwater discharges from the C-44 canal. The data clearly indicate that the benthic communities respond quickly to environmental changes and that they reflect changes within the monitored areas in the SLE and IRL.

A Water Quality Box Model for the St. Lucie Estuary and the Southern Indian River Lagoon

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A water quality model was developed for the St. Lucie Estuary (SLE) and Southern Indian River Lagoon (SIRL) using a box model approach. The model describes the mass balance of nutrients (nitrogen and phosphorus) and chlorophyll *a*. An empirical linear relationship between daily phytoplankton production and the product of chlorophyll biomass, photic depth, and incident irradiance (the BZI formulation) was used to simulate algae growth in this model. Data collected from water quality monitoring stations from 1999 to 2011 were used for model calibration and verification. The results indicated that seasonal variations in water quality were well represented by the model. The model was able to explain the majority of variation (>50%) in nutrients for both the SLE and the SIRL, and in chlorophyll *a* in the SLE. The simplicity of the model allows for explanation of estuarine response to nutrient loading as a function of residence time, light attenuation, depth and hydraulic forcing from both the upstream (riverine) and downstream (ocean).

The Smithsonian's Indian River Lagoon Species Inventory: Using Education to Promote Lagoon Health

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The Indian River Lagoon (IRL) has been designated as an EPA Estuary of National Significance for over 20 years, and has been promoted as one of the most diverse estuaries in North America. However, accessible documentation to support the claims of lagoon diversity has been limited. In 1997, the IRL Species Inventory was established as an online depository for information on the various habitats and thousands of species associated with the lagoon. The program is now hoping to expand its efforts by adding online tools, partnering with colleges and universities, and providing local teacher workshops and

outreach events. Programs like the Inventory are necessary to increase public awareness and appreciation that will lead to preserving the health and significance of this unique estuary.

Slime & Aliens: Exploring Links between Biofilms and Invasive Species

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Biofilms are found on submerged surfaces in all marine environments, and are transported worldwide on ship hulls. Composition of these microscopic assemblages is a well-recognized factor affecting larval settlement response and recruitment in marine invertebrates, both native and invasive. As a result, it seems likely that invasions via shipping are largely controlled by biofilms, a fundamental yet currently overlooked piece of the invasive species picture. Biofilms were cultivated and transplanted between two distinct inlets in order to determine the effect of transport on biofilm community structure. Composition of the original and transplanted biofilms will be discussed, along with observations of macrofouling organisms recruiting to the biofilms. Examining these communities will help reveal the degree to which biofilms influence invasions.

Community and Spatiotemporal Dynamics of the Dolphin Social Network in the Indian River Lagoon

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Social network analysis has garnered recent popularity as a tool to study the social structure of animals. Network theory can be used to study all levels of social organization and can be useful when examining health issues such as epidemiological events and gene flow. We use network analyses, association analyses and lagged association rates to assess the community and spatiotemporal structure of the IRL population of estuarine bottlenose dolphins. The linear aspect of the study area makes it unique compared to other social network dolphin studies. Network measures show a highly differentiated society (S = 0.723), with few strong associations and a generally low association index (HWI = 0.01). Community analysis indicates six distinct communities with a strong modularity coefficient (Q = 0.541). Temporal analysis suggests that most associations were brief (best model based on QAIC = rapid disassociation and casual acquaintances). Even these brief associations should be considered when investigating the many epidemiological events affecting this population.

Physiology and Ecology of Bloom-forming Macroalgae in the Indian River Lagoon, FL

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Blooms of macroalgae are well-known ecosystem responses of increasing nutrients and eutrophication. Protection of healthy seagrasses represents the management endpoint for the Indian River Lagoon (IRL). Macroalgae are good bioindicators, but species utilize different nutrient assimilation, storage, and uptake kinetics dependent on respective morphologies. Recent water quality analyses show nutrient shifts (nitrogen, N versus phosphorus, P) throughout the lagoon: P-limitation in the north and N-limitation in the central and southern areas (TDN:TDP dry season 2011; 69.76 to 27.91 and TDN:TDP wet season 2011/2012; 59.02 to 23.48; north to south). We hypothesized all species will proliferate in Titusville (north IRL), a site high in nutrients and P-limited. However, a species specific preference will make *U. lactuca* have greater specific growth here compared to *Hypnea musciformis* and *Gracilaria tikvahiae*.

Ulva lactuca's increased growth was correlated to its global bloom potential by investigating health of this species in the Florida Keys as well.

Integrated Remote and *In Situ* Sensing System for Monitoring Manatee Abundance and Behavior in Relation to Changing Environmental Conditions

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Recent observations suggest that a significant number of manatees utilize the Harbor Branch channel in Fort Pierce, FL as a thermal refugee during the cold winter months. We developed an integrated monitoring system using both *in situ* and remote sensing, augmented with longer term observations made by a network of community volunteers to gain a better insight into manatee behavior in relation to environmental factors, specifically rapidly changing water and air temperatures. High spatial and temporal resolution water temperature profiles are collected, coincident with automated continuous habitat surveillance using high resolution optical imagery. Temperature profiles, automated imagery and observational data are then synthesized using custom processing software and database tools. We are currently exploring the potential of surveillance imagery for identification of individual manatees, the estimation of abundance, and documentation of behavior. The remote sensing dataset is soon to be enhanced with hyperspectral imagery to monitor both the animals and additional environmental parameters within the habitat.

Oyster Reef Restoration in Mosquito Lagoon: Long-Term Data and the Impact of the 2012 Brown Tide

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In Mosquito Lagoon, one of the primary threats to reefs of the intertidal oyster *Crassostrea virginica* is wakes from recreational boats. Wakes dislodge live clusters and tumble them into piles that extend above mean high water. Because the area is microtidal, the clusters do not roll back down and the oysters subsequently perish, with only bleached piles of disarticulated shells remaining. No-wake zones are unlikely to be developed for this popular fishing area, so restoration protocols were developed that could withstand intense boating activities. Since 2007, 58 reefs have been restored with the assistance of over 27,000 citizen volunteers. With an average of 372 live oysters m^{-2} on restored footprints as of 2012, seagrass has also returned to 21% of reefs. In the summer of 2012, there was a brown tide event in Mosquito Lagoon. Monitoring is underway to determine how restored and control reefs have responded to this challenge.

Restoration Initiative Utilizing Laboratory-reared *Ruppia maritima* Seedlings

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Global seagrass bed biomass and species biodiversity have been reduced due to natural disasters and other anthropogenic perturbations. Much effort has been made to restore these coastal seagrass beds worldwide. The goal of this project is to develop a protocol for the most effective transplanting of laboratory-reared *Ruppia maritima* seedlings. Thus far, approximately 1400 seeds were harvested from natural beds of *R. maritima* from the Indian River Lagoon, of which 90% were proven viable. The seeds were treated using dry and cold stratification techniques to incite faster germination of the seeds post storage. Various combinations of anchoring devices and natural bio-degradable plant holding materials will be tested for

effectiveness. The success of the transplanting units will be assessed at a pilot field location, Daytona Beach, FL. This project will help develop science-based technologies and cost-effective practices to restore and enhance coastal seagrass beds using *Ruppia* seeds and seedlings.

Improving Community-Based Shoreline Stabilization: Impact of Nurse Plants on Red Mangrove Biomass Production and Survival

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Mangrove communities act as nurseries, breeding grounds, and protect coastal areas from erosion. Red mangroves (*Rhizophora mangle*) may benefit from neighboring nurse plants (*Batis maritima*, *Salicornia perennis*) if they increase mangrove seedling growth and survival. A replicated greenhouse experiment has shown that these nurse plants had no significant impact on mangrove leaf count. However, deployed *R. mangle* that were grown with nurse plants had high retention. A second experiment has been initiated to investigate if *B. maritima* and S. *perennis* aid in enhanced attachment of *R. mangle* by increasing total belowground and aboveground biomass. This would improve community-based shoreline stabilization projects by increasing survival and retention of mangroves.

Popcorn Science: A Seminar Series in the Town of Melbourne Beach

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In 2012, the Melbourne Beach Environmental Advisory Board started the Popcorn Science seminar series with the goals of (1) increasing community awareness and interest in the local environment and (2) educating the community in a casual and fun setting. The attendees of Popcorn Science events can learn, eat popcorn and other snacks, and have the opportunity to actively participate in discussions regarding local biology and ecology. The first Popcorn Science seminar talk was given by Zack Jud, a lionfish biologist, who discussed the presence of the invasive fish in the Indian River Lagoon. The event was a huge success in the community, with roughly fifty people in attendance. Our poster will highlight the details of Popcorn Science, feedback we have received, and our goals for future events.

A Forum on Lagoon Health

So What? Translating Science into Management

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We know a lot about the Indian River Lagoon. So what? That is, given what we now know, what should be our next step? By "our," I mean society in general and scientists in particular. We will never have "enough" research, but we have to make decisions now. Is it sufficient to control the input of nutrients, sediments, and freshwater (bottom-up control)? Or have we screwed up the food web by harvesting top predators (top-down control)? Have we even asked the right questions? I will review some successes and failures, pointing out some weak points for further discussion.

An Overview of Education, Outreach and Public Involvement Programs Ongoing throughout the Indian River Lagoon Region

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Throughout the five counties encompassed by the Indian River Lagoon, a number of highly successful and informative public programs are being implemented. These serve to educate lagoon stakeholders about various aspects of the lagoon ecosystem while also influencing participating stakeholders to become better environmental stewards. This talk will review a variety of the lagoon-focused outreach, education and public participation programs being implemented throughout the region by agencies, local governments, non-profit organizations, and community groups, and will provide the framework for discussion of if and how organizations may work more closely to improve public understanding and concern for the Indian River Lagoon.

"Political Will" for Lagoon Remediation?

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Governmental entities, scientists and non-profit organizations have contributed to the knowledge of the Lagoon and its habitats, increased awareness and worked to correct some problems. However, over a two-year period the Lagoon has shown significant degradation. Citizens are saying "we need to do something about the Lagoon"; but who is "we"? There appears to be a political minefield inhibiting solutions to the problem. This raises some important questions: What organizations should take a lead role? Is there political will for Lagoon remediation? Are old paradigms going to work? Will it take citizen input to create a sense of urgency?