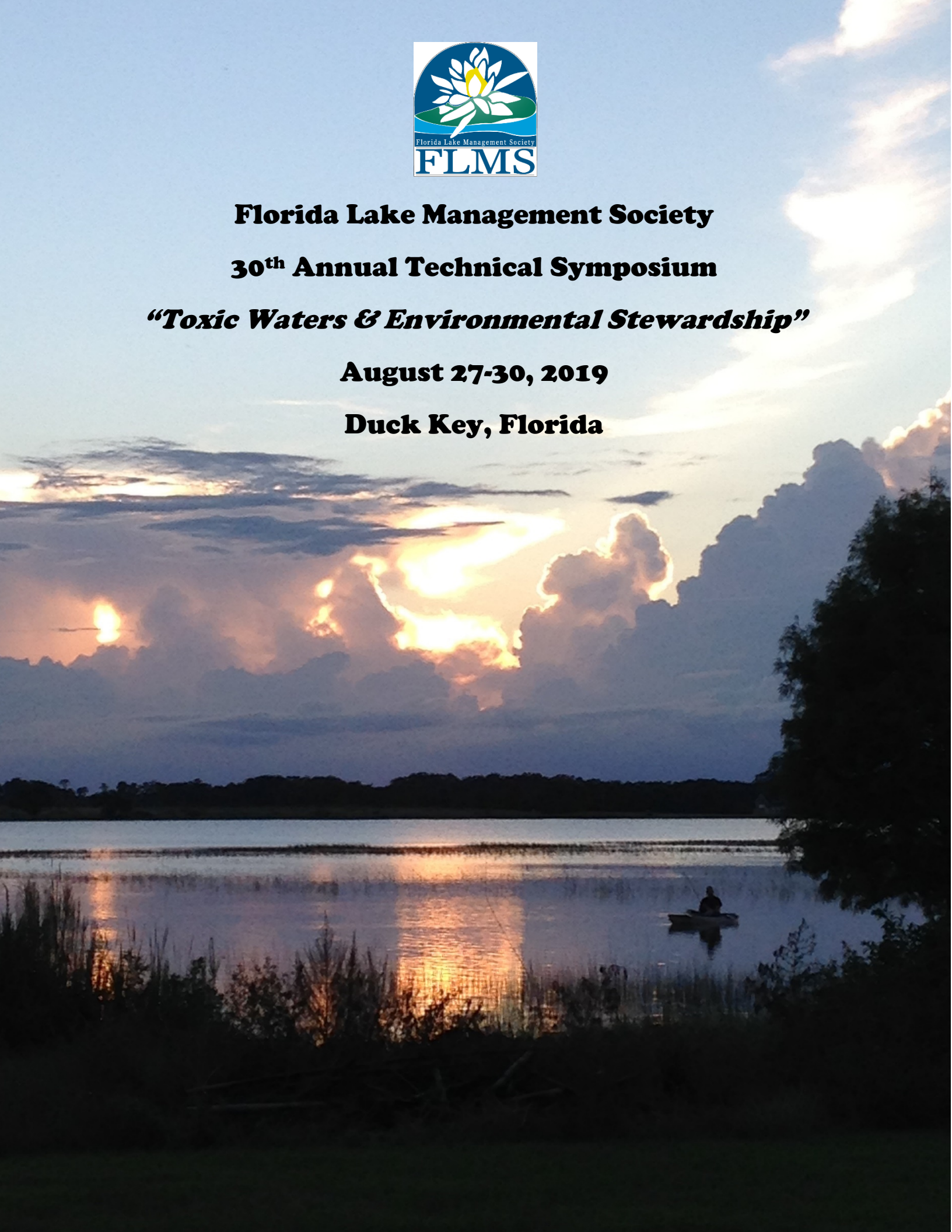

Florida Lake Management Society

30th Annual Technical Symposium

"Toxic Waters & Environmental Stewardship"

August 27-30, 2019

Duck Key, Florida

Florida Lake Management Society

30th Annual Technical Symposium

August 27-30, 2019

Hawks Cay Resort, Duck Key, Florida

Program Theme:

Toxic Waters & Environmental Stewardship

SYMPOSIUM PROGRAM

TABLE OF CONTENTS

TUESDAY – August 27, 2019- WORKSHOPS

Overseas Ballrooms

8:00 AM-5:00 PM	**Check-In and Registration** (Dolphin Foyer)

8:15 – 12:15 pm	**Workshop 1: Introduction to Statistical Analysis and Machine Learning in R - Part 1**. Dan Schmutz, M.S., Chief Environmental Scientist, Greenman-Pedersen, Inc.
8:15 – 12:15 pm	**Workshop 2: Algal Identification in the Environment. – Part 1.** Dr. Dail Laughinghouse, Assistant Professor and Mr. David Berthold, M.S., Biological Scientist – Applied Phycology, University of Florida/IFAS, Fort Lauderdale Research and Education Center. (if you have capability of bringing your own microscope, it is highly recommended but not a requirement for the workshop)

10:00 – 10:15 am	**MORNING BREAK**
12:15 – 1:00 pm	**LUNCH** (*provided with full-day Workshop registration*)
2:45 – 3:00 pm	**AFTERNOON BREAK**

12:45 – 4:45 pm	**Workshop 3: Algal Identification in the Environment. – Part 2.** Dr. Dail Laughinghouse, Assistant Professor and Mr. David Berthold, M.S., Biological Scientist – Applied Phycology, University of Florida/IFAS, Fort Lauderdale Research and Education Center **(Part 1 am workshop required)** if you have capability of bringing your own microscope, it is highly recommended but not a requirement for the workshop.
12:45 – 4:45 pm	**Workshop 4: Introduction to Statistical Analysis and Machine Learning in R - Part 2 (Part 1 am workshop required)**. Dan Schmutz, M.S., Chief Environmental Scientist, Greenman-Pedersen, Inc.
12:45 – 4:45 pm	**Workshop 5: Invasive Plant Identification and Management.** Dr. Lyn Gettys, Assistant Professor – Aquatic and Wetland Plant Science, University of Florida Fort Lauderdale Research and Education Center

WEDNESDAY – August 28, 2019 MORNING – SYMPOSIUM

(* - Denotes student paper)

8:00 AM-5:00 PM	**Check-In and Registration** (Dolphin Foyer)
7:00 AM-8:30 AM	**Breakfast** (Dolphin Ballroom)

Opening Program (Overseas Ballroom)

8:30-8:45 AM **Welcome & Opening Remarks: Rob Burnes, Outgoing FLMS President**

8:45-10:00 AM **Keynote Speaker:** Claudia Listopad, Ph.D., GISP- Principal Scientist and President, Applied Ecology and Leesa Souto, Ph.D.- Executive Director of Marine Resources Council

10:00-10:30 AM **MORNING BREAK** (Exhibit Hall- Dolphin Ballroom)

Program Track A: Watershed and Water Resources Management (Overseas Ballroom)

Session A1: Indian River Lagoon-Identifying Problems

Moderator: Claudia Listopad Ph.D.

DACS CEUs: 1.5 Aquatic Weed Control

10:30-10:35 AM *Session Introduction*

10:35-10:50 AM Progression of Harmful Algal Bloom Management in Martin County-*Dianne Hughes*

10:50-11:05 AM Lake Okeechobee and the Story of the South Lagoon-*Jim Moir*

11:05-11:20 AM Passing a Sales Tax for Environmental Restoration: The Save our Indian River Lagoon Project Plan-*Virginia Barker*

11:20-11:35 AM Hidden Sources: Measuring Groundwater Loads to the Indian River Lagoon-*Leesa Souto Ph.D./Claudia Listopad Ph.D.*

11:35-11:50 AM Emergent Contaminants in our Waters: Technical and Regulatory Issues Associated with the use of Per- and Polyfluoroalkyl Substances (PFAS)-*Eric Sager*

11:50-12:00 PM *Session Q&A*

12:00-1:30 PM Annual Business Luncheon, NALMS Update (Dolphin Ballroom)

WEDNESDAY – August 28, 2019 AFTERNOON

Program Track A: Watershed and Water Resources Management (Overseas Ballroom)

Session A2: Indian River Lagoon-The Science Behind the Problems

Moderator: Margaret Lasi Ph.D.

DACS CEUs: 1.5 Aquatic Weed Control

1:30-1:35 PM	*Session Introduction*
1:35-1:50 PM	Shifting Nutrient Regimes and Harmful Algal Blooms in the Indian River Lagoon, Florida- *Margaret Lasi Ph.D.*
1:50-2:05 PM	Bottom-up Controls in the IRL: Nutritional Preferences & Capabilities of the 'Superbloom' Taxa-*Josh Papacek Ph.D.*
2:05-2:20 PM	Abrupt and Extensive Seagrass Loss in the Indian River Lagoon: Indication of a Regime Shift?-*Lori Morris*
2:20-2:35 PM	Visualizing Algal Blooms in the Indian River Lagoon Estuary using Multi-Spectral Satellite Imagery - *Rex Ellis Ph.D.*
2:35-2:50 PM	Temporal and Spatial Variations in Benthic Fluxes of Nitrogen and Phosphorus from Fine-grained, Organic-rich Sediments in a Subtropical Estuary and Evaluation of Restoration Techniques- *Austin L. Fox Ph.D.*
2:50-3:00 PM	*Session Q&A*

Program Track B: Water Resources Science and Technology (Overseas Ballroom)

Session B1: Resource Management Planning

Moderator: Mary Szafraniec Ph.D.

DACS CEUs: 1.5 487 General Standards/Core or 1.5 482 General Standards/Core

1:30-1:35 PM	*Session Introduction*
1:35-1:50 PM	Numeric Nutrient Criteria – What Do They Really Protect? The Curious Case of Lake Pickett-*Harvey Harper Ph.D.*
1:50-2:05 PM	Developing Science-Based Resource Management Plans for over 100 Lakes on the Lake Wales Ridge in Florida-*Mary Szafraniec Ph.D.*
2:05-2:20 PM	Settling and Entrainment Properties of Stormwater Treatment Area (STA) particulates-*Serge Thomas Ph.D.*
2:20-2:35 PM	Developing a Hydrologic and Water Quality History of Lake Tarpon Using Historical and Paleolimnological Data-*Megan Long*
2:35-2:50 PM	Climate Change and Your Lake: What You Need to Know-*Ken Wagner Ph.D.*
2:50-3:00 PM	*Session Q&A*
3:00-3:30 PM	**AFTERNOON BREAK** (Exhibit Hall- Dolphin Ballroom)

WEDNESDAY – August 28, 2019 AFTERNOON (Cont.)

Program Track A: Water Resources Science and Technology (Overseas Ballroom)

Session A3: Indian River Lagoon-Proposing Solutions

Moderator: Claudia Listopad Ph.D.

3:30-3:35 PM	*Session Introduction*
3:35-3:50 PM	Developing Data-Driven Septic Policy for the Indian River Lagoon- *Danielle Huffner/ Claudia Listopad Ph.D./Anthony Gubler*
3:50-4:05 PM	How did this Year's Legislative Session Impact the Nitrogen Reducing Onsite Sewage Treatment and Disposal Systems (OSTDS)? -*Roxanne Groover*
4:05-4:20 PM	The Elephant in the room: Addressing Wastewater Sources of Pollution-*Anthony Gubler*
4:20-4:35 PM	Restoring Rain's Natural Path: A Tool in the Restoration of the Indian River Lagoon- *Joanie Regan*
4:35-4:50 PM	It isn't all about the Muck: Innovative Environmental Dredging Applications- *Walker Dawson*
4:50-5:00 PM	*Session Q&A*

Program Track B: Water Resources Science and Technology (Overseas Ballroom)

Session B2: Algae and Bacteria Investigations

Moderator: Rob Burnes

DACS CEUs: 1.5 Aquatic Weed Control

3:30-3:35 PM	*Session Introduction*
3:35-3:50 PM	Cyanotoxin Patterns in the St. Johns River Estuary - *Tiffany Trent*
3:50-4:05 PM	The State of the Practice for Identifying Bacteria and Nutrient Sources in Urban Waters -*Erin Reed Ph.D./Jared Ervin Ph.D.*
4:05-4:20 PM	Investigation of Factors Influencing Cyanobacterial Bloom Development in the Lower St. Johns River Basin -*Rolland Fulton Ph.D.*
4:20-4:35 PM	Association between Trophic State, Watershed Use, and Blooms of Cyanobacteria in South-Central Chile-*Dail Laughinghouse IV Ph.D.*
4:35-4:50 PM	*Session Q&A*

WEDNESDAY - August 28, 2019 EVENING

5:00-5:30 PM	**FLMS Board of Directors Meeting**
6:00-8:00 PM	**EXHIBITORS' SOCIAL** (Exhibit Hall – Dolphin Ballroom)

6:00-8:00 PM **Poster Session** Exhibit Hall – Dolphin Ballroom)

Moderators: Gloria Eby & April Verpoorten

1. Muck Removal Where, Why, How, and at What Costs-*Richard Bryan*
2. Lake Apopka Submerged Aquatic Habitat on the Road to Recovery-*Kendall Fioravante*
3. Seagrass Mapping in the Indian River Lagoon: Recent Trends and a Re-evaluation of Seagrass Depth Limit Targets-*Lauren Hall*
4. The Effects of Algaecides and Herbicides on a Microcystis Winter Bloom in Lake Okeechobee, FL-*Forrest Lefler**
5. Restoration of Clam Population in the Indian River Lagoon for Water Quality Improvement-*José M. Núñez*
6. Innovative Geophysical Study Indian River Lagoon Rockledge, Florida-*Shailesh K Patel, M.Sc. CPSSc.*
7. The Return of Lake Apopka's Submerged Aquatic Habitat- Restoring Adaptively to Maximize Success- *Jodi Slater*
8. Challenges to Predicting Concentrations of Chlorophyll-a using Multi-spectral Satellite Imagery –*Ali Simpson*

THURSDAY - August 29, 2019 MORNING

(* - Denotes student paper)

8:00 AM-5:00 PM	**Check-In and Registration** (Dolphin Foyer)
7:00 AM-8:30 AM	**Breakfast** (Dolphin Ballroom)

Morning Program (Overseas Ballroom)

8:25-8:30 AM **Announcements:** Robbin Huffines, Incoming FLMS President

8:30 -9:30 AM **Keynote Speaker**: Lieutenant Colonel Jennifer A. Reynolds, Deputy District Commander for South Florida, US Army Corps of Engineers

9:30-10:00 AM **MORNING BREAK** (Exhibit Hall – Dolphin Ballroom)

Program Track A: Watershed and Water Resources Management (Overseas Ballroom)

Session A4: Programmatic Aquatic Plant Management

Moderator: Stephen Montgomery

DACS CEUs: 0.5 Aquatic Weed Control

10:00-10:05 AM *Session Introduction*

10:05-10:20 AM Florida's Aquatic Plant Management Program-*Rick Clark*

10:20-10:35 AM Stakeholder Opinions of Hydrilla and Hydrilla Management on Lake Harris- *Daniel Nelson*

10:35-10:50 AM Enhancing Stormwater Quality through a Statewide Hybrid Extension Program for Pond Managers – *Abbey Tyrna Ph.D.*

10:50-11:00 AM *Session Q&A*

Program Track B: Water Resources Science and Technology (Overseas Ballroom)

Session B3: Lake Restoration

Moderator: Robbin Huffines

DACS CEUs: 0.5 Aquatic Weed Control

10:00-10:05 AM *Session Introduction*

10:05-10:20 AM Lake Okeechobee Aquatic Habitat Conservation and Restoration- *Alyssa Jordan*

10:20-10:35 AM Hydrologic Restoration of Bonnet Lake- *Chris Shea*

10:35-10:50 AM Habitat Restoration and Management in an Urban Setting a Community Approach to Ecological Improvement –*Tim Egan*

10:50-11:00 AM *Session Q&A*

THURSDAY - August 29, 2019 MORNING (Cont.)

(* - Denotes student paper)

Program Track A: Watershed and Water Resources Management (Overseas Ballroom)

Session A5: Water Chemistry Dynamics Management

Moderator: Erich Marzolf Ph.D.

DACS CEUs: 0.5 Aquatic Weed Control

11:00-11:05 AM *Session Introduction*

11:05-11:20 AM Salinity Drives Water Chemistry Dynamics in Northwest Florida Coastal Dune Lakes- *Dana Stephens Ph.D.*

11:20-11:35 AM Relationships between Macrophyte Communities and Salinity among Northwest Florida Coastal Dune Lakes – *Richie Gray**

11:35-11:50 AM Evaluating the Potential Effects of Increased Biosolids Application within the Upper St. John's River Basin- *Erich Marzolf Ph.D.*

11:50-12:00 PM *Session Q&A*

Program Track B: Water Resources Science and Technology (Overseas Ballroom)

Session B4: Importance of Aquatic Plants in Stormwater Ponds

Moderator: Shannon Wetzel

DACS CEUs: 0.5 Aquatic Weed Control

11:00-11:05 AM *Session Introduction*

11:05-11:20 AM Planting Stormwater Ponds: Determining the Benefits and Best Management Practices for Ornamental Plants in an Underutilized Portion of Residential Landscapes- *Michelle Atkinson*

11:20-11:35 AM Stormwater ponds: an increasing habitat for invasive plants - *Basil V Iannone III Ph.D.*

11:35-11:50 AM Assessing the Applicability of Floating Wetland Treatment for Wet Retention Ponds –*Devon Moore*

11:50-12:00 PM *Session Q&A*

12:00-1:30 PM **FLMS Annual Awards Luncheon** (Dolphin Ballroom)

THURSDAY – August 29, 2019 AFTERNOON

(* - Denotes student paper)

Program Track A: Watershed and Water Resources Management (Overseas Ballroom)

Session A6: Urban Lake Management

Moderator: Rob Burnes

1:30-1:35 PM *Session Introduction*

1:35-1:50 PM A tale of two lobes: A summary of nutrient inputs to an urban lake in Central Florida- *Mike Hardin Ph.D./Tara Urbanik*

1:50-2:05 PM Leaf Litter on Urban Impervious Surfaces as a Source of Nitrogen and Phosphorus in Stormwater Runoff- *Zijing Liao**

2:05-2:20 PM Carbon Dynamics of Urban Stormwater Ponds: Burial, Gas Flux, and DOM Composition- *Audrey Goeckner**

2:20-2:35 PM How do Urban Stormwater Infiltration Basins Treat Nitrogen along a Hydrologic Flow Path Gradient? - *Qianyaou Si**

2:35-2:45 PM *Session Q&A*

Program Track B: Water Resources Science and Technology (Overseas Ballroom)

Session B5: Nutrient Sources and Reduction

Moderator: Ernesto Lasso de la Vega Ed.D.

1:30-1:35 PM *Session Introduction*

1:35-1:50 PM Sediment Nutrient Release – It's Not Just for Eutrophic Lakes!-*Harvey Harper Ph.D.*

1:50-2:05 PM Land Acquisition as a Method of Reducing Nutrients to Lake Denham in the Harris Chain- *Ron Hart*

2:05-2:20 PM Nutrients, Wastewater Tracers, and the Pesticide Imidacloprid in the Watershed of a North Florida Lake- *Casey Harris*

2:20-2:35 PM Unintended consequences of the Fertilizer Ordinance on Lee County storm water ponds.- *Ernesto Lasso de la Vega Ed.D.*

2:35-2:45 PM *Session Q&A*

2:45-3:15 PM **AFTERNOON BREAK** (Exhibit Hall –Dolphin Ballroom)

THURSDAY – August 29, 2019 AFTERNOON (Cont.)

(* - Denotes student paper)

Program Track A: Watershed and Water Resources Management (Overseas Ballroom)

Session A7: Fisheries Management

Moderator: Ron Hart

DACS CEUs: 1.5 Aquatic Weed Control

3:15-3:20 PM	*Session Introduction*
3:20-3:35 PM	Effects of Nutrient Reduction on the Water Quality and Large Mouth Bass (*Micropterus salmoides)* Population in Lake Alice, Gainesville, Florida- *Marina Schwartz**
3:35-3:50 PM	Managing Risk from Florida's Ongoing mercury Water Quality Problem-*Ted Lange*
3:50-4:05 PM	Bycatch of Non-Target Species by Commercial Gill Nets in Lake George- *Steven Miller*
4:05-4:20 PM	Empirical Analyses of Water Quality, Long-Term Fish and Aquatic Plant Population Data in Relation to Aquatic Plant Management Actions- *Mark Hoyer*
4:20-4:30 PM	*Session Q&A*

Program Track B: Water Resources Science and Technology (Overseas Ballroom)

Session B6: Water Resources Innovation and Technology

Moderator: Patrick Goodwin

DACS CEUs: 1.0 Aquatic Weed Control

3:15-3:20 PM	*Session Introduction*
3:20-3:35 PM	Mapping with UAV's (Unmanned Aerial Vehicles) and USV's [Unmanned Surface Vehicles (Boats)]-*David O'Brein*
3:35-3:50 PM	Innovative Surveying Technique Locates Contaminated Sediments for Surgical Removal- *Shailesh K Patel, M.Sc. CPSSc.*
3:50-4:05 PM	An Emerging Technology Using a Resilient Fabric Material for Living Shorelines- *Brian Fischer*
4:05-4:20 PM	A Scientific Evaluation of Bacterial Digesting Products in a Storm Water Pond in Volusia County FL, USA- *Patrick Goodwin*
4:20-4:30 PM	*Session Q&A*

5:00-10:00 PM	CONCH CRAWL BUS TO KEY WEST STUDENT FUNDRAISER – Hawks Cay Main Lobby

FRIDAY – August 30, 2019 MORNING

(* - Denotes student paper)

7:00 AM-8:30 AM	**Breakfast** (Dolphin Ballroom)

8:25-8:30 AM Announcements: Robbin Huffines, Incoming FLMS President

Program Track A: Watershed and Water Resources Management (Overseas Ballroom)

Session A8: Resource and Data Management

Moderator: Lance Lumbard

8:30-8:35 AM *Session Introduction*

8:35-8:50 AM Lake County Water Authority's Nutrient Reduction Facility: Operations Post-Hurricane Irma.-*Jason Danaher Ph.D.*

8:50-9:05 AM Redesigning a Monitoring Network for Effective Resource Allocation-*Trevor Fagan*

9:05-9:20 AM Data Organization & Dashboard Software for Data Driven Decisions-*Savannah Winstanley*

9:20-9:35 AM Lake Prima Vista and the Case of the Smoking Gun –*Lance Lumbard*

9:35-9:50 AM The Effect of Karst Lakes and Streams on Water Quality of Wakulla Springshed-*Sean E. McGlynn*

9:50-10:00 AM *Session Q&A*

10:00-10:25 AM	**MORNING BREAK** (Exhibit Hall – Dolphin Ballroom)

Program Track B: Watershed and Water Resources Management (Overseas Ballroom)

Session B7: Lake Management Tools

Moderator: Dan Schmutz

10:25-10:30 AM *Session Introduction*

10:30-10:45 AM Analysis of Copper Based Herbicidal Toxicity on Exotic Apple Snails-*Savannah Berger**

10:45-11:00 AM Lake Restoration: It's all about the Phosphorus, no Algae using the Replenish Treatment Solution- *Ed Weinberg*

11:00-11:15 AM Line Vs. Point Aeration Designs: A Cost-Benefit Analysis-*Patrick Goodwin*

11:15-11:30 AM Understanding the Components of Light Extinction Coefficients in Central Florida Lakes: A Machine Learning Perspective-*Dan Schmutz/Rolland Fulton*

11:30-11:40 AM *Session Q&A*

11:40 -12:00 PM	Student Awards and Closing Remarks – Robbin Huffines, FLMS President

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Aquatic Vegetation Control, Inc. (AVC) is a Florida corporation founded in 1986 offering vegetation management and general environmental consulting services throughout the southeast. Since its establishment as an exotic/nuisance vegetation management company specializing in the control of invasive wetland and upland species, AVC has broadened its scope of capabilities to include chemical mowing, certified lake management, re-vegetation, restoration services, roadside and utility vegetation management, and general environmental/ecological consulting.

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Wednesday Keynote Speaker

Dr. Claudia Listopad

Claudia Listopad has 19 years of specialized experience in geospatial project management, remote sensing, and statistical analyses for resolving a multitude of environmental problems. As a trained marine biologist, ecologist, and conservation biologist, Dr. Listopad worked in the private consulting world for over 8 years prior to founding Applied Ecology, Inc. Claudia Listopad has combined geospatial analyses and ENVI remote sensing skills with over 6 years of in-depth use of LiDAR for water resources and ecological studies. Her interest focuses on the application of cutting-edge remote sensing technology and advanced modeling to conservation and natural resource management.

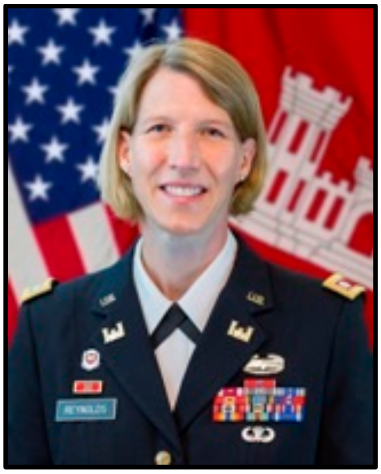
Dr. Listopad specializes in the application of GIS, modeling, database development, statistical analyses, and remote sensing to complex data sets, particularly those related to stormwater, utilities, water resources, natural resources, and consumptive permitting. Since founding AEI, Dr. Listopad has provided stormwater, surface and groundwater quality monitoring, statistical analyses, and modeling services directly as a prime or subconsultant for Brevard County NRMO, City of Indian Harbour Beach, City of Cocoa Beach, City of Cape Canaveral, City of Titusville, City of Rockledge, and the US Air Force.

Dr. Listopad is often involved in agency negotiation and is currently working closely with the SFWMD, SJRWMD, SWFWMD, and FDEP, among other public agencies. She has designed and implemented several large infrastructure geodatabases for municipalities, including custom reporting and portable collection forms, which streamline NDPES, inspection, and maintenance efforts. In addition, she focuses on data management of spatial and non-spatial datasets, impact detection, spatial and geodatabase design and development, and ecological and hydrological field assessments.

Dr. Listopad has been and is continuously involved in several projects funded by the State Legislature related to water quality of the Indian River Lagoon, including several groundwater source studies, which include large-scale monitoring, geospatial modeling, and statistical analyses. Additionally, she is actively involved in both the research and public consulting world for water resources. She presents at domestic and international conferences on a variety of ecological and remote sensing topics and participates in public workshops for water resources issues and their implementation.

Thursday Keynote Speaker

Lieutenant Colonel Jennifer A. Reynolds



Lieutenant Colonel Jennifer A. Reynolds is currently serving as the Deputy District Commander for South Florida in the Jacksonville District, U.S. Army Corps of Engineers. Her most recent previous assignment was as the G33, Chief of the USACE Operations Center at the Headquarters, U.S. Army Corps of Engineers from April 2014 to May 2015. She was responsible for managing current and future operations that provide situational awareness and advice to the leadership on national disasters and contingency operations world-wide. She also served in the Headquarters as the Assistant Director, Civil Works from 2011 to 2014.

She earned her commission from the Reserve Officer Training Corps program at Western Illinois University in 1995 with a Bachelor of Science in Natural Resource Management. She earned a Master of Military Arts and Science Degree from the Command and General Staff College in 2009 and a Master of Arts from Webster University in Procurement and Acquisitions in 2008.

As a result of her graduation from the School of Advanced Military Studies (SAMS) in 2009, Lt. Col. Reynolds holds a secondary specialty as a strategic and operational planner. She was selected to serve the ISAF and USFOR-A Commander as the ISAF Interagency Strategic Planner from July 2009 to July 2010. In this position, she reported to both the ISAF Operations Officer and the Political Military Counselor at the U.S. Embassy.

Lt. Col Reynolds' previous assignments include Brigade Engineer, 3rd Brigade, 82nd Airborne Division; Strategic Planner, International Security Assistance Force – Afghanistan; Deputy Area Engineer, Mosul, Iraq; Company Commander, Iron Mountain Recruiting Company, Michigan; Company Commander and Staff Officer, 82nd Engineer Battalion, 1st Infantry Division, Bamberg, Germany; Training Officer, Engineer Brigade, 4th Infantry Division, Fort Hood, Texas; Budget Officer, 13th COSCOM, Fort Hood, Texas; Platoon Leader, 62nd Engineer Battalion, Fort Hood, Texas.

She has deployed to Bosnia (1996-1997), Kosovo (2000 and 2002-2003), Iraq (2006-2007) and Afghanistan (2009-2010). Her awards and decorations include the Bronze Star Medal (with 1 Oak Leaf Cluster), Meritorious Service Medal (with 1 Oak Leaf Cluster), Army Commendation Medal (with 5 Oak Leaf Clusters), Army Achievement Medal (with two Oak Leaf Clusters), Combat Action Badge, Parachutist Badge, and the Army Recruiter Badge.

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FLMS 2019 AWARDS OF EXCELLENCE

The Board of Directors is pleased to announce this year's award winners!

THE MARJORIE CARR AWARD

presented to

Dr. Harvey Harper

The Marjorie Carr Award *is the Society's highest award and is given for lifetime work on behalf of Florida's aquatic resources. This award is named in honor of Marjorie Carr who, among other things, organized citizens and brought to an end the proposed Cross Florida Barge Canal.*

THE EDWARD DEEVEY, JR. AWARD

presented to

Dr. Rolland Fulton

The Edward Deevey, Jr. Award *is given to an individual for contributing to our scientific understanding of Florida's water bodies. Edward Deevey was an internationally recognized limnologist and affiliated with the State Museum of Florida at the time of his death.*

THE MARJORY STONEMAN DOUGLAS AWARD

presented to

WKMG CBS News 6

The Marjory Stoneman Douglas Award *is given to individuals who report on aquatic resource issues. This award is named in honor of Marjory Stoneman Douglas who authored the book "Everglades: River of Grass", founded the Friends of the Everglades and who has been environmentally active in south Florida.*

THE SCOTT DRIVER AWARD

presented to

Jim Thomas

The Scott Driver Award *is given to an environmental advocate who has promoted the restoration, protection and/or appreciation of Florida's aquatic resources. Scott was a well know activist on behalf of Lake Okeechobee and a member of the steering committee that founded the FLMS.*

FLMS 2019 AWARDS OF EXCELLENCE

The Board of Directors is pleased to announce this year's award winners!

THE RICHARD COLEMAN AWARD

presented to

Tim Egan

The Richard Coleman Aquatic Resources Award *is given to a professional who has worked to restore, protect and/or advance our understanding of Florida's aquatic resources*

THE DR. DANIEL E. CANFIELD, JR. VOLUNTEERISM AWARD

presented to

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The Dr. Daniel E. Canfield, Jr. Volunteerism Award *is given to a volunteer organization or outstanding volunteer for significant contributions to the research, restoration and/or preservation of our water resources. The award is named after Dr. Daniel Canfield, founder of Florida LAKEWATCH, the pioneering citizen-volunteer water quality monitoring program involving over 1,200 lakes statewide, and now being emulated across the United States.*

THE YOUNG PROFESSIONAL AWARD

presented to

Patrick Goodwin

The Young Professional *Award is presented to a young lake management professional who exhibits exemplary professional accomplishments and a commitment to water resource protection and management of our lakes and watersheds.*

Session Abstracts

Session A1: Indian River Lagoon-Identifying Problems
Moderator: Claudia Listopad Ph.D.
Wednesday, August 28, 2019. 10:30 am to 12:00 pm

PROGRESSION OF HARMFUL ALGAL BLOOM MANAGEMENT IN MARTIN COUNTY

Dianne Hughes,
Senior Ecosystem Specialist, Martin County Public Works Department, Stuart, FL

Harmful algal blooms (HABs) can occur anytime water quality is impaired due to excessive accumulation of nutrients. The occurrence of HABs is affected by a complex set of physical, chemical, biological, hydrological and meteorological conditions, making it difficult to isolate specific causative environmental factors. Conditions within Lake Okeechobee and the St. Lucie River and Estuary have created an environment allowing for HABs to occur on a regular basis, often garnering national attention.

In 2013, the Florida Department of Health in Martin County issued advisories to avoid contact with visible algae in the St. Lucie River and estuary after initial test results detected bloom concentrations of *Microcystis aeruginosa*, a type of blue-green algae that can produce toxins.

In 2016, freshwater discharges from Lake Okeechobee to the estuary began on January 29 and had virtually turned the estuary into a freshwater environment by early summer. A 33-square mile algae bloom of *Microcystis aeruginosa* was discovered in the lake on May 9. The bloom seeded the estuary during the discharges. Optimal conditions in the estuary allowed the algae to bloom and form thick mats in certain areas of the watershed causing concern.

In May of 2018, Martin County received approximately 25 inches of rainfall countywide and the lake began rising prior to the official start of the rainy season. On July 9 Governor Rick Scott issued an emergency order to help combat HABs in Glades, Hendry, Lee, Martin, Okeechobee, Palm Beach and St. Lucie counties caused by freshwater discharged from Lake Okeechobee.

HABs are known to cause both irritant and adverse health effects in humans and animals. Martin County has coordinated with federal, state and local partners on addressing the blooms and each bloom has brought new insights and understanding of how these blooms occur. Martin County will present on these findings and how we managed and responded to the HABs with each successive year. applied to countless other lakes throughout Florida and beyond.

LAKE OKEECHOBEE AND THE STORY OF THE SOUTH LAGOON

Jim Moir
Rivers Coalition, Jensen Beach, FL

The presentation summarizes the efforts to influence Lake Okeechobee management and to storage use to reduce discharges to the St. Lucie and Caloosahatchee Rivers. The Rivers Coalition continues to educate the public, exchange in dialogue with state and federal agencies, and advocate "sending the water south," so as not to waste the millions of gallons of fresh water that go to sea through our estuary and most important to send it south to the Everglades where it is needed and nature intended.

PASSING A SALES TAX FOR ENVIRONMENTAL RESTORATION: THE SAVE OUR INDIAN RIVER PROJECT PLAN

Virginia H. Barker
Director, Brevard County Natural Resources Management Department, Melbourne, FL

This presentation will focus on the voter-approved tax used exclusively for restoring estuary health in the Indian River Lagoon. The science-based Save Our Indian River Lagoon Project Plan (SOIRLPP) focuses on REDUCING nutrient inputs through fertilizer education, wastewater upgrades, septic to sewer conversions, septic upgrades, and stormwater retrofits; REMOVING decomposing muck deposits; as well as RESTORING natural filtration systems.

HIDDEN SOURCES: MEASURING GROUNDWATER LOADS TO THE INDIAN RIVER LAGOON

Leesa Souto, Ph.D.
Executive Director, Marine Resources Council, Palm Bay, FL

Nutrients from the watershed enter coastal waters from both stormwater and groundwater sources. As much as 25% to 50% of nutrient loads to the Indian River Lagoon may be coming from groundwater. This groundwater research improves nutrient load estimates and provides important information to prioritize septic to sewer conversion projects.

EMERGENT CONTAMINANTS IN OUR WATERS: TECHNICAL AND REGULATORY ISSUES ASSOCIATED WITH THE USE OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Eric Sager, P.G.
Principal Geologist, Geosyntec Consultants, Clearwater, FL

Per- and polyfluoroalkyl substances (PFAS) are a family of more than 4,000 manmade fluorinated chemicals. Due to their unique physical and chemical properties (water soluble, heat resistant, surfactant hydrophobic/oleophobic, etc.), PFAS have been extensively manufactured and used worldwide. Two PFAS, perfluorooctanoate (PFOA) and perfluorooctane sulfonate (PFOS), have been linked to human health concerns, and PFAS in the environment have been identified as contaminants of emerging concern. In 2016, USEPA recommended a Lifetime Health Advisory of 70 parts per trillion for PFOA, PFOS, or both in drinking water. At the request of FDEP, the University of Florida developed provisional cleanup target levels (CTLs) in 2018 for PFOA and PFOS in soil and groundwater, and these provisional CTLs are being applied to site rehabilitation under Chapter 62-780, Florida Administrative Code. Although FDEP has not requested the calculation of provisional surface water CTLs, surface water represents a potential human-health exposure pathway and an exposure pathway for ecological receptors. EPA's PFAS Action Plan released in February 2019 includes long-term actions to evaluate if data support the development of Clean Water Action Section 304(a) ambient water quality criteria to set permit limits on discharges to waterbodies and to determine if a waterbody requires cleanup to protect human health and aquatic life. EPA also plans to seek additional information from industry to aid in the identification of industrial sources that may warrant potential regulation through national effluent limitation guidelines.

Session A2: Indian River Lagoon-The Science Behind the Problems
Moderator: Margaret Lasi Ph.D.
Wednesday, August 28, 2019. 1:35 pm to 3:00 pm

SHIFTING NUTRIENT REGIMES AND HARMFUL ALGAL BLOOMS IN THE INDIAN RIVER LAGOON, FLORIDA

Margaret Lasi Ph.D.,[1] Edward Phlips Ph.D.[2], Susan Badylak[2], Jan Miller[1] & Charles Jacoby Ph.D.[1]
[1] St. Johns River Water Management District, Palatka, FL
[2] University of Florida, Gainesville, FL

The Indian River Lagoon (IRL) is one of a growing number of coastal systems that suffer from cultural eutrophication. Recent data indicate that the three lagoons comprising this estuary of national significance may have been pushed past the limits of their ecological resilience. The northern IRL was known for its expansive seagrass beds, abundant fisheries and rich biodiversity until 2011, when it experienced a bloom of pico-nanoplanktonic algae (most < 7 µm in diameter) that was unprecedented in magnitude (chlorophyll a concentrations > 130 µg/L) and duration (9-10 months). The resultant light stress led to major losses of

seagrasses, with further losses following subsequent, sometimes stronger or longer-lasting blooms. The first recorded brown tide (*Aureoumbra lagunensis*) occurred in 2012 (up to 200 µg/L of chlorophyll a), a moderately intense (< 50 µg/L of chlorophyll a) and long-lasting (14 months) bloom of pico-nanoplankton took place in 2015-2016, and a devastating brown tide returned in 2016 (up to 165 µg/L of chlorophyll a). The initial bloom was preceded by a sharp increase in concentrations of phosphorus following some unusual events. Relative to the preceding 14-year period, median values of total phosphorus increased 1.5-2.0 times, nitrogen-to-phosphorus (N:P) ratios decreased by half, and concentrations of chlorophyll a increased 2.5-fold. These results suggest phosphorus was the primary limiting nutrient in this portion of the system. Such shifts in the stoichiometry of coastal systems often are associated with changes in the composition of phytoplanktonic assemblages, with conditions favoring smaller taxa that recycle nutrients efficiently and often possess unconventional strategies for acquiring nutrients. Our long-term data on water quality and phytoplankton indicate similar changes may have taken place in the IRL. Potentially major implications for food-webs, toxin production, and biogeochemical cycling are being explored.

BOTTOM-UP CONTROLS IN THE IRL: NUTRITIONAL PREFERENCES & CAPABILITIES OF THE 'SUPERBLOOM' TAXA

Joshua Papacek Ph.D.[1], Edward Phlips Ph.D.[2], Margaret Lasi Ph.D.[3], & Patrick Inglett Ph.D.[1]
[1]Soil and Water Sciences Department, University of Florida, Gainesville, FL
[2]School of Forest Resources and Conservation, University of Florida, Gainesville, FL
[3]St. Johns River Water Management District, Palatka, FL

Ecosystem-disruptive harmful algal blooms (HABs) are increasingly common in estuaries such as the northern Indian River Lagoon (IRL). While growing nitrogen (N) and phosphorus (P) supply can explain this expansion of HABs to many coastal systems, the internal sources, forms (e.g. organic vs. inorganic), and ratios of N and P are likely important in selecting for the taxa of blooms. We investigated changing nutrient regimes and internal processes as potential factors for recent HAB shifts in the IRL. First, we carried out a series of uptake experiments by tracing N substrates into biomass from cultures of 'Superbloom' phytoplankton and tracking the disappearance of P from culture solution. Uptake results directly confirmed cultures' preference for chemically-reduced N (i.e. ammonium) and the ability to use organic N and P substrate. Additionally, we hypothesized that biological nitrogen fixation (BNF)—the conversion of atmospheric N (N_2) to bioavailable N—could be a largely unaccounted-for process supplying N to HABs in the IRL. While bi-monthly BNF assays from September 2014 to June 2016 showed that water column rates were highly episodic, rates during August 2015 sampling period were significantly higher than rates previously measured in the IRL due to available P concentrations. Despite temporally inconsistent rates, *nifH* gene sequencing revealed a consistently diverse assemblage of N_2-fixing bacteria throughout the IRL, although community structure significantly differed during the 2015-16 *Aureoumbra lagunensis* bloom. Together, these results suggest that recent shifts in internal nutrient forms and sources in the IRL likely favor specific taxa with advantageous physiological traits. Combined with the overall shift from benthic to the water-column production, the turnover of available nutrients via the 'microbial loop' could lead to an ecosystem state favoring widespread and sustained HABs of nano- and picoplanktonic algae.

ABRUPT AND EXTENSIVE SEAGRASS LOSS IN THE INDIAN RIVER LAGOON: INDICATION OF A REGIME SHIFT?

Lori Morris[1], Charles Jacoby Ph.D.[1], Lauren Hall[2], Jan Miller[1], Robert Chamberlain[3], Robert Virnstein Ph.D.[3]
[1] St. Johns River Water Management District, Palatka, FL
[2] St. Johns River Water Management District, Melbourne, FL
[3] Retired, St. Johns River Water Management District, Palatka, FL

The Indian River Lagoon, along the east coast of Florida, experienced tremendous losses of seagrass following a "superbloom" of phytoplankton in 2011. Seagrass has continued to decline due to subsequent blooms that were more intense and of longer duration. In fact, mapping in 2017 showed a loss of more than 50% of the seagrass that was mapped throughout the lagoon in 2009. In total, about 130 km^2 have been lost, and the average cover of seagrass has declined to a record low 5%. A decade ago, this system appeared to be thriving, as the extent of seagrass approached targets for restoration. What happened? The phytoplankton blooms, with chlorophyll-a concentrations more than double historical maxima and the concomitant reduction in light penetration have shifted the allocation of carbon and associated nitrogen and phosphorus from seagrass that grows and dies relatively slowly and drifting macroalgae that grow and die at a moderate pace to fast-growing, boom-and-bust phytoplankton. This change in primary producer assemblages suggests a regime shift with important ramifications for nutrient cycling. Future studies may benefit from improved data on all major primary producers and their abilities to acquire and sequester carbon and macronutrients.

VISUALIZING ALGAL BLOOMS IN THE INDIAN RIVER LAGOON ESTUARY USING MULTI-SPECTRAL SATELLITE IMAGERY

Rex Ellis Ph.D., Ali Simpson & Charles Jacoby Ph.D.
St. Johns River Water Management District, Palatka, FL

The Indian River Lagoon recently experienced a series of intensive algal blooms spanning more than 100 km in latitude. A network of 57 monthly surface water sampling sites was in place and captured both the intensity and spatial extent of these blooms. To complement this dataset, we created spatial visualizations of the blooms from freely available Landsat satellite imagery. These visualizations were a time series of chlorophyll *a* maps and matching natural color band composite images. The chlorophyll *a* maps were created by applying regression models to each pixel of a Landsat scene. The regression models were developed using multiple linear regression of chlorophyll *a* from the water sample network and surface reflectance at the sample locations as measured by Landsat. From 1984 to present, Landsat 5, 7, and 8 satellites have capture scenes at a frequency of every 16 days. These scenes are often available for user download within days of data capture. The regression models, combined with the history, frequency, and availability of Landsat imagery, area a powerful tool for managers seeking to rapidly detect and visualize current blooms or to comprehend the extent and intensity of historical blooms.

TEMPORAL AND SPATIAL VARIATIONS IN BENTHIC FLUXES OF NITROGEN AND PHOSPHORUS FROM FINE-GRAINED, ORGANIC-RICH SEDIMENTS IN A SUBTROPICAL ESTUARY AND EVALUATION OF RESTORATION TECHNIQUES

Austin L. Fox Ph.D.
Florida Institute of Technology, Melbourne, FL

Fine-grained, organic-rich sediments, locally referred to as "muck" cover 5-10% of the bottom of the central and northern Indian River Lagoon (IRL), a bar-built estuary along the central east coast of Florida. Decomposition of organic matter in muck continuously releases (fluxes) nitrogen (N) and phosphorus (P) to overlying water. Overall, releases from muck contribute >30% of the annual inputs of bioavailable N and P to this system; the remaining fractions are supplied by stormwater runoff, groundwater/baseflow and atmospheric deposition. Releases of N and P from muck vary temporally and spatially following patterns for sediment temperature and sediment composition. Temporally, benthic fluxes of N and P increase by 6-10% per degree Celsius increase in sediment temperature over the typical annual range of sediment temperatures from ~15°C to ~30°C. Spatially, fluxes of nitrogen from muck varied by 20-fold, between ~5 and >100 tons N/km^2/year following patterns for sediment composition, with strong correlations identified between N flux and sediment water and organic matter content plus organic carbon and nitrogen content of sediments. A large new dataset for benthic fluxes of N and P is now being applied to track reductions in benthic N and P fluxes during and after restoration projects, including environmental dredging, sediment aeration and subaqueous sand capping.

Session B1: Resource Management Planning
Moderator: Mary Szafraniec Ph.D.
Wednesday, August 28, 2019. 1:30 pm to 3:00 pm

NUMERIC NUTRIENT CRITERIA-WHAT DO THEY REALLY PROTECT? THE CURIOUS CASE OF LAKE PICKETT

Harvey H. Harper, Ph.D., P.E.
Environmental Research & Design, Inc. (ERD), Orlando, FL

Lake Pickett is a 745-acre, colored, oligotrophic lake in a rural portion of northeast Orange County. Current concentrations of TP, TN, and chlorophyll-a in Lake Pickett are approximately 8, 500, and 6 ug/L, respectively. Watershed areas surrounding the lake are experiencing intensive development pressure, and concerns have been expressed over water quality impacts from future development. Florida Numeric Nutrient Criteria (NNC) were adopted in 2012 to protect Florida lakes and provide minimum and maximum nutrient standards for lakes based on color and alkalinity. For colored lakes, such as Lake Pickett (color > 40 Pt-Co units), the minimum allowable nutrient standards are 50 ug/L for TP, 1,270 ug/L for TN, and 20 ug/L for chlorophyll-a, respectively, all of which reflect eutrophic conditions. The current NNC fail to protect oligotrophic waterbodies until the lakes become eutrophic.

DEVELOPING SCIENCE-BASED RESOURCE MANAGEMENT PLANS FOR OVER 100 LAKES ON THE LAKE WALES RIDGE IN FLORIDA

Mary Szafraniec Ph.D. and Megan Long
Wood Environment and Infrastructure Solutions, Inc., Tampa, FL

We conducted spatial land use assessments and multivariate statistical analyses to provide insight into the possible sources of water quality issues and trends in over 100 lakes on the Lake Wales Ridge in Central Florida. Our results suggested that hydrologic condition (i.e. lake level and groundwater connectivity) was a primary influencer of water quality impacts. Conceptual plans for groundwater and surface water quality restoration projects for a prioritized set of impaired lakes were provided and will be discussed.

SETTLING AND ENTRAINMENT PROPERITES OF STORMWATER TREATMENT AREA (STA) PARTICULATES

Serge Thomas Ph.D.
Assistant Professor, Florida Gulf Coast University, Fort Myers, FL

FIU, in partnership with FGCU and the AERDC has recently been contracted by the SFWMD to lead a study focusing on the characteristics of the particulate settling, resuspension and overall sediment entrainment in Stormwater Treatment Areas (STAs) 2 and 3/4 under stagnant, low, and high flows. These STAs receive surficial water from canals draining the Everglades Agricultural Area (EAA) located south of Lake Okeechobee. STAs are flowthrough constructed operated to reduce phosphorus (P) via various mechanisms involving i) plant and microbial uptake, ii) biologically mediated chemical changes enhancing P sequestration (e.g. pH change yielding P co-precipitation with calcite), iii) particulate settling and entrapment within the vegetation, iv) chemical (e.g. P sorption), overall resulting in P-storage via accretion. Despite undeniable P removal successes with over 85% reduction in P load in recent years, additional efforts are necessary to achieve stringent regulatory limits, including finding ways to reduce particulate P at the outflow which is generally 50% of outflow total P. This investigation, which is part of a larger study to quantify and determine the nature of internal P cycling in the STAs, aims to assess the i) temporal and spatial variation in velocity by making cross sectional flow velocity transects along the flow ways, ii) particle settling rates by size and TP contents, iii) threshold velocity/critical shear stress to remobilize various sediment class sizes and TP contents and entrain them downstream and iv) the correlation between particulate load and hydrologic/weather conditions. These various goals involve field and laboratory studies using field-sampled materials. Preliminary results show that high velocity (2m/s) were periodically observed especially in remnant ditches (i.e. privileged scoured areas) and that sediment/floc is constantly remobilized in the water column from settled particulate. The use of underwater time-lapse cameras over sediment plate traps asserts this constant remobilization as well as captured sloughed periphyton from the surrounding biological environment and sediment/floc bioturbation from fishes. Suspended particulates follow a diurnal pattern associated with afternoon winds. In addition to the wave effect, winds were responsible for as much as 40% of the variability in mean flow magnitudes. Suspended sediment and shear stress peaked in late afternoons. Critical shear stresses for resuspension of sediment were significantly higher than those for deposition, so that high suspended sediment concentrations persisted long after the winds stopped. The

erodibility of the sediment from sampled cores (i.e. as measured with a SedFlume and a GUST chamber) was quite consistent over the various sediment collected from the inflow to the outflow in all STAs. The sediment traps deployed point out that the settled particle size is smaller from inflow to outflow.

DEVELOPING A HYDROLOGIC AND WATER QUALITY HISTORY OF LAKE TARPON USING HISTORICAL AND PALEOLIMNOLOGICAL DATA

Megan Long[1], *Mary Szafraniec*[1], *Robert Burnes*[2]

[1]Wood Environment and Infrastructure Solutions, Inc., Tampa, FL
[2]Pinellas County, FL

As early as the 1800's, Lake Tarpon has experienced human alterations (intentional and unintentional) of its hydraulics, hydrology, water chemistry, nutrient inputs, and aquatic ecosystems. This study combined historical research with paleolimnological and hydrological analysis techniques to develop a more complete history of water quality conditions, which will help inform future lake management decisions.

CLIMATE CHANGE AND YOUR LAKE: WHAT YOU NEED TO KNOW

Kenneth J. Wagner, Ph.D., CLM,
Water Resource Services, Inc., Wilbraham, MA

Climate change is real; we can debate the causes, but it has always existed and is being strongly manifested globally today. Focusing on slight changes in average temperature is misleading; the biggest danger is in variability, which increases with increasing average. Florida is already a warm place, but climate change can still have substantial impacts. Increasing frequency of extreme events includes larger storms that affect water quality and longer droughts that impact water quantity. Increasing temperature at the sediment-water interface increases oxygen demand at a potentially alarming rate; loss of oxygen has as much impact on water quality and biological integrity as any factor influencing lakes. Colder extremes can harm species not adapted to the increasing range of temperature. Warmer water favors cyanobacteria and faster growth by vascular plants. We cannot control climate change in our lifetimes, but we can take steps to adjust to it. Key steps include more detention capacity, better control of nutrient loading and availability, provision of oxygen to offset losses from increased temperature, and application of plant management techniques. The need for lake management will increase with increasing temperature, even in Florida.

Session A3: Indian River Lagoon-Proposing Solutions
Moderator: Claudia Listopad Ph.D.
Wednesday, August 28, 2019. 3:30 pm to 5:00 pm

DEVELOPING DATA-DRIVEN SEPTIC POLICY FOR THE INDIAN RIVER LAGOON

Danielle Huffner[1] *and Anthony Gubler*[2]
[1]Environmental Scientist II, Applied Ecology, Inc., Indialantic, FL
[2]Save Our Indian River Lagoon Program, Brevard County, FL

Solutions to restore the Indian River Lagoon include local pollution prevention regulations. The presentation provides the methodology and results from a large simulation effort utilizing ArcNLET modelling of groundwater transport of septic system nitrogen loadings and how these results were used to guide science-based policy decisions.

HOW DID THIS YEAR'S LEGISLATIVE SESSION IMPACT THE NITROGEN REDUCING ONSITE SEWAGE TREATMENT AND DISPOSAL SYSTEMS (OSTDS)?

Roxanne Groover
Executive Director of Florida Onsite Wastewater Association, Lake Alfred, FL

This presentation will provide updates to the 2019 legislative session as it relates to human wastewater and OSTDS. Then continue the discussion with a fast -paced journey highlighting the various nitrogen reducing OSTDS available to meet the needs of Florida's wastewater infrastructure challenges.

THE ELEPHANT IN THE ROOM: ADDRESSING WASTEWATER SOURCES OF POLLUTION

Anthony Gubler
Save Our Indian River Lagoon Program, Brevard County, FL

A comprehensive plan to restore a waterbody needs to consider all major sources of pollution, including potential septic contributions, leaky sewer laterals, package plants, rapid infiltration basins, sprayfields and reclaimed water. This presentation describes the multifaceted approach used in the Save our Indian River Lagoon Project Plan to reduce wastewater sources.

RESTORING RAIN'S NATURAL PATH: A TOOL IN THE RESTORATION OF THE INDIAN RIVER LAGOON

Joanie Regan
Stormwater Utility Manager, City of Cocoa Beach, Cocoa Beach, FL

Low Impact Development/Design (LID) is becoming an essential tool in redeveloping urbanized built-out areas. Large cities started this green infrastructure movement, but little urbanized town are now seeing the benefit of removing impervious, adding green space and creative BMPs - with benefits to our built environment that even go beyond stormwater management.

IT ISN'T ALL ABOUT THE MUCK: INNOVATIVE ENVIRONMENTAL DREDGING APPLICATIONS

Walker Dawson, PE
Engineer III, Save Our Indian River Lagoon Program, Brevard County, FL

This presentation will discuss lessons learned on implementing innovative technology for environmental dredging. Case studies from Indian River Lagoon dredging efforts.

Session B2: Algae and Bacteria Investigations
Moderator: Rob Burnes
Wednesday, August 28, 2019. 3:30 pm to 5:00 pm

CYANOTOXIN OCCURRENCE IN THE LOWER ST. JOHNS RIVER ESTUARY, 2005-2017

Tiffany Trent, Casey Harris, and John Hendrickson
St. Johns River Water Management District, Palatka, FL

The St. Johns River Water Management District has monitored outbreaks of algal and bacterial blooms in the Lower St Johns River (LSJR) following an estuary-wide bloom in 2005. Focusing on the cyanotoxins microcystin (MYN) and cylindrospermopsin (CYN), we report a comprehensive assessment of the relationship between zones of the estuary, inter-annual and seasonal occurrence, dominant co-occurring cyanobacteria, and cyanotoxin concentration, from 2005-2017. Highest MYN levels and occurrences were found in Doctor's Lake, Crescent Lake, and the Oligohaline reach. CYN followed a similar pattern, and occurred most frequently in Doctor's Lake, Crescent Lake, and the Freshwater reach. Both toxins occurrences typically peak in frequency and intensity in the 3rd quarter of most years. Quantile regression

was employed to evaluate the major cyanobacteria genera most significantly correlated with cyanotoxin, and the maximum cyanotoxin to biovolume ratios. Models of the log-base10 *Cylindrospermopsis spp*. and *Oscillatoria-cf spp*. biovolume identified significant upper 8th and 9th quantile relationships with log-base10 cylindrospermopsin concentration, in every river section except the Oligohaline. Similar log-log models relating biovolume to microcystin identified significant upper quantile relationships with *Microcystis spp*. in Doctor's Lake and the marine reach of the LSJR, but also for several filamentous cyanobacteria in Lake George. Overall, the frequency of exceedance of the draft EPA criteria was low (4ppb for MYN, and 8ppb for CYN), though relatively much greater for microcystin (69 occurrences) than for cylindrospermopsin (1 occurrence). While these results indicate that zones of the SJRE appear to express different levels of toxin production potential per unit biomass, relationships of between cyanotoxin concentration and the major cyanobacteria is equivocal relative to a putative genera or species, due to tendencies for co-occurrence, or limitations in taxonomy.

THE STATE OF THE PRACTICE FOR IDENTIFYING BACTERIA AND NUTRIENT SOURCES IN URBAN WATERS

Jared Ervin Ph.D., and Erin Reed Ph.D., P.E.
Geosyntec Consultants, Sanford, FL

Surface waters in many urban areas are frequently contaminated with elevated concentrations of fecal indicator bacteria, signaling a potential health risk, and nutrients, leading to algal growth and depleted oxygen levels that result in risk to aquatic habitat. Bacteria and nutrients are two of the most common pollutants on Florida's 303(d) lists of impaired waterbodies, and TMDLs have been established to control the contribution of urban sources in many watersheds. However, surface water concentrations may be elevated due to a variety of anthropogenic and non-anthropogenic sources, and not all sources present the same risk to receiving water beneficial uses. The tools used in most current illicit discharge detection and elimination (IDDE) programs are often not capable of identifying sources (e.g., human vs non-human) or locating inputs so that management actions can be taken. To better assess sources, Geosyntec Consultants is using advanced forensic tools to identify human versus non-human sources of contamination in surface and ground waters. DNA-based markers and chemical sewage indicators are being used to identify where human sewage sources are present. Stable isotope analysis is being used to distinguish nutrients from sewage, fertilizers, or natural sources. The use of these advanced tools in combination with traditional IDDE tools (e.g., CCTV and dye testing) allows for bacteria and nutrient sources to more efficiently be tracked and controlled. By efficiently identifying and eliminating sources, greater public and aquatic health benefit and significant cost savings may be achieved compared to structural stormwater implementation such as green infrastructure.

INVESTIGATION OF FACTORS INFLUENCING CYANOBACTERIAL BLOOM DEVELOPMENT IN THE LOWER ST. JOHNS RIVER BASIN

Rolland Fulton Ph.D., Casey Harris, John Hendrickson, and Tiffany Trent
St. Johns River Water Management District, Palatka, FL

The lower St. Johns River experiences regular cyanobacteria blooms in its predominantly freshwater and oligohaline reaches. Univariate and multivariate analyses were conducted to evaluate relationships of water quality and hydrological factors with phytoplankton community development in the lower St. Johns River basin, with particular reference to *Microcystis*, nitrogen-fixers, and other cyanobacteria. Different analysis methods have pointed to varying factors as being associated with cyanobacteria. However, total nitrogen, total nitrogen to total phosphorus ratio, and water temperature were most consistently positively associated with cyanobacteria biovolumes. Inorganic nitrogen and soluble reactive phosphorus tended to be negatively associated with cyanobacteria. There were some differences in responses between sites in the freshwater zone of the river and in oligohaline Doctors Lake. In the freshwater zone, cyanobacteria tended to be positively associated with conductivity and negatively associated with discharges and water color. In Doctors Lake, cyanobacteria tended to be negatively associated with conductivity and positively or weakly associated with discharges and water color.

ASSOCIATION BETWEEN TROPHIC STATE, WATER USE, AND BLOOMS OF CYANOBACTERIA IN SOUTH-CENTRAL CHILE

H. Dail Laughinghouse IV Ph.D.
Fort Lauderdale Research and Education Center, University of Florida/IFAS, Davie, FL

An increase in the distribution and frequency of cyanobacterial blooms has been reported for many regions worldwide. Due to this fact, we studied the variables that influence the abundance of natural populations of planktonic cyanobacteria in temperate lakes of central and southern Chile. These lakes differed in trophic state and watershed use. Cyanobacteria dominated in meso- and eutrophic systems and their occurrence correlated to watershed use (tree plantations and urban). Ochrophyta and Bacillariophyta were dominant in oligotrophic lakes, where native forest dominated land usage. In these lakes, the maximum depth of the euphotic zone influenced the community structure and the genera of cyanobacteria. *Dolichospermum* was the most abundant, frequent, and widely distributed genus, found in oligotrophic and eutrophic lakes, forming blooms in eutrophic systems.

The concentration of total phosphorus and total nitrogen positively influenced cyanobacterial abundance and bloom formation, mainly by *Aphanizomenon*, *Aphanocapsa*, *Aphanothece*, and *Dolichospermum*, and *Microcystis*. In contrast to many reports on their occurrence in the northern hemisphere, these genera occurred widely at less than 20 °C, forming dispersive blooms, at low temperatures in autumn and winter (10.8–15.6 °C). This shows that eutrophication is the main factor for bloom formation and these genera can form blooms independent of temperature. However, some genera, such as *Microcystis*, increased their abundance and presented more intense

blooms (scums) at high temperatures. Our study provides baseline data to document long-term changes in lentic systems of the western south-central area of South America, including genera that could respond by increasing their abundance with eutrophication and projected climatic changes.

Session A4: Programmatic Aquatic Plant Management
Moderator: Monty Montgomery
Thursday, August 29, 2019. 10:00 am to 11:00 am

FWC'S AQUATIC PLANT MANAGEMENT: THE PAUSE AND FUTURE DIRECTION

Rick Clark
Invasive Plant Management, Aquatics Subsection Administrator, Florida Fish and Wildlife Conservation Commission, Tallahassee, FL

Florida has had to adapt to many changing and challenging conditions in order to combat the invasive plant issues in the state. This presentation will highlight the new and innovative approaches Florida will be using to address new management issues. Discussions will include a database and accountability tracking system, advances and standardization of plant mapping and identification protocol, new formulations for herbicide management, as well as new stakeholder engagements. One highlighted stakeholder engagement is a new outreach effort called "What's Happening on My Lake" geared towards educating, encouraging participation and gaining a better rapport with interested members of the public.

CATEGORIZING LAKE HARRIS USER GROUPS AND THEIR OPINIONS OF HYDRILLA AND HYDRILLA MANAGEMENT

Daniel Nelson, Brandon Thompson, and Nia Morales
Florida Fish and Wildlife Conservation Commission, Eustis, FL

Hydrilla has expanded throughout the Harris Chain and in the summer of 2018, vegetation surveys identified greater than 4,000 acres of hydrilla at Lake Harris. The invasive plant management section spent over 4 million dollars treating hydrilla at Lake Harris alone, and the herbicide treatment in April of 2018 created immediate controversy with anglers, lakefront homeowners, boaters and concerned members of the public. There is a critical and urgent need for aquatic plant and fisheries managers to better understand who the stakeholders are at Lake Harris and their opinions of hydrilla management at Lake Harris. Basic knowledge of the primary users at Lake Harris becomes important to ensure all groups are properly represented as managers aim to make informed plant management decisions. In December 2018, we initiated a study design that utilizes a year-round roving creel survey with additional access point surveys to estimate the annual effort of all user groups at Lake Harris. We also designed a survey that will be used to compare opinions of hydrilla and hydrilla management among user groups at Lake Harris. Further, during this survey, we are soliciting contact information from those participating in the survey which should provide a robust and

representative stakeholder contact list. In the first four months of the study, results from over 300 surveys have shown interesting differences among users regarding their opinion of hydrilla and hydrilla management.

ENHANCING STORMWATER QUALITY THROUGH A STATEWIDE HYRBRID EXTENSION PROGRAM FOR POND MANAGERS

Abbey Tyrna Ph.D.[1], *Michelle Atkinson*[2], *Eban Bean Ph.D, P.E..*[2], *and Mary Lusk Ph.D.*[3]
[1]University of Florida IFAS Extension, Sarasota, FL
[2]University of Florida IFAS School of Forest Resources and Conservation, Gainesville, FL
[3]University of Florida IFAS Gulf Coast Research and Education Center, Wimauma, FL

Stormwater is the biggest contributor to water pollution in Florida and wet detention ponds are the most common method for stormwater management. Thus, improving stormwater detention ponds and lakes is a major focus of University of Florida's Institute of Food and Agricultural Sciences (IFAS) Extension Service. A "hybrid" training program focused on providing pond managers with evidence-based tools for a holistic approach to pond management that enhances water quality, wildlife habitat, and pond longevity has been created. The program targets technicians of commercial pond management companies, homeowner association leaders (HOAs), community association managers (CAMs), local government pond managers, and private pond owners.

Session B3: Lake Restoration
Moderator: Robbin Huffines
Thursday, August 29, 2019. 10:00 am to 11:00 am

LAKE OKEECHOBEE AQUATIC HABITAT CONSERVATION AND RESTORATION

Alyssa Jordan
Florida Fish and Wildlife Conservation Commission, Okeechobee FL

Florida Fish and Wildlife Conservation Commission (FWC) has worked many years to help conserve and restore Florida's largest lake, Lake Okeechobee. FWC has utilized many management strategies, such as herbicide, prescribed fire, native plantings and sediment removal, to improve littoral habitat, Everglade snail kite response and migratory bird usage.

FWC created six islands in the northwest marsh of Lake Okeechobee, in 2001 and 2008 to remove a ridge of organic sediment that had formed during a period of high water, effectively blocking the flow of water into the interior marsh. FWC has been working to "rehabilitate" these spoil islands, planting over 10,000 trees and shrubs from over forty-five native species. In addition to the islands, a bald cypress fringe is being re-established. In the early 1900's, there were records of a band of bald cypress, but due to logging, wildfires,

hydrologic changes and cattle grazing, those trees had disappeared. Over 10,000 wetland trees and shrubs from twelve different species have been planted with the primary focus being on bald cypress. This area may be beneficial to wildlife as a corridor between central Florida and the Everglades when human population expands. Herbicide control of vines and other invasive species help these young plantings survive. Additional sediment removal projects have been planned for when conditions allow.

In addition to plantings, multiple prescribed fires have been conducted this fire season with approximately 14,000 acres burned as of May 2019. Targeted cattail and torpedograss treatments were designed to reduce monotypic stands to allow a variety of native species to spread. These treatments are often combined with prescribed fire to help increase control of invasive species and promote natives. New techniques are currently being explored to help control invasive species.

HYDROLOGIC RESTORATION OF BONNET LAKE

Christopher Shea
Tampa Bay Water, Clearwater, FL

Tampa Bay Water operates a potable water supply wellfield, pumping water from the Floridan Aquifer, on the 8,300 acre Starkey Wilderness Park in Pasco County. Groundwater pumpage began in 1974 and the wellfield was operated at annual average levels between 12 and 15 million gallons per day (mgd) from 1989 to 2007. Environmental impacts to wetlands (e.g. lower water levels, vegetative changes) were documented in the 1990s and regulatory, permitting and operational changes have resulted in a reduction of pumpage to its current level of approximately 5 mgd. A recovery assessment program is being conducted to document the hydrologic and ecologic response of wetlands to this reduction in groundwater withdrawal.

Bonnet Lake is a five acre pond on the Starkey Wilderness Park which has experienced lowered water levels and vegetative changes as a result of nearby groundwater withdrawals. Bonnet Lake has responded positively to the reduction in groundwater pumpage, with a post-cutback median water level increase of 1.07 feet. Vegetative changes have also been seen, with pines invading the lake fringes dying back with higher water levels. The post-cutback median lake level, however, is still below a recovery metric established for wetlands of its type. A restoration project designed to restore the pond's historic hydrology, through a high-water connection with an adjacent, much larger lake (known as Grass Prairie or Grassy Lake), was implemented in early 2019. During the feasibility stage of the restoration project, water budgets were developed for both Bonnet Lake and Grass Prairie. Simulated water levels from these water budgets indicate that Bonnet Lake should be able to meet its target level with augmentation, with negligible impact (predicted 0.14 foot decline in median lake level) to the larger donor lake, Grass Prairie. Hydrologic and ecological effects of the reduction in pumpage, and the augmentation, will be discussed.

HABITAT RESTORATION AND MANAGEMENT IN AN URBAN SETTING A COMMUNITY APPROACH TO ECOLOGICAL IMPROVEMENT

Timothy J. Egan[1], *Annemarie Smith*[2], *Amanda J. Martin*[3], *Catherine Bowman*[4]
[1] City of Winter Park, FL
[2] Private Citizen, Volunteer Coordinator
[3] Tarflower Chapter, Florida Native Plant Society
[4] Tarflower Chapter, Florida Native Plant Society

Skunk-vine (*Paederia foetida*) has been problematic in parts of west central Florida for many decades. The UF/IFAS Center for Aquatic and Invasive Plants reports that the first introduction of this plant into Florida occurred in Hernando County in the late 19th Century. Imported from Asia as a potential fiber crop, it quickly escaped cultivation and now occurs in 17 Florida counties. The Florida Exotic Pest Plant Council's List of Invasive Species classifies skunk-vine as a Category 1 species. The source and date of introduction to Winter Park is unknown. Complaints about heavy infestations in Mead Botanical Garden, and subsequent control efforts began in the early 1990's. Since that time, infestations and control efforts have spread north along Howell Branch Creek.

Skunk-vine and other exotic vines caused significant, adverse impacts to terrestrial habitats in open space and park properties owned by the City of Winter Park. The city currently has approximately 60 acres of natural land under active management and recently acquired an additional 55 acres that will come online later this year. An integrated management approach using chemical, manual, educational and ecological control techniques is implemented by city staff, contractors and volunteer groups has been successful in restoring the natural functions and habitat value of these systems.

Session A5: Water Chemistry Dynamics Management
Moderator: Erich Marzolf Ph.D.
Thursday, August 29, 2019. 11:00 am to 12:00 pm

SALINITY DRIVES WATER CHEMISTRY DYNAMICS IN NORTHWEST FLORIDA COASTAL DUNE LAKES

Dana Stephens Ph.D. and A. Challen Hyman
Mattie M. Kelly Environmental Institute, Northwest Florida State College, Niceville, FL

Coastal dune lakes of Northwest Florida are semi-isolated coastal systems with intermittent connection to the Gulf of Mexico. These waterbodies oscillate between fresh and brackish conditions through breaching of a berm to the sea. Dynamic flux of these systems provided opportunity to examine relationships between salinity and water chemistry variables and resilience over time. A citizen scientist monitoring dataset was used for analysis, which included monthly water chemistry variables (e.g., i.e., chlorophyll, pH, salinity,

total phosphorus, total nitrogen, and water clarity) collected 2003-2017 for 16 coastal dune lakes. Lake volume at the point when the berm breached in each lake was estimated. Shifts from this point allowed identification of the status of the coastal dune lake (i.e., freshwater outflow, seawater inflow, or closed) over the time series examined. Among the population of coastal dune lakes, increased salinity resulted in increased pH and water clarity and decreased total nitrogen. No relationships were found between salinity and chlorophyll or total phosphorus. Frequency of freshwater outflows and seawater inflows coupled by associated shifts in lake volume showed the magnitude of salinity as a driver of water chemistry. Salinity not only impacted temporal shifts in water chemistry, but also influenced water chemistry across a spatial gradient from the outfall (opening point) through the entire lake.

RELATIONSHIP BETWEEN MACROPHYTE COMMUNITIES AND SALINITY AMONG NORTWEST FLORIDA COASTAL DUNE LAKES

Richie Gray[1], Challen Hyman[1,2], and Dana Stephens Ph.D.[1]
[1]Mattie M. Kelly Environmental Institute, Northwest Florida State College, Niceville, FL
[2]Choctawhatchee Basin Alliance, Santa Rosa Beach, FL

The purpose of this study was to examine biodiversity of the macrophyte community within and among a population of 16 coastal dune lakes located in Northwest Florida. Due to intermittent connection with the Gulf of Mexico, coastal dune lakes experience dynamic biogeochemical fluxes providing opportunity to understand shifts in the macrophyte community. Macrophyte surveys were conducted quarterly to encompass a sampling event each season (i.e., winter, spring, summer, and fall) of the year. Percent area covered (PAC) was determined for each emergent and floating macrophyte identified in a 1-m quadrat, which included sampling every 3m along a 20m transect from the shoreline in four, randomly selected areas of the waterbody. PAC for submersed macrophytes was determined using Lowrance side scan and structure scan units. Based on mean annual salinity, coastal dune lakes were placed in three categories: fresh (mean salinity= 0 ppt), intermediate (4.1 ppt), and brackish (8.8 ppt). Shannon-Weiner index (alpha diversity) was used to estimate richness and the Sorenson index (beta diversity) to estimate evenness. These indices of biodiversity suggest the population of coastal dune lakes dominated by freshwater conditions have higher richness. Evenness was not affected by the flux in salinity concentrations, frequency of opening and closing of waterbody to the Gulf of Mexico, among the coastal dune lakes.

RECOMMENDED CHANGES TO BIOSOLIDS APPLICATION TO REDUCE PHOSPHORUS LOADING TO SURFACE WATERS IN FLORIDA

Erich Marzolf Ph.D., Dean Dobberfuhl Ph.D., John Hendrickson
Div. of Water and Lands Resources, St. Johns River Water Management District, Palatka, FL

The upper St. Johns River (USJR) is an ecosystem of restored herbaceous marsh and run-of-the-river lakes. The SJRWMD owns and manages over 166,000 acres, striving to restore wetland functions. Despite restoration progress, many of the headwater lakes and streams exhibit significant increasing phosphorus trends and increasing incidences of harmful cyanobacterial blooms, an ominous manifestation for this potable water supply. This upward phosphorus trend is coincident with an increase in the application of wastewater biosolids on pastures in the watersheds.

Phosphorus concentrations are significantly correlated with cumulative biosolid phosphorus application. Application in the USJR's watershed intensified following prohibition in the adjacent Okeechobee watershed. Current regulations base biosolids application on crop nitrogen requirements, which is problematic for a low N:P product. The Florida Department of Environmental Protection recently convened an advisory committee to evaluate the regulations for biosolids use. The committee recommended: establishing the rate of biosolids application based on site specifics (soil adsorption capacity, water table, hydrogeology, site use, distance to surface water; evaluating the percentage of water extractable phosphorus in all biosolids; establishing criteria for low, medium and high-risk sites that guide application practices; increasing the site inspection rate; developing site specific groundwater and/or surface water monitoring protocols to detect nutrient migration; developing and conduct biosolid and nutrient management research on nutrient run-off through surface and groundwater flow with various application rates, biosolids types and different geologic conditions; promoting innovative technology pilot projects for biosolids processing that could provide a wider range of beneficial end products.

Session B4: Importance of Aquatic Plants in Stormwater Ponds
Moderator: Shannon Wetzel
Thursday, August 29, 2019. 11:00 am to 12:00 pm

PLANTING STORMWATER PONDS: DETERMINING THE BENEFITS AND BEST MANAGEMENT PRACTICES FOR ORNAMENTAL PLANTS IN AN UNDERUTILIZED PORTION OF RESIDENTIAL LANDSCAPES

Michelle Atkinson, Basil V. Iannone III Ph.D.[1], Mary Lusk Ph.D.[2], Paul Monaghan Ph.D.[3], Alexander Reisinger Ph.D.[4]
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Collaborators on this project have a sincere interest in protecting downstream water resources and have been working together to define best management practices for both the landscape and stormwater pond maintenance contractors pertaining to maintenance of planted buffer zone areas. While conducting this project, after the installation of plant material in the stormwater pond buffer zone areas, community homeowner response was unpredicted.

STORMWATER PONDS: AN INCREASING HABITAT FOR INVASIVE PLANTS

Basil V. Iannone III Ph.D.[1], *James Sinclair Ph.D.*[1], *Alexander Reisinger Ph.D.* [1], *Eban Bean Ph.D.*[1], *Damian C. Adams Ph.D.*[1], *Lindsey Reisinger Ph.D.*[1], *and Allyson Holmes*[1]
[1]University of Florida IFAS, Gainesville, FL

Stormwater ponds are an increasingly common engineered ecosystem in urban landscapes that provide flood control and capture stormwater runoff and pollutants. Stormwater ponds can be hydrologically-dynamic and nutrient-rich environments, making them well-suited for invasive plant establishment. Furthermore, their abundance may increase opportunities for invasive plant establishment and spread. For instance, we found approximately 76,000 stormwater ponds in Florida alone. To determine the degree to which stormwater ponds harbor invasive plants, we sampled 30 stormwater ponds in Gainesville, FL. We found 28 different invasive plant species, i.e. high invader diversity and species turnover. This diversity presents challenges for invasive plant management historically reliant on single-species control strategies. For this reason, we compiled data on 70 functional traits for the 28 invasive plant species that we found to identify inter-specific commonalities. We learned that all invaders are perennial. Most were also introduced as ornamental species and exhibit both sexual and asexual reproduction, rapid growth, tolerance of disturbed habitats, and a diversity of dispersal mechanisms i.e. traits associated with successful plant invaders. Furthermore, the species we found commonly invade natural wetlands, creating concerns for the conservation of native wetland plant communities. We also found evidence that managing stormwater pond plant communities to be aesthetically appealing to urban residents decreases invasion and causes the invasive plants that do establish to be those well-suited for early successional communities. Finally, stormwater ponds designed to maintain permanent pools (detention ponds) exhibit less invasion than those designed to go dry (retention ponds). These findings reveal that stormwater ponds harbor a diversity of invasive plant species and that invasions and invader traits are affected by stormwater pond management and design. Future work will determine the degree to which stormwater ponds facilitate invasive plant movement and how to design stormwater ponds to be resistant to plant invasions.

ASSESSING THE APPLICABILITY OF FLOATING WETLAND TREATMENT FOR WET RETENTION PONDS

Devon Moore
Environmental Scientist, City of Winter Haven, Winter Haven, FL

In 2017, the City of Winter Haven, with funding from the FLMS Love Your Lake Grant, installed a floating treatment wetland as part a test project aimed at improving stormwater quality and fostering public education and engagement. After a 12 month grow-out period, substantial nutrient reduction occurred at the test site and the City distributed over 120 plants as part of a community outreach event.

Session A6: Urban Lake Management
Moderator: Rob Burnes
Thursday, August 29, 2019. 1:30 pm to 2:45 pm

A TALE OF TWO LOBES: A SUMMARY OF NUTRIENT INPUTS TO AN URBAN LAKE IN CENTRAL FLORIDA

Tara Urbanik[1] *& Mike Hardin, PhD, PE, CFM*[2]
[1]Orange County, Environmental Protection Division, Orlando, FL
[2]Geosyntec Consultants, Inc., Winter Springs, FL

Geosyntec Consultants, Inc., is performing a water quality master plan including a nutrient/hydrologic budget and prioritized recommendations for improvement projects for Lake Conway. Lake Conway is an approximately 1,278 acre lake that has a highly urbanized watershed consisting of mostly residential land uses and is located in unincorporated Orange County and within the Cities of Belle Isle and Edgewood. Lake Conway is part of a chain of lakes within the Boggy Creek Drainage Basin in Central Florida. The analysis presented in this talk focuses on the middle and south lobes of Lake Conway, herein referred to as Lake Conway. The nutrient monitoring tasks associated with this project include surface water, stormwater, seepage, and sediment sampling as well as an internal recycling assessment of the sediments. To date, Geosyntec has completed the sampling efforts for these tasks.

Based on the results of the historical water quality analysis and sampling results, Lake Conway can be characterized as an oligotrophic through mid-eutrophic lake that is phosphorus limited. Surface water sampling results indicated seasonal variation with respect to Secchi disk depth and chlorophyll-a concentrations. The stormwater sampling demonstrated that contributing areas with BMPs tended to have lower concentrations of nutrients than areas without BMPs. Additionally, the stormwater sampling indicated some bacterial issues with some of the stormwater sampling locations associated with public parks. This could be an indication of pet waste not being picked up or waste from other animals impacting stormwater in these basins. TN and TP concentrations were also elevated for these basins.

The lake sediment assessment demonstrated that most of the unconsolidated sediments were located in the deeper parts of the lake, with these areas also having a higher nutrient content than sediments in other parts of the lake. The phosphorus fractionalization indicated that most of the sediment bound phosphorus was associated with iron-bound phosphorus, which could potentially be released into the water column under anoxic conditions. The internal recycling assessment showed some phosphorus release during both aerobic and anoxic conditions, but this wasn't significant, suggesting that internal recycling may not play a significant role in lake phosphorus concentrations. Seepage was also examined to determine the impacts of groundwater to the lake. The seepage assessment demonstrated that seepage into the lake did not contain significant phosphorus concentrations but did have elevated nitrogen concentrations.

LEAF LITTER ON URBAN IMPERVIOUS SURFACES AS A SOURCE OF NITROGEN AND PHOSPHORUS IN STORMWATER RUNOFF

Zijing Liao, Mary Lusk Ph.D., Jack Rechcigl
University of Florida, Soil and Water Sciences Department, Gulf Coast Research and Education Center, Wimauma, FL

While receiving little regulation and attention, leaf litter may leach out significant amount of nutrients (N and P) to stormwater through its decomposition on urban impervious surfaces. Excessive nutrients leached can be picked up by stormwater runoff and/or carry particulate nutrients to receiving surface waters, eventually contributing to water quality degradation. Thus, understanding the nutrients leached out as a function of leaf decomposition on different urban surfaces is crucial to managing nutrient inflow to local watersheds. This experiment compares leachable nutrients (NO3-, NH4+ and PO43-) from live oak tree leaf litter on different urban impervious surfaces (lawn, sidewalk, forestland and storm-grate) at different stages of decomposition. Leaf litter is enclosed in fiberglass mesh bags, placed on the location of interest, and collected for analysis once a month. Upon retrieval, a portion of leaf litter is ground and tissue is analyzed for total N and P, as well as leachable nutrients by leaching with water for to simulate a natural rainfall event. Leachates are being collected and analyzed for NO3-, NH4+, PO43-, total nitrogen and organic carbon content. We combine our data on nutrient leaching from leaf litter with a field investigation of particulate-bound nutrients in stormwater runoff from 2 Tampa Bay area urban neighborhoods with contrasting levels of tree canopy cover. This work will provide actionable data about potential nutrient loading to stormwater from seasonal leaf litter and will aid in local management decisions about mitigating N and P transport to surface waters.

CARBON DYNAMICS OF URBAN STORMWATER PONDS: BURIAL, GAS FLUX, AND DOM COMPOSITION

Audrey Goeckner[1], Mary Lusk Ph.D.[1], AJ Reisinger Ph.D.[2], Joseph Smoak Ph.D.[3], Thomas Bianchi Ph.D.[4]
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[2]Department of Soil and Water Sciences, University of Florida, Gainesville, FL
[3]Department of Environmental Science, Policy, and Geography, University of South Florida, St. Petersburg, FL
[4]Department of Geological Sciences, University of Florida, Gainesville, FL

Urbanization alters biogeochemical processes on the landscape. Stormwater wet retention ponds are aquatic engineered stormwater management systems found in urbanized areas that have been overlooked as active sites of biogeochemical cycling. Stormwater runoff picks up residues from anthropogenic activities, altering the chemistry of water funneled into these ponds. Although small in size, wet stormwater ponds make up 1% of land area in the state of Florida and can play a significant role in regional carbon cycling. This study aims to assess the potential impact of urban stormwater ponds on regional carbon cycling by examining burial rates, greenhouse gas flux, and the composition of dissolved organic matter (DOM). Rates of carbon burial and gas flux (CO_2 and CH_4) were observed on five residential stormwater ponds selected by an age

gradient (14-34 years) in the Lakewood Ranch community of Bradenton, FL. We hypothesized that urban stormwater ponds would bury significant quantities of carbon and be sources of greenhouse gases to the atmosphere. Additionally, we predict runoff to consist of relatively labile sources of terrestrial DOM and the pond to contain more labile sources of internally produced DOM. Data will be presented on carbon burial rates from pond sediment cores collected during May 2019, as well as preliminary data on biweekly measurements of GHG emissions and OM quality via fluorescence spectrometry. The goal of this study is to understand how small constructed aquatic systems intercept water from the landscape and transform carbon that is either stored, emitted to the atmosphere, or sent downstream to naturally occurring streams, rivers, wetlands, or lakes.

HOW DO URBAN STORMWATER INFILTRATION BASINS TREAT NITROGEN ALONG A HYDROLOGIC FLOW PATH GRADIENT?

Qianyao Si[1], Mary Lusk Ph.D.[1], Patrick Inglett Ph.D.[2], Jean-Claude Bonzongo Ph.D.[3]
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[2] University of Florida, Soil and Water Sciences Dept., Gainesville, FL
[3]University of Florida, Department of Environmental Engineering Sciences, Gainesville, FL

Stormwater infiltration basins are designed to mitigate the potentially negative effect of excess stormwater runoff and pollutant loads in urban environments. The main and original purpose of infiltration basins is flood control, but they may also serve to transform and remove pollutants such as nitrogen (N), though the N removal function of infiltration basins is highly variable and needs further study. So, in this research project, the N cycle processes (mineralization, nitrification, denitrification) and the N removal efficiency in sediments of urban stormwater infiltration basins will be identified and compared along a hydrologic flow path from the inlets of the basins' outward—with the hypothesis that increased sedimentation near the inlet pipe will result in a gradient of soil properties that will in turn lead to a gradient in N cycling and N transport to the underlying groundwater. We present preliminary data of soil physical and chemical properties associated with denitrification, a major process of soil N removal, and demonstrate variability of these properties along the basins' hydrologic flow path and with depth. This data suggests that N-removal treatment by infiltration basin soils will be spatially variable and that stormwater interacting with soils near the basins' inflows may be treated differently than that interacting with soils near the basins' centers. To test this, we combine the investigation of soil N cycling processes with a comparison of basin inflows (stormwater) and outflows (subsurface leaching) during dry and wet seasons and during storm events of various sizes. We will discuss N removal efficiency along basin hydrologic flow paths and relate this removal to soil physical and chemical properties. By identifying the N removal ability of infiltration basins, we could improve their design for increased N removal with solid data support.

Session B5: Nutrient Sources and Reduction
Moderator: Ernesto Lasso de la Vega Ed.D.
Thursday, August 29, 2019. 1:30 pm to 2:45 pm

SEDIMENT NUTRIENT RELEASE- IT'S NOT JUST FOR EUTROPHIC LAKES!

Harvey H. Harper, Ph.D., PE
Environmental Research & Design Inc. (ERD), Orlando, FL

Benthic nutrient release is often the most significant source of nutrient loadings to eutrophic lakes, although it is often ignored in lake restoration plans. However, sediment nutrient release occurs in all lakes, even oligotrophic waterbodies. Data from nutrient release experiments were evaluated from 40 Florida lakes, ranging from oligotrophic to hyper-eutrophic, to characterize typical release rates for oligotrophic, mesotrophic, eutrophic, and hyper-eutrophic lakes. In general, sediment nutrient release increases with trophic status, and nutrient release of phosphorus is a significant part of the phosphorus budget, even in oligotrophic waterbodies.

LAND ACQUISTION AS A METHOD OF REDUCING NUTRIENTS TO LAKE DENHAM IN THE HARRIS CHAIN

Ron Hart
Water Resources Director, Lake County Water Authority, Tavares, FL

Lake Denham is a 252-acre waterbody and the western most lake within the Harris Chain of Lakes in Lake County, Florida. Water from the lake outfalls east to Lake Harris via Helena Run. The lake has a 6,641-acre watershed that is composed primarily of wetlands (50%), agriculture (20%), and urban development (7%). It has also been identified by the Florida Department of Environmental Protection (FDEP) as a waterbody that can't meet the Numeric Nutrient Criteria unless nutrient reduction projects are implemented. The FDEP report sets a goal for the Total Phosphorus concentrations in the lake at 50ppb. For the modeling period of 2000-2012, the measured average Total Phosphorus was 95ppb. The Lake Denham Muck Farm is the largest controllable source of nutrients to Lake Denham by a significant margin with 1101.6lbs of TP/year or 66.9% of the controllable lake load. The farm has a perimeter levee and contributes these nutrient loads as a result of pumping that dries peaty wetland soils causing oxidation. To date, soils elevations within the levee have been reduced by up to 7 feet. The farm and the canal connecting to Lake Denham were constructed between 1947 and 1958.

If the nutrients from the farm are eliminated, it is projected that the loading to the lake would be reduced more than enough to meet the TMDL requirements. If this extremely large load is not eliminated, then it is highly unlikely that the lake will ever meet the load reductions necessary to reach the water quality goals. The Lake County Water Authority proposes to eliminate this source of pollution by purchasing the farm from the owners and stopping pumping.

NUTRIENTS, WASTEWATER TRACERS, AND THE PESTICIDE IMIDACLOPRID IN THE WATERSHED OF A NORTH FLORIDA LAKE

Casey Harris, Yanbing Jia, Bakari Powell, Chounghyun Seong, John Hendrickson
St. Johns River Water Management District, Palatka, FL

Doctors Lake in Clay County, Florida, is a freshwater to brackish lake connected to the St. Johns River and mainly surrounded by residential land use. Nutrients, water chemistry, wastewater tracers, and other trace components in storm runoff were measured throughout the watershed during storm events in 2018–2019. These measurements along with modeled hydrologic data were used to compare sources, concentrations, and loads of nutrients originating from different parts of the watershed. One of the trace components measured in storm runoff, the pesticide imidacloprid, exceeded published EPA benchmarks for aquatic invertebrates and warrants further monitoring and evaluation. Additionally, an Excel spreadsheet model was used to estimate nutrient applications to land throughout the watershed as well as nutrient transport/delivery to the lake, with an emphasis on comparing overall nutrient contributions to the lake from fertilizer, reclaimed irrigation, and septic tanks.

UNINTENDED CONSEQUENCES OF THE FERTILIZER ORDINANCE ON LEE COUNTY STORM WATER PONDS

Ernesto Lasso de la Vega Ed.D.
Lee County Hyacinth Control District

The Lee County Fertilizer Ordinance was implemented in 2008. Data collected since then by volunteers in the Pond Watch Program of the Lee County Hyacinth Control District had shown how nutrients run off might have changed according to landscape practices and other environmental factors.

Session A7: Fisheries Management
Moderator: Ron Hart
Thursday, August 29, 2019. 3:15 pm to 4:30 pm

EFFECTS OF NUTRIENT REDUCTION ON THE WATER QUALITY AND LARGEMOUTH BASS *MICROPTERUS SALMOIDES* POPULATION IN LAKE ALICE, GAINESVILLE, FLORIDA

Marina Schwartz
University of Florida, Gainesville, FL

Phosphorus and nitrogen are widely considered the limiting nutrients in lake systems. Prior to 1994, Lake Alice in Gainesville (FL) received treated effluent from the University of Florida's wastewater treatment facility. In October 1994, a new wastewater reclamation plant was opened, and the treated effluent was rerouted, thus no longer contributing excess nutrients to the lake. Lake Alice is also home to an unfished population of Largemouth Bass *Micropterus salmoides.* This study examines how the water quality and the Largemouth Bass population responded to the reduction in nutrients. Water chemistry and Largemouth Bass Data collected by UF's Introduction to Fisheries science classes were analyzed for the years surrounding the removal of effluent and examined for relationships between effluent presence, absence, and bass population parameters. Years following the removal of treated effluent to the lake showed a significant increase in Secchi depths, and reductions in Total Phosphorus (TP), Total Nitrogen (TN), and chlorophyll (CHL) as well as a reduction in Proportional Size Distribution (PSD) of Largemouth Bass. However, after evaluating long term data, the changes seen in the Largemouth Bass population during the study period are small oscillations in a larger trend and were not related to the effluent removal event. Utilizing long-term monitoring programs, instead of studies from northern lakes, to drive management decisions for Florida's lakes, will improve lake management practices to protect and preserve these freshwater systems.

MANAGING RISK FROM FLORIDA'S ONGOING MERCURY WATER QUALITY PROBLEM

Ted Lange[1] *and Andrew Reich* [2]
[1]Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, Eustis, FL
[2]Bureau of Environmental Health, Florida Department of Health, Tallahassee, FL

Mercury (Hg) bioaccumulation in fish and wildlife has remained a significant water quality problem in Florida waters since the early 1980s when the Florida Fish and Wildlife Conservation Commission (FWC), the Florida Department of Environmental Protection (DEP), and the Florida Department of Health (DOH) began actively investigating its occurrence. Decades-long research and monitoring efforts have led to better understanding of the distribution of, and causes for, high Hg in fish and wildlife that are consumed by humans and wildlife. Of relevance to lake managers is the wide-ranging extent of contamination in fish.

The primary source of Hg to Florida waters is through atmospheric deposition resulting in virtually all waters having fish with detectable levels of Hg. Variations in fish Hg levels occur across the state and are a result of how efficiently atmospherically derived Hg is transformed to methyl-mercury (meHg) and how efficiently meHg integrates into the aquatic food web. Because of variations in these processes, Hg varies both among and within species by several orders of magnitude with the highest concentrations generally occurring in long-lived predatory species such as Largemouth Bass (bass). We estimate that 70% of all Florida lakes have bass populations with Hg in excess of the 0.3 mg/kg USEPA criterion for the protection of human health. Yet there are many native and non-native species that co-occur with bass that remain low in Hg and pose little human health risk.

Current management of the Hg water quality problem include a Hg Total Maximum Daily Load (TMDL) assessment for state fresh waters and public health messaging (i.e. fish consumption advisories). Statewide trends in fish mercury levels suggest that both ecological and human health risks from Hg in fish will persist into the foreseeable future. We will discuss current monitoring and assessment programs as well as efforts to more efficiently communicate both the risk and benefits of consuming wild-caught fish from Florida waters.

WHAT ELSE IS CAUGHT BY THE GILL NETS? ASSESSING BYCATCH OF NON-TARGET SPECIES CAPTURED BY THE LAKE GEORGE GIZZARD SHAD REMOVAL PROGRAM

Steven J Miller, Johns Higman, and Wendy Tweedale
St. Johns River Water Management District, Palatka, FL

Florida Governor Executive Order 19-12 instructs state WMD's to prioritize funding for projects that address harmful algal blooms and maximize nutrient reductions. In response, the SJRWMD is continuing a program started in 2013 using gill nets to harvest *Dorosoma cepedianum* (Gizzard Shad) and other rough fish from Lake George, a mainstem lake at the headwaters of the St. Johns River estuary. Commercially harvesting Gizzard Shad is a cost-effective method for directly removing phosphorous from lakes. However, there are conservation concerns regarding potential negative effects of gill nets on anadromous river herrings, sport fish, and other non-target species (bycatch). Conducting an effective commercial harvest that has minimal negative impacts due to bycatch is critical to maintaining regulatory agency and public support for the program. From 2013-2018, over 3,100,000 kg of Gizzard Shad were commercially harvested from Lake George. Fishing was confined to the months of May through September. Non-target species (bycatch) comprised < 2% of both the estimated total number and weight of fishes caught by commercial fisherman. Bycatch was composed of 15 freshwater and 10 estuarine fish species. Dominant freshwater species captured during the commercial harvest were *Ictalurus punctatus* (Channel Catfish), *Pomoxis nigromaculatus* (Black Crappie), and *Morone spp.* (Hybrid Striped Bass), whereas dominant estuarine taxa were *Elops saurus* (Ladyfish) and *Micropogonias undulatus* (Atlantic Croaker). Comparison of bycatch estimates to creel and other population surveys suggest commercial fishing has had minimal impact on sport and other non-target fishes in Lake George. In addition, restricting the commercial harvest to the late spring and summer months eliminated potential adverse impacts of the program on anadromous river herrings.

EMPERICAL ANALYSES OF WATER QUALITY, LONG-TERM FISH AND AQUATIC PLANT POPULATION DATA IN RELATION TO AQUATIC PLANT MANAGEMENT ACTIONS

Mark V. Hoyer, Marina K. Schwartz and Christine A. Horsburgh
Florida LAKEWATCH, UF, Gainesville, FL

Multiple long-term data sets available in Florida that can be used to examine relations among aquatic plant and fish population metrics, water quality, and aquatic plant management activities. The Invasive Plant Management section (IPM) of Florida Fish and Wildlife Conservation Commission (FWC) conducts an annual plant survey, which has been continued from other agencies since 1982. The data base contains aquatic plants surveyed on 397 lakes from 53 Florida counties and includes information on over 200 species of aquatic plants. However, recent data contains only information on plants (e.g., hydrilla, water hyacinth, and water lettuce) of major management concern. Since 2010, IPM has maintained Plant Management and Accounting Retrieval System (PMARS) data, which records all aquatic plant herbicide management activities. Florida LAKEWATCH, a volunteer water quality monitoring program, was initiated in 1986 yielding over three decades of water quality data. The following parameters have been monitored monthly (> 1,000 lakes): total phosphorus, total nitrogen, chlorophyll and water clarity (color and specific conductance are also measured since 2010). In 1999, Florida LAKEWATCH in cooperation with FWC started a long-term fish monitoring program, that was standardized by FWC in 2006 yielding consistent fisheries data on approximately 30 public lakes for the last decade. These long-term fisheries data include spring time electrofishing data on largemouth bass (LMB), black crappie (BLCR) trawl data, and community sampling data including information on LMB, BLCR, exotic fishes, forage fishes, rough fishes, sunfishes, game fish. Electronic copies of these data set have been obtained and a common lake identifier has been created for each data base so they can be merged for analyses. This presentation will describe preliminary data merging and analyses.

Session B6: Water Resources Innovation and Technology
Moderator: Patrick Goodwin
Thursday, August 29, 2019. 3:15 pm to 4:30 pm

MAPPING WITH UAV'S (UNMANNED AERIAL VEHICLES) AND USV'S [UNMANNED SURFACE VEHICLES (BOATS)]

David O'Brien PSM, Jordan Kowenski Pilot, Henry Simpkins PSM
Servtech Solutions, Tampa, FL

The presentation will focus on the advancements in the mapping industry due to unmanned vehicles, including aerial and hydrographic mapping. Unmanned aerial vehicles (Drones) came onto the scene approximately five years ago. Since that time productivity, reliability and efficiency has continued to increase. There are many uses of UAV's from outside of the mapping market, including inspection, video and multi spectral applications. For the mapping industry the two main technologies are photogrammetry and LiDAR. The advantage of using imagery is cost effectiveness, planimetric location and ortho-imagery.

Drawbacks can be vegetation, processing time, and repeatable accuracy. The second and less common technology is utilizing airborne LiDAR on a UAV. LiDAR systems require onboard, RTK (real time kinematic) or PPK (post processed kinematic) GPS, with survey grade accuracy and an IMU (inertial measurement unit), correcting for craft orientation, such as heave, pitch and roll. Done correctly, UAV LiDAR systems can achieve accuracies of greater than +/- 0.1 feet and the results are consistent. With USV (unmanned surface vehicles) there are typically two types of hydrographic (bathymetric) surveys that can be performed. These technologies are multi beam and single beam sonar. With USV's weight is not a limiting factor as with UAV's, so USV's have much longer mission times. As with LiDAR and Photogrammetric UAV's, multi beam USV's are much more expensive than single beam USV's and therefore much less common in the industry. The advantage to single beam is the reduced cost, but the drawback is much less data than the multi beam unit.

The presentation will depict examples of the different mapping technologies used for projects throughout numerous industries and markets.

INNOVATIVE GEOPHYSICAL STUDY INDIAN RIVER LAGOON, ROCKLEDGE, FLORIDA

Shailesh K. Patel, M.Sc., CPSSc., and John F. Sawyer
ArcDMC Sediment Solutions, LLC, Melbourne, FL

The purpose of the test survey was to verify that a new geophysical survey system, Aquares, developed and widely used throughout the UK, would accurately acquire subsurface geophysical data in the Indian River Lagoon, specifically identifying the interface of contaminated and non-contaminated sediments for muck removal dredging projects. Test results were compared to probes, core borings, dual frequency sounding and other historic data.

The geophysical survey was performed simultaneously during the bathymetric survey, providing a georeferenced model of the surface and subsurface to be excavated. The system measures the electrical resistance of subsurface structures in ohms. Sediments such as silt record values of 0.01 ohm while firm materials such as stiff clay and rock record much higher resistivity readings. All changes in the subsurface are observed in a color coded 4D geophysical model (X,Y,Z & Ohm) By observing changes in the subsurface model, engineers, environmentalists, planners, owners, contractors, etc. now have a basis for selecting the location of sediment identification core borings rather than using best guess practices. The Aquares system substantially reduces the number of core borings required to describe subsurface conditions on dredging projects and can describe 100% of the project subsurface.

The test survey at Rockledge showed great promise to serve the dredging industry with greater success. ArcDMC not only identified the quantity and interface of contaminated sediments to be excavated, but also proved that the contaminated sediments were mostly contained in specific locations and not across the width of the waterway as previous determined by probes. Over $200 million has been appropriated by Brevard County, Florida for the restoration of the Indian River Lagoon. ArcDMC has provided precise bathymetric and geophysical survey results that will permit cost effective surgical or precision dredging of areas of concern, assisting the County with the tools to best utilize public funding.

AN EMERGING TECHNOLOGY USING A RESILIENT FABRIC MATERIAL FOR LIVING SHORELINES

Brian Fischer
Sox Erosion Solutions, Boca Raton, Florida

Shoreline erosion is the major contributor to watershed sediment loss, enabling precipitation events to transport nutrients (N & P) into lakes, canal systems stormwater ponds and fragile estuarine ecosystems contributing to eutrophication. As a direct consequence, eroding shorelines decimate littoral zone habitat and deplete valuable stabilizing soil for buffer vegetation. Eroded shorelines increase the infestation of invasive plants, destabilizing productive ecosystems. Economically speaking, shoreline erosion significantly lowers property values adjacent to water bodies. Stormwater runoff is one of the highest contributors to shoreline erosion but is often neglected due to overstretched municipal budgets. Implementing environmentally sound practices of vegetative buffering and habitat restoration are of increasing importance to policy-makers, water managers and consulting engineers. A relatively recent holistic approach to stabilizing shorelines is gaining international momentum utilizing a patented bioengineered fiber material distributed by SOX Erosion Solutions of Boca Raton, Florida. This high strength fabric uses densely knitted permeable mesh proven to last decades. The "SOX" approach has been shown to withstand hurricane-force wave intensity, northern lake ice fracturing and intense tidal friction. As a result within months after a SOX installation, native plants flourish and grow within the integrated fabric improving nutrient buffering, reducing soil loss and increasing wildlife habitat. Municipalities and states are increasingly turning to *living shorelines* approaches as opposed to expensive cement walls, "rip-rap" or installing impermeable synthetic tubing. The SOX fabric approach has been shown to be the most conducive ecological method to achieve living shoreline goals and is the best cost-effective method on the market. This presentation will focus specifically on stormwater control examples with documented case studies from recent satisfied clients.

A SCIENTIFIC EVALUATION OF BACTERIAL DIGESTING PRODUCTS IN A STORM WATER POND IN VOLUSIA COUNTY, FLORIDA

Patrick Goodwin
Aquatic Systems Inc., Pompano Beach FL

In this study, three products: BioZyme Nitrifiers ™, BioZyme Powder Formula ™, and BioZyme Activator ™ were added according to manufactures instructions to a stormwater pond in Volusia County Florida to assess the efficacy of these products in reducing accumulated sediment organics. Unconsolidated sediment depths and sediment composition (n = 14) were measured before and after 27 weekly bacterial treatments. Sediments inoculated with bacteria were not associated with significant reductions in mean unconsolidated sediment depths. However, sediment composition after treatment with bacteria showed a significant decrease in percent sediment organic content and an increase in water weight. This study suggests that lake sediments with low sediment organic matter (< 25 %) relative to the unconsolidated sediment depth (0.31 m; 1 ft.) will not exhibit significant reductions in mean unconsolidated sediment depths when using these

bacterial digesting products over a 6 month period. Determining a lake's mean sediment organic content and unconsolidated sediment depth are useful metrics in assessing the feasibility of bacterial products for sediment reduction. An overview of the application process and cost is also provided for applied lake managers looking to utilize this technique.

Session A8: Resource and Data Management
Moderator: Lance Lumbard
Friday, August 30, 2019. 8:30 am to 10:00 am

LAKE COUNTY WATER AUTHORITY'S NUTRIENT REDUCTION FACILITY (NuRF): OPERATIONS POST-HURICANE IRMA

Jason Danaher,Ph.D, Ron Hart, Michael Perry
Lake County Water Authority, Tavares, FL

Discharge from Lake Apopka is the single largest controllable source of pollution in Lake County. Discharge volume from Lake Apopka is dependent on rainfall and removal of dissolved nutrients from this water volume would provide long-term benefits to the downstream Harris Chain of Lakes. Construction of the Nutrient Reduction Facility (NuRF) began in October 2007 and the facility became operational on March 2, 2009. The NuRF utilizes off-line liquid aluminum sulfate (i.e. alum) injection to remove pollutants flowing out of Lake Apopka into the Harris Chain of Lakes.

The NuRF facility was designed to handle a constant flow of 50 cubic feet per second (cfs) and elevated flows up to 300 cfs for a short time. To date, the facility has treated approximately 53.5 billion gallons of water and has utilized nearly 12 million gallons of alum. Total phosphorus (TP) concentration entering the NuRF inflow averages 91.4 ppb with a treated TP concentration average of 38.6 ppb at the facility outfall canal. The NuRF has removed approximately 58% of the TP concentration received resulting in nearly 26,700 pounds of TP removed since the facility's start-up.

After Hurricane Irma the NuRF experienced flows greater than 100 cfs for 192 days and in that time period flows exceeded 350 cfs for 42 days. This resulted in operation of the facility 24/7 and attrition of the equipment and staff. In this presentation, we will discuss issues the Lake County Water Authority experienced regarding logistics in obtaining a steady supply of alum, storing dewatered sediment in the designated containment area, hiring and training temporary staffing and prolonged operation of the water treatment technologies.

REDESIGNING A MONITORING NETWORK FOR EFFECTIVE RESOURCE ALLOCATION

Trevor Fagan
Staff Environmental Scientist, Southwest Florida Water Management District, Tampa, FL

The Southwest Florida Water Management District (SWFWMD) is undertaking an effort to redesign their Ambient Lakes Monitoring Network to maximize the use of resources provided through taxpayer funds. This is being done in conjunction with several sections at SWFWMD such that data collection efforts are being employed to support each section's area of responsibility. The historical design of this network was based on selecting lakes that were exhibiting increasing trends for trophic state index and sampling for a three year period to support impairment assessments conducted by Florida Department of Environmental Protection (FDEP). The mandate that the state's water management districts adopt minimum flows and levels (mfl's) for water bodies facilitated a need to conduct monitoring in support of these efforts. A collaborative approach was undertaken between SWFWMD stakeholders, such that each section could communicate and share available resources and information to see what water quality constituents need to be monitored for lakes and at what frequency for establishing and re-evaluating mfl's. The results of this effort yielded a set of lakes that were recommended for monitoring in conjunction with the establishment and re-evaluation of mfls. We found through this effort that water quality data could be collected on lakes in a manner that supports the needs of both the FDEP and the SWFWMD.

DATA ORGANIZATION & DASHBOARD SOFTWARE FOR DATA-DRIVEN DECISIONS

Savannah Winstanley
City of Winter Haven, Winter Haven, FL

Towards the goal of making data-driven decisions in lake management and promoting interagency communication, the City has designed a Microsoft Access database for lake monitoring data ranging from species diversity, biovolume, water quality, and surface levels. This database is then connected to an online data visualization & organization software called Tableau which lets users easily and simply organize data to present the broad spectrum of information in an interactive, filterable, and visually presentable dashboard that facilitates interagency communication and the City's ability to make informed, rapid decisions in response to monitored lake conditions. As an interactive tool, the online dashboard application enables lake managers and stakeholders to ask on-the-fly questions of a large complex dataset based on a specific time period, lake group, or a specific lake. Hosting online makes sharing data easy, with the ability to export the raw data behind the various visualizations embedded into the application. In tandem to developing this visualization application, City staff has been collaborating with other local governmental organizations to standardize sampling practices. This has helped collect data from multiple sources and store it in one centralized place. It is hoped that this tool will be used not only by lake managers to quickly access information, but will eventually engage interested members of the public in learning about their lake ecosystems.

LAKE PRIMA VISTA AND THE CASE OF THE SMOKING GUN

Lance Lumbard[1], *Richard Campanale*[2]
[1]Wood Environment & Infrastructure Solutions, Orlando, FL
[2]City of Ocoee, Ocoee, FL

Lake Prima Vista is a 20-acre lake located within the City of Ocoee about three miles from Lake Apopka. Citrus groves that once surrounded the lake have transitioned to residential development with the exception of the western side of the lake where a blueberry farm began operations in the late 2000s. Beginning in the late 2000s, Lake Prima Vista experienced a persistent cyanobacteria bloom and was subsequently listed as an impaired water due to exceedance of Numeric Nutrient Criteria. The City of Ocoee conducted a study of Lake Prima Vista in 2018 to investigate the source of water quality impairments. The study concluded that nutrients were likely entering the lake from various sources including untreated stormwater runoff but the majority of nitrogen inputs to the lake were found in seepage downgradient of the blueberry farm. Several alternatives for improving Lake Prima Vista's water quality are under consideration including agricultural best management practices; implementation of denitrification technologies and groundwater collection/reuse; chemical inactivation of sediment phosphorus; and stormwater best management practices such as exfiltration systems. The City of Ocoee and Orange County are working with the Florida Department of Environmental Protection to implement a 4e Nutrient Reduction Plan to address the current water quality impairments.

THE EFFECT OF KARST LAKES AND STREAMS ON WATER QUALITY OF WAKULLA SPRINGSHED

Seán E. McGlynn
Wakulla Springs Alliance, Chair, and Florida Water Resources Monitoring Council, Board Member

Their pollutant loading is greater than previously thought. Sinking lakes and streams in the Wakulla Springshed account for 17% of the nitrogen loading to Wakulla Spring, making these the second largest source of nitrogen loading in the Wakulla Springshed (septic tanks are the #1 source). Estimates in the Nitrogen Source Inventory Loading Tool (NSILT) and the subsequent Basin Management Action Plan (BMAP) for the loadings to Wakulla Springs need to be revised to include the loadings from these sinking water bodies. Their pollutant loading was excluded from the NSILT for two reasons: first, the Wakulla Springshed is the only springshed in Florida with sinking streams or sinking lakes and they wanted the BMAPs to be similar for all the springs; and two, and there was a prevailing notion among the regulators that they could not actually fix the problems associated with the sinking lakes and streams.

Hydrological gaging stations were installed (metered stage, rainfall, flow, and other hydrological data) on most of the significant streams and lakes in the springshed due to concerns about flooding, most were funded by FEMA. Using water level data and rainfall collected at the most significant of these separate waterbodies, I evaluated the water quality and hydrologic conditions for seven sinking lake systems (listed in declining order by size): Iamonia, Miccosukee, Lafayette, Jackson, Munson, Bradford Brook Chain of Lakes, and

Killearn Chain of Lakes. I evaluated the water quality and hydrologic conditions for four sinking stream systems (listed by size): Lost, Fisher, Black and Jump Creeks.

Our analysis shows that the sinking waterbodies contribute significantly to the impairment of the water quality of Wakulla Spring and the Upper Wakulla River. These loadings are almost evenly split, 51% for the sinking lakes and 49% for the sinking streams. These findings suggest that the sinking waterbodies, in the Wakulla Springshed, contribute 17% of the total nitrogen load to the Springshed. Their protection and restoration should be a remediation priority of the Basin Management Action Plan since they will be the largest nitrogen source contributor when the septic tank problem is solved. However it is being totally ignored. Even though the BMAP for Wakulla Springs only limits nitrogen, the biological integrity of the spring must become satisfactory for the BMAP to be complete, and thus eventually the impacts of the karst waterbodies in the Wakulla Springshed will have to be dealt with if we are to save Wakulla Spring.

Session B7: Lake Management Tools
Moderator: Dan Schmutz
Friday, August 30, 2019. 10:25 am to 11:40 am

ANALYSIS OF COPPER BASED HERBICIDAL TOXICITY IN EXOTIC APPLE SNAILS

Savannah Berger[1], *Colin Lewis*[2], *Ernesto Lasso de la Vega Ed.D*[2]
[1]Florida Gulf Coast University, Fort Myers, FL
[2]Lee County Hyacinth Control District, Lehigh Acres, FL

Exotic invasive apple snails, *Pomacea maculata*, have been invading Cape Coral canals in South West Florida for the last two decades. Some herbicides, which have copper ions as active ingredient, have shown to be toxic to these snails. This experiment was designed to determine the exact concentration at which copper ions present in water becomes lethal to *Pomacea maculata*, using them as an environmental indicator.

LAKE RESTORATION: IT'S ALL ABOUT THE PHOSPHORUS, NO ALGAE - USING THE REPLENISH TREATMENT SOLUTION

Ed Weinberg, PE
ESSRE Consulting, Inc., Richboro, PA

ESSRE RePleNish treatment solution for dissolved Phosphorus reduction is applicable to all sources and pathways of nutrient pollutant P within a watershed and can be safely applied to nutrient impaired lakes or streams. Specialized adsorptive media removes Legacy P continuously without the need for chemicals and can also serve as a lake nutrient monitoring tool for internal and external lake Phosphorus fluxes.

RePleNish treatment for soluble pollutant P has been demonstrated as farm field edge-of-treatment and at pilot-scale to remove P from ag fertilizer impaired river water. The latter was conducted as a Top Ten Finalist of the George Barley Water Prize sponsored by The Everglades Foundation. That work inspired the concept of deploying ESSRE RePleNish as a measuring, monitoring and modeling tool before attempting HABs mitigation via P reduction in the water column.
This presentation will describe how P flux measuring and monitoring in lake water or ponds at depth enhances the removal of P from overloaded waters more effectively than chemical treatment such as alum dosing.

LINE VS. POINT AERATION DESIGNS: A COST-BENEFIT ANALSYSIS

Patrick Goodwin
Vertex Water Features, Pompano Beach FL

In this study, a cost-benefit analysis is presented for line and point aeration designs. The metrics compared include % water moved or turnover per day, oxygen transfer efficiency's, chlorophyll *a* (chl. a) reduction, labor, capital costs, and operation costs. Published equations for calculating turnover and oxygen transfer were used to compare the efficacy of line and point aeration diffusers at varying depths and densities. Current aeration models were used to assess the efficacy of line and point aeration designs concerning lake chl. *a*. Case studies were used to compare labor, capital, and operational costs. Results indicate that both line and point aeration designs can meet desired aeration objectives. Turnover and oxygen transfer were superior with line diffusers at shallow depths (< 3 m), while point diffusers were superior at deeper depths (> 3 m). Point aeration designs provided greater reductions in chl. *a* at lesser airflow than line aeration designs. Initial capital savings may be provided using line aeration, but long-term maintenance and electrical costs are likely greater. Both line and point aeration designs should be considered on a site by site basis and should account for lakes physical attributes and the aeration objectives at hand. Multiple designs should be presented to stakeholders such that best management practices can be fostered.

UNDERSTANDING THE COMPONENTS OF LIGHT EXTINCTION COEFFICIENTS IN CENTRAL FLORIDA LAKES: A MACHINE LEARNING PERSPECTIVE

Dan Schmutz, M.S.[1], Rolland Fulton Ph.D.[2]
[1]GPI, Orlando, FL
[2] St. Johns River Water Management District, Palatka, FL

Light extinction coefficients are important to predicting the abundance and distribution of submerged aquatic macrophytes. Light extinction coefficients can be measured directly or inferred from various water quality characteristics (e.g., chlorophyll A, turbidity, color, etc.). A machine learning approach of developing and testing statistical models both within and between eight Central Florida lakes was used to identify the most important water quality characteristics for predicting light extinction coefficients.

Poster Session
Moderators: Gloria Eby & April Verpoorten
Wednesday, August 28, 2019. 6:00 pm to 8:00 pm

MUCK REMOVAL WHERE, WHY, HOW, AND AT WHAT COSTS

Richard Bryan
Lake Powell Community Alliance, Panama City Beach, FL

The poster presentation indicates the geographical areas already identified as having significant muck deposits. Known areas of deeper water, shallow water and areas in need of investigation for purposes of decision-making are noted on a bathymetric map furnished by Lakewatch. Current research on the benefits of muck in certain areas will be presented as it relates to Lake Powell with graphic representation. The dangers of environmental harm will also be noted. Specific sampling of areas of concern will be indicated graphically and in abbreviated written form with cost estimates for services provided by reputable vendors. Treatment and removal methods with cost/benefit factors will reveal the possibilities both logistically and financially to define the project to be adopted. The feasibility will be determined by comparative analysis for the purpose of decision-making. This will be displayed on a chart for ease of understanding. Various potential funding sources will be listed. A variety of timelines for planning and implementation including seasons, vendor availability, grant times for availability, local staffing, and the best time for volunteer participation will yield information for the Lake Powell Community Alliance Board of Directors to initiate the project or projects to go forward.

LAKE APOPKA SUBMERGED AQUATIC HABITAT ON THE ROAD TO RECOVERY

Kendall Fioravante, Jodi Slater, Jim Peterson
St. Johns River Water Management District, Palatka, FL

Lake Apopka, the fourth largest lake in Florida, historically supported one of the state's most productive fisheries and an abundance of submerged aquatic habitat. As a result of decades of nutrient loading and chronic eutrophic conditions, submerged aquatic vegetation vanished from the lake along with game fish populations. The recovery of submerged aquatic habitat (SAH), which is the cumulative area of both submerged aquatic vegetation (SAV) and emergent floating vegetation (EFV), is essential to the restoration of historic water quality and fish habitat in Lake Apopka. Over the last decade, Lake Apopka has seen an expansion of total lakewide SAH as a result of improving water quality, planting efforts, and natural recruitment and expansion. Species currently present within the lake include eel grass (*Vallisneria americana*), coontail (*Ceratophyllum demersum*), southern naiad (*Najas guadalupensis*), and muskgrass

(*Char sp*.), as well as the floating species spatterdock (*Nuphar advena*), Mexican water-lily (*Nymphaea mexicana*), American water-lily (*Nymphaea odorata*), and yellow lotus (*Nelumbo lutea*). Since 1995, monitoring has been intermittent, and methodology adapted over time to meet the gradually increasing presence of SAV. In 2011, a rigorous random stratified sampling method of the lake perimeter was implemented in order to produce an annual lakewide estimate of total SAH acreage. This was adapted in 2018 and 2019 to include a presence/absence study of SAV and EFV along the entire lake perimeter, as well as an attempt to delineate all surviving planted SAV and EFV. In 2018, SAH was present at 75% of Lake Apopka's perimeter and a total of 109.1 acres of naturally occurring SAH was estimated. Additionally, a total of approximately 110 acres of planted EFV were identified in 2018.

SEAGRASS MAPPING IN THE INDIAN RIVER LAGOON: RECENT TRENDS AND A RE-EVALUATION OF SEAGRASS DEPTH LIMIT TARGETS

Lauren Hall,[1] *Ali Simpson*[2], *Lori Morris*[2], *Charles Jacoby Ph.D.*[2]
[1] St. Johns River Water Management District, Melbourne, FL
[2] St. Johns River Water Management District, Palatka, FL

Seagrass represents critical habitat in the Indian River Lagoon (IRL). Several state and federal programs recognize seagrass mapping as an essential stratagem for setting goals for restoration, evaluating success, and adapting management where necessary. Mapping has been done for 1943 and approximately every 2-3 years since 1986, with 2019 mapping underway. A union coverage based on maps from 1943 through 1999 was used to establish targets for the deep edges of seagrass beds in Banana River Lagoon and the north and central portions of the Indian River Lagoon. These targets were used to estimate sustainable total maximum daily loads (TMDLs) for nutrients, and the targets are used to evaluate the success of restoration. Success is evaluated using the deep edges of the union coverage that generated the targets and a union coverage created with the four most recent maps. Points are distributed along the deep edges of seagrass beds in both coverages. Step one involves comparing the cumulative frequency distributions of depths for both sets of points. Success is declared if the median and at least 50% of the points from the recent maps are deeper than those from the maps used to create the target. Step two compares medians for each of the recent four years to the median for the target coverage, with success declared if three of the four recent years had medians deeper than the target. Large declines in acres of seagrass have been observed since 2011, due to several years of algal blooms. Likewise, median depth limits have decreased. One challenge to continued use of the two-step evaluation is a reduction in the number of suitable points. A plan to cope with this challenge is being formulated in collaboration with the Florida Department of Environmental Protection.

THE EFFECTS OF ALGAECIDES AND HERBICIDES ON A *MICROCYSTIS* WINTER BLOOM IN LAKE OKEECHOBEE, FLORIDA

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Microcystis-dominated cyanobacterial harmful algal blooms (cyanoHABs) are a reoccurring problem within the Lake Okeechobee Waterway resulting in widespread economic and health impacts. As public awareness on the risks of blooms increases, there is an urgent need for studies on both short-term and long-term management of cyanoHABs. In order to provide science-based best management practices or eradication/treatment options, we tested various concentrations and combinations of algaecides and herbicides. Bloom waters were collected from Lake Okeechobee in November/2018 and were dominated by *Microcystis wesenbergii*, with some *M. aeruginosa* and *Dolichospermum circinale* colonies present. The bloom material was exposed to fifteen different algaecides, herbicides, or combinations, using four different concentrations. Cell abundance and morphology, chlorophyll a/b, phycocyanin and microscopic analyses were undertaken at the time of collection and 24 and 72 hours post-treatment. Microcystin concentrations were measured from the crude bloom, but were determined too low to undertake microcystin degradation analyses. Overall, the effectiveness of the chemicals varied. The most efficacious at treating this bloom included sodium carbonate peroxyhydrate, copper sulfate pentahydrate, copper ethanolamine complex, and combinations of diquat dibromide with endothall, copper gluconate/citrate, and/or copper ethanolamine. Other promising treatment methods included combinations of flumioxazin with copper gluconate/citrate and endothall with liquid H_2O_2. Some chemicals, including liquid H_2O_2 and endothall alone, were unable to deplete cyanobacterial abundance and therefore considered an ineffective treatment option for the treatment of *M. wesenbergii*-dominated blooms. Future work aims at treating toxic blooms and monitoring cell abundance together with toxin production and release for effective treatments *in situ*.

RESTORATION OF CLAM POPULATIONS IN THE INDIAN RIVER LAGOON FOR WATER QUALITY IMPROVEMENT

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Hard clams have historically been significant contributors to healthy water quality in the Indian River Lagoon (IRL) via filter feeding that both reduces turbidity from algae and detritus and removes organic nutrients from the water column and deposits them in sediments. Unfortunately, overfishing and environmental degradation have led to the collapse of native clam populations in the IRL. We propose to leverage recent environmental stressors (algal blooms, hypoxia) that have naturally selected for the hardiest, most stress resistant filter-feeding bivalves in the IRL, by collecting surviving individuals of historically abundant species (including hard clam, *Mercenaria mercenaria/campechiensis,* sunray

venus clam, *Macrocallista nimbosa* and possibly others) in these environmentally stressed areas for use in ecosystem restoration. Objectives of this project are: (1) collect broodstock from impacted areas of the IRL, (2) spawn and grow out clams to planting size in nursery facilities (3) repatriate nursery-raised native clam populations to selected clam leases (in partnership with the aquaculture industry), (4) monitor survivorship during course of project, and (5) conduct surveys of existing populations along historical transects to provide a baseline for future comparisons of restoration success and regional stock assessments. Project areas for collection and repatriation of clams will be chosen along the northern, central and southern IRL system, including the Mosquito and Banana River lagoons. To date we are successfully rearing the progeny of adult *Mercenaria* clam survivors (6-8 years old) that were collected in the Mosquito Lagoon. At project's completion we expect to establish a stress-tolerant broodstock for use in restoration and aquaculture, successfully repatriate a minimum of 2-3 million clams with volunteer participation, document survivorship, and provide a summary report synthesizing efforts, techniques, and results, along with recommendations for future clam restoration efforts in the IRL.

INNOVATIVE GEOPHYSICAL STUDY INDIAN RIVER LAGOON ROCKLEDGE, FLORIDA

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The purpose of the test survey was to verify that a new geophysical survey system, Aquares, developed and widely used throughout the UK, would accurately acquire subsurface geophysical data in the Indian River Lagoon, specifically identifying the interface of contaminated and non-contaminated sediments for muck removal dredging projects. Test results were compared to probes, core borings, dual frequency sounding and other historic data. The geophysical survey was performed simultaneously during the bathymetric survey, providing a georeferenced model of the surface and subsurface to be excavated. The system measures the electrical resistance of subsurface structures in ohms. Sediments such as silt record values of 0.01 ohm while firm materials such as stiff clay and rock record much higher resistivity readings. All changes in the subsurface are observed in a color coded 4D geophysical model (X,Y,Z & Ohm) By observing changes in the subsurface model, engineers, environmentalists, planners, owners, contractors, etc. now have a basis for selecting the location of sediment identification core borings rather than using best guess practices. The Aquares system substantially reduces the number of core borings required to describe subsurface conditions on dredging projects and can describe 100% of the project subsurface.The test survey at Rockledge showed great promise to serve the dredging industry with greater success. ArcDMC not only identified the quantity and interface of contaminated sediments to be excavated, but also proved that the contaminated sediments were mostly contained in specific locations and not across the width of the waterway as previous determined by probes.

THE RETURN OF LAKE APOPKA'S SUBMERGED AQUATIC HABITAT – RESTORING ADAPTIVELY TO MAXIMIZE SUCCESS

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Persistent algal blooms, abundant flocculent material and aquatic macrophyte loss have plagued Lake Apopka since the 1950s. Submerged aquatic habitat (SAH) restoration on a large spatial scale has the potential to supplement natural expansion and improve local environmental conditions by stabilizing sediments, increasing water clarity and assimilating nutrients; therefore, revegetation is a priority for water managers (St. John's River Water Management District [SJRWMD]) to improve lake conditions. Restoration of this lake to its original macrophyte-dominated state with clear water and abundant fisheries still faces difficulties due to the persistent environmental conditions that continue to stress or limit aquatic plant reproduction and expansion in Lake Apopka. Initial improvements in water quality along with previous restoration planting efforts have allowed the reestablishment of SAH in recent years. SJRWMD is now using an adaptive approach to monitor existing SAH, estimate lake-wide extents of naturally recruited or expanded SAH, track successful establishment and persistence in planted restoration areas, and to identify areas most suitable for future SAH planting efforts. Multiple projects are currently underway that will 1) more accurately measure the quantity and composition of SAH naturally occurring in the lake, 2) plant more SAH in the lake, including reintroducing pondweed (*Potamogeton illinoensis)* - a native species that had been locally eradicated and 3) determine the best path forward for future large-scale planting efforts in order to maximize SAH survival and persistence

CHALLENGES TO PREDICTING CONCENTRATIONS OF CHLOROPHYLL *A* USING MULTI-SPECTRAL SATELLITE IMAGERY

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Data from an existing network of sites where water quality is sampled monthly were combined with reflectance values from multi-spectral satellites to predict concentrations of chlorophyll *a* in the Indian River Lagoon. Regressions were developed using ratios of reflectance values in the green and blue bands of multiple sensors, and the resulting models were evaluated for accuracy using field data. Coefficients in the most useful models were specific to the sensor that captured the reflectance values. However, for a given sensor, the means of the deviations from field data were not consistent through time, with concentrations of chlorophyll *a* being underpredicted or overpredicted across whole images for some dates. Within an image, deviations from field data were largest in areas with high turbidity or where *Aureoumbra lagunensis* (brown tide) dominated the phytoplanktonic assemblage. A specific model was developed for brown tides, and residual kriging was explored as a tool to correct local deviations and scene-wide deviations.

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