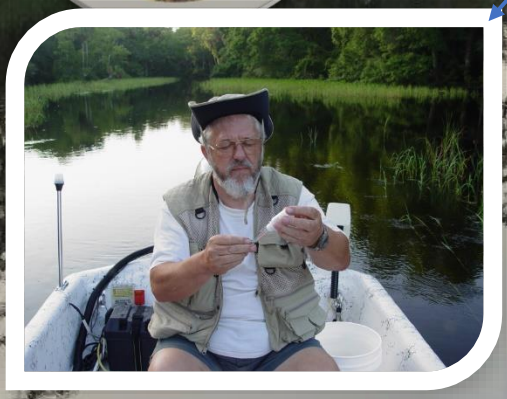
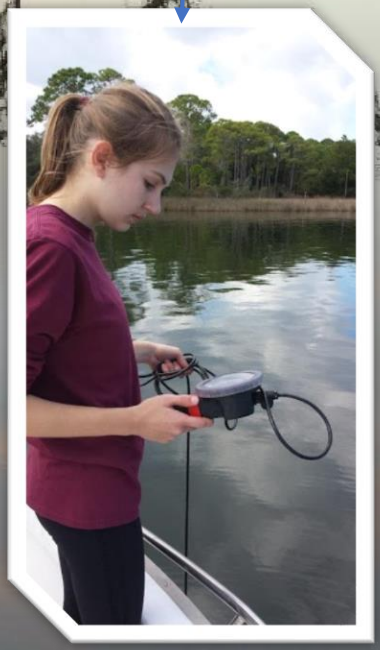
Florida Lake Management Society
32nd Annual Technical Symposium
Theme: Citizen Involvement in Aquatic Resource Management

Florida Lake Management Society
FLMS





August 31 to September 3, 2021
Hawks Cay Resort
Duck Key, Florida

Florida Lake Management Society

32nd Annual Technical Symposium

August 31st - September 3rd, 2021

Hawks Cay Resort, Duck Key, Florida

Program Theme:

Citizen Involvement in Aquatic Resource Management

SYMPOSIUM PROGRAM

TABLE OF CONTENTS

TUESDAY – August 31, 2021- WORKSHOPS

Overseas Ballrooms

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

8:15 – 12:00 pm	**Workshop 1: Algal Identification in the Environment. - Part 1**. Dr. Dail Laughinghouse, Assistant Professor and Dr. 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)
8:15 – 12:00 pm	**Workshop 2: Oxygenation and Circulation Techniques to Improve Water Quality. – Part 1.** Paul Gantzer, Ph.D., P.E. – Gantzer Water LLC, and Patrick Goodwin M.S., CLM – Vertex Aquatic Solutions.
8:15 – 12:00 pm	**Workshop 3: Geospatial Data Science with R. – Part 1.** Dan Schmutz, M.S., Greenman Pedersen, Inc.

10:00 – 10:15 am	**MORNING BREAK**
12:00 – 12:45 pm	**LUNCH** (*provided with full-day Workshop registration*)
2:30 – 2:45 pm	**AFTERNOON BREAK**

12:45 – 4:15 pm	**Workshop 4: 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 – 4:15 pm	**Workshop 5 Oxygenation and Circulation Techniques to Improve Water Quality – Part 2.** Paul Gantzer, Ph.D., P.E. – Gantzer Water LLC, and Patrick Goodwin M.S., CLM – Vertex Aquatic Solutions. **(Part 1 am workshop required)**
12:45 – 4:15 pm	**Workshop 6: : Geospatial Data Science with R. – Part 2.** Dan Schmutz, M.S., Greenman Pedersen, Inc. **(Part 1 am workshop required)**

WEDNESDAY – September 1, 2021 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)

8:30-8:40 AM **Welcome & Opening Remarks: Serge Thomas, Outgoing FLMS President**

8:40-10:00 AM **Citizen Science Programming Round Table:**

Round table discussion about citizen science programs for aquatic resource management – *Mark V. Hoyer, Melissa Harrison, Maryann Krisovitch & Ernesto Lasso de la Vega*

10:00-10:45 AM **MORNING BREAK** (Exhibit Hall - Dolphin Ballroom)

Session A1: Citizen Science in Action (Overseas Ballroom)

Moderator: Ernesto Lasso De La Vega

10:45-10:50 AM	*Session Introduction*
10:50-11:05 AM	Volunteer-Collected Water Quality Data can be Used for Science and Management - *Mark V. Hoyer*
11:05-11:20 AM	Leveraging Benefits of Web GIS for Connecting with the Public Concerning Invasive Plant Control - *Chad Minteer*
11:20-11:35 AM	Free and Easy - Lake Water Quality Data When You Want It - *Jerome "Jay" Madigan*
11:35-11:50 AM	Seminole County Serv Program: Involving Citizens in Watershed Stewardship - *Elizabeth Stephens*
11:50-12:00 PM	*Session Q&A*

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

WEDNESDAY – September 1, 2019 AFTERNOON

Session A2: Lake Management (Overseas Ballroom)

Moderator: Harvey Harper Ph.D.

1:30-1:35 PM	*Session Introduction*
1:35-1:50 PM	Winter Haven Lakes Report: A More Comprehensive Lake Health Evaluation and Management Tool - *Devon Moore & Savannah Winstanley*
1:50-2:05 PM	Water Quality, Sediment, and Ecological Impacts from 25 Years of Alum Additions to Lake Holden - *Harvey H. Harper, Ph.D., P.E.*
2:05-2:20 PM	Seepage Meters: A Window into the Inner Workings of a Lake - *James Preston*
2:20-2:35 PM	Phosphorus Filtration: A Proactive Management Tool for Flowing Water - *Rory Roten Ph.D.*
2:35-2:45 PM	*Session Q&A*
2:45-3:30 PM	**AFTERNOON BREAK** (Exhibit Hall - Dolphin Ballroom)

Session A3: Nutrient Evaluation and Reduction (Overseas Ballroom)

Moderator: Mary Szafraniec Ph.D.

3:30-3:35 PM	*Session Introduction*
3:35-3:50 PM	Use of Peroxyacetic Acid (Pa)/Hydrogen Peroxide in Freshwater Cyanobacterial Control-Cased Study of Lab Scale Trails and Treatments in Relation to Florida Treatment Site - *Tom Warmuth*
3:50-4:05 PM	In-Lake Phosphorus Mitigation for the Restoration of Impaired Lakes - *Scott Shuler*
4:05-4:20 PM	Using Advancements in Pollutant Source Tracking to Hunt for Hot Spots in Mixed-Use Watersheds - *Mary Szafraniec Ph.D.*
4:20-4:30 PM	*Session Q&A*

WEDNESDAY – September 1, 2021 AFTERNOON (Cont.)

Session A4: UAVs in Water Resources (Overseas Ballroom)

Moderator: Serge Thomas Ph.D.

4:30-4:35 PM	*Session Introduction*
4:35-4:50 PM	Unmanned Aircraft Systems as Part of an Invasive Plant Management Program - *Bill Reynolds*
5:50-5:05 PM	Do Drones Swim? How CCI Teamed-Up Unmanned Aerial System and Bathymetric Sonar to Help Restore Lake Cane - *Jerome "Jay" Madigan*
5:05-5:20 PM	Does lush green vegetation equate to green stormwater ponds? - *Serge Thomas Ph.D.*
5:20-5:30 PM	*Session Q&A*

WEDNESDAY – September 1, 2021 EVENING

6:00-8:00 PM	**EXHIBITORS' SOCIAL** (Exhibit Hall – Dolphin Ballroom)

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

Moderators: Rob Burnes

1. Florida Species and Habitat Monitoring Programs Catalog (Terra-CAT) - *Amanda Christiansen*
2. Evaluating Waterway Quality Via Microbial Community Monitoring - *Michael Kratz*
3. Taxonomic Assessment and Composition Analysis of Cyanobacteria Present in Lake Okeechobee Freshwater Samples - *Julia Davis*
4. Fish predation of Microcystis aeruginosa bloom observed in the Caloosahatchee River, Florida - *Taylor Hancock*
5. Microcystis aeruginosa Growth Inhibition by Three Chemical Treatments- Insight for Ecological Mitigation Methods - *Elizabeth Dahedl*
6. Using Multispectral Imagery in Natural Resource Management - *Rex Ellis Ph.D.*

THURSDAY – September 2, 2021 MORNING

(* - Denotes student paper)

8:00 AM-5:00 PM	**Check-In and Registration** (Dolphin Foyer)
7:00 AM-8:45 AM	**Breakfast** (Dolphin Ballroom)

Morning Program (Overseas Ballroom)

8:45-9:00 AM	**Welcome & Opening Remarks:** Gloria Eby, Incoming FLMS President
9:00 -10:00 AM	**Keynote Speaker**: Jennifer Hecker, Coastal and Heartland National Estuary Program

10:00-10:45 AM	**MORNING BREAK** (Exhibit Hall – Dolphin Ballroom)

Session A5: Nutrient Studies (Overseas Ballroom)

Moderator: Eesa Ali

10:45-10:50 AM	*Session Introduction*
10:50-11:05 AM	Diving into the Lake from the Lab: Scaling Up Sediment Treatment Alternatives Analysis from Bench Scale to In-Situ Mesocosm - *Francesca Lauterman*
11:05-11:20 AM	Nitrogen Removal from Stormwater with Biosorption Activated Media; How Does It Actually Happen and Why Does It Matter? - *Andrew Charles Hood, PhD, EI*
11:20-11:35 AM	Nutrient Recycling in Wetland Soils for Crop Production in Southwest Florida: A Wetlaculture™ Experiment - *Hannah Hartzler**
11:35-11:50 AM	Challenges in Quantifying Lacustrine Groundwater Flux - *Daniel Canfield**
11:50-12:00 PM	*Session Q&A*

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

THURSDAY – September 2, 2021 AFTERNOON

(* - Denotes student paper)

Session A6: Aquatic Vegetation in Water Resources Management (Overseas Ballroom)

Moderator: Ron Hart

1:30-1:35 PM	*Session Introduction*
1:35-1:50 PM	Establishing Vegetation under Harsh Conditions Using Anionic Polyacrylamide - *Eddie Snell*
1:50-2:05 PM	Fighting Nutrient Pollution with the Aquatic Plant *Vallisneria americana*; Tape Grass - *Brondum Krebs**
2:05-2:20 PM	Status Update on Submerged Aquatic Habitat in Lake Apopka - *Jodie Slater*
2:20-2:35 PM	The Ecology of Submersed Aquatic Vegetation Communities under Management in Select Florida Lakes - *Jacob Thayer**
2:35-2:45 PM	*Session Q&A*

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

Session A7: Algal Evaluation and Control (Overseas Ballroom)

Moderator: Rob Burnes

3:15-3:20 PM	*Session Introduction*
3:20-3:35 PM	Understanding the Physiological Impact of Glyphosate on Cyanobacteria and Green Algae in a Competition Experiment - *Barry Rosen Ph.D.*
3:35-3:50 PM	Farm Field Reduction of Phosphorus Losses for Proactive Lake HABs Mitigation - *Ed Weinberg P.E.*
3:50-4:05 PM	Investigation of Unusual Algal Blooms within Lake Minneola - *Lance Lumbard*
4:05-4:20 PM	Hydrogen Peroxide in Subtropical Aquatic Systems and its Application for Cyanobacterial Bloom Control -*Hidetoshi Urakawa Ph.D.*
4:20-4:30 PM	*Session Q&A*

6:15 PM	SUNSET CRUISE STUDENT SCHOLARSHIP FUNDRAISER – Lagoon Dock, (Details & Tickets at Registration Desk)

FRIDAY – September 3, 2021 MORNING

(* - Denotes student paper)

7:00 AM-8:45 AM	**Breakfast** (Dolphin Ballroom)

8:45-9:00 AM Announcements: Gloria Eby, Incoming FLMS President

Session A8: Resource Management (Overseas Ballroom)

Moderator: Patrick Goodwin

9:00-9:05 AM *Session Introduction*

9:05-9:20 AM Distribution and Concentration of Polycyclic Aromatic Hydrocarbons (PAH's) in Southwest Florida Surficial Sediments - *James Javaruski**,

9:20-9:35 AM What's Poppin': The Impact of Nanobubbles on Microcystis for the Chemical-Free Control of Harmful Algae - *Christian Ference*

9:35-9:50 AM Using PAM to Build and Maintain Artificial Ponds - *Eddie Snell*

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

10:00-10:35 AM	**MORNING BREAK** (Exhibit Hall – Dolphin Ballroom)

Session A9: Lake Management Tools (Overseas Ballroom)

Moderator: Dan Schmutz

10:35-10:40 AM *Session Introduction*

10:40-10:55 AM A General Approach to Hydrologic Recovery Metric Development with Application to Geographically Isolated Wetlands and Lakes in Xeric Landscapes - *Dan Schmutz*

10:55-11:10 AM Using Polyaluminum Chloride (PACL) for Phosphorus Removal in Lake Remediation - *Brad Key*

11:10-11:25 AM Self-Funding Nutrient Management and Carbon Sequestration - *Kyle Jensen*

11:25-11:35 AM *Session Q&A*

11:35 -12:00 PM	Student Awards and Closing Remarks – Gloria Eby, 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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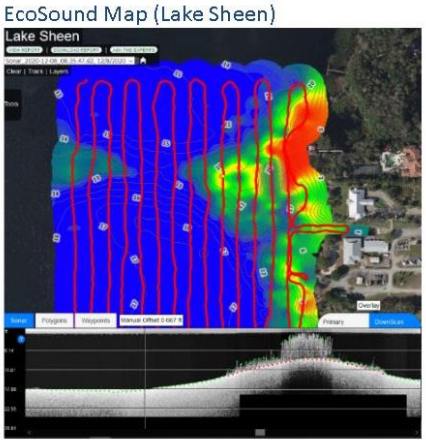
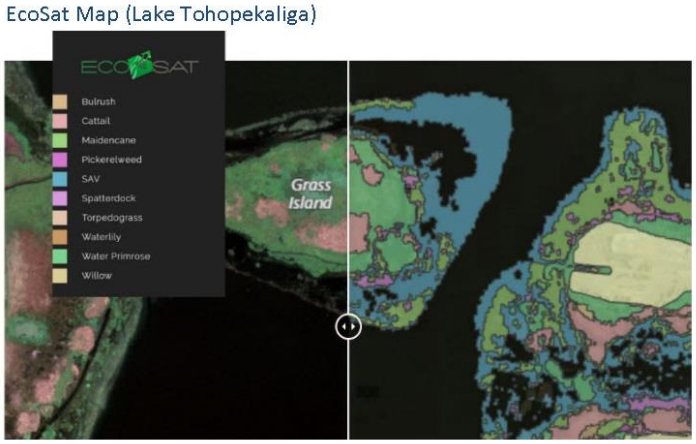
EcoSound Map (Lake Sheen)



EcoSat Map (Lake Tohopekaliga)



Florida Lake Management Society
FLMS

The Florida Lake Management Society Greatly appreciates the support of our generous exhibitors and sponsors.

We couldn't do it with you! Thank you!

Thursday Keynote Speaker

Jennifer Hecker

Jennifer Hecker is the Executive Director of the Coastal & Heartland National Estuary Partnership (CHNEP, formerly the Charlotte Harbor National Estuary Program), responsible for working with diverse stakeholders and local, state and federal govts. to restore and protect the water resources in the CHNEP area in Central and Southwest Florida. She serves as a Science Advisory Committee member to Everglades Restoration as well as the Chair of the Environmental Advisory Committee for the Southwest Florida Water Management District.

Prior to joining CHNEP, Jennifer was the Director of Natural Resource Policy for the Conservancy of Southwest Florida, specializing in water resource and listed species policy, everglades restoration, environmental lands acquisition and management and natural resources legislation. In her 12+ years that capacity, Jennifer served on numerous boards including the national Great Waters Coalition, Everglades Coalition, Florida Coastal and Oceans Coalition, CREW land and Water Trust and Southwest Florida Watershed Council. Before the Conservancy, Jennifer was a Project Ecologist for WilsonMiller and had worked for Hillsborough County, FL as an Environmental Specialist in their Environmental Lands Acquisition and Management Program.

Her educational background includes a Bachelors in Environmental Studies from Prescott College, a graduate degree in Tropical Biology and Conservation from University of Missouri-St. Louis. She has been selected by Florida Weekly to be a "Power Woman of Southwest Florida", is an alum of Leadership Collier, has been qualified as a water quality expert in a court of law, and was appointed by the Florida Department of Environmental Protection to its Statewide Stormwater Technical Advisory Committee. Having worked for government, for-profit, and the non-profit sectors, Jennifer embraces an approach of involving diverse stakeholders to protect and restore the exceptional natural resources in Florida.

In memory of our dear friend
Marissa L. Williams
1985 - 2021

Marissa Williams devoted her life to promoting an understanding of and active involvement in Florida's aquatic resources. As the Natural Resource Office at the City of Casselberry, she managed water quality and aquatic vegetation in the city's surface waters and waterways. She also led their environmental education program directly working with citizens. She worked as the Coordinator and Project Director for the Cambrian Foundation, planning and organizing expeditions and volunteers throughout Florida that focused on water quality projects. She served as the Stormwater and Lakes Management Coordinator for the City of Maitland and as a Regional Biologist for the Department of Environmental Protection working on aquatic plants, notably lakefront permitting for vegetation removal and maintenance.

Marissa was a valuable part of every team she worked and build strong connections with every person she met. Many of us were privileged to have been a part of her passion and devotion to improve humanity's connection to the aquatic environment. Her service on the Florida Lake Management Society's Board of Directors contributed to our goal for FLMS conferences to be of benefit to all participants and, indirectly, the aquatic environment. Many of you who joined FLMS for our first virtual symposium saw Marissa as our moderator during several sessions.

On April 24, 2021, Marissa unexpectedly passed away. There is a gap without her cheerful smile and enthusiastic approach to making positive change for the environment. However, her legacy continues with the lifetime of work she's completed on behalf of Florida's aquatic resources. We at the Florida Lake Management Society are honored to present this year's Marjorie Carr award in her memory. Thank you, Marissa for your lasting impact. You will be forever missed.

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Tiffany Trent, St Johns River Water Mgmt District

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Lee County Hyacinth Control District

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Gloria Eby, Seminole County
Rory Roten, SePro Corporation
Eesa Ali, Flatwoods Consulting Group

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FLMS 2021 AWARDS OF EXCELLENCE

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

THE MARJORIE CARR AWARD

presented to

Marissa L. Williams

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

Deborah Shelley

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

Bill Smith, The News Press

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

Bob Knight

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.*

THE RICHARD COLEMAN AWARD

presented to

Ed Hayes

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

LagoonWatch

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 MARISSA L. WILLIAMS YOUNG PROFESSIONAL AWARD

presented to

Joey Cordell

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.*

THE BOB GRAHAM AWARD

presented to

Seminole County Commissioner Bob Dallari

The Bob Graham Award *is given to persons elected to office who demonstrate a commitment to lake and aquatic resource conservation. Bob Graham is remembered for his support of many environmental initiatives including the purchase for preservation of thousands of acres of Gulf Coast wetlands.*

FLMS 2020 AWARDS OF EXCELLENCE

The Board of Directors is pleased recognize last year's award winners!

THE MARJORIE CARR AWARD

presented to

Dr. Sherry Brandt

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. Michael Netherland

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

WGCU – Gulf Coast Live

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

Leesa Souto

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.*

THE RICHARD COLEMAN AWARD

presented to

Kelli Hammer-Levy

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

Lee County Pond Watch

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 MARISSA L. WILLIAMS YOUNG PROFESSIONAL AWARD

presented to

Dawn Ritter

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.*

PRESIDENT'S AWARD

presented to

John Gardner

The President's Award is given at the discretion of the FLMS President, for contributions by individuals on behalf of the society.

Session Abstracts

Session A1: Citizen Science in Action
Moderator: Ernesto Lasso De La Vega
Wednesday, September 1, 2021. 10:45 am to 12:00 pm

VOLUNTEER-COLLECTED WATER QUALITY DATA CAN BE USED FOR SCIENCE AND MANAGEMENT

Mark V. Hoyer & Daniel E. Canfield Jr.
University of Florida, Gainesville, Florida

This study addresses concerns that comparison studies between professional and volunteer-collected data have been of limited scope, conducted under experimental conditions, and that results may not be applicable to existing large-scale, long-term volunteer monitoring datasets. Historical (2008 to 2019) phosphorus, nitrogen, chlorophyll, and Secchi data collected by 5 Florida organizations charged with monitoring water quality were compared with Florida LAKEWATCH volunteer-collected data from 216 lakes. The state organizations had National Environmental Laboratory Accreditation Conference (NELAC)-certified laboratories and LAKEWATCH used modified procedures needed to accommodate a volunteer program. The lakes are located in central Florida, range in trophic status from oligotrophic to hypereutrophic, and provided approximately 650 independent overlapping annual geometric mean pairs for comparison. Paired t-tests comparing logarithmic transformed annual geometric mean data pooled from all professional organizations with similar overlapping volunteer-collected data showed significant ($P<0.05$) differences for phosphorus, nitrogen, and Secchi depth but not for chlorophyll. The significant differences when reported arithmetically were only 1.1 mg/L, 1.1 mg/L, and 0.1m, respectively. Regression analyses on the same data showed strong significant ($P<0.05$) relations with coefficient of determinations (R2) of 0.91, 0.98, 0.79, and 0.78 for phosphorus, nitrogen, chlorophyll, and Secchi depth, respectively. Slopes for each paired regression were not significantly different from 1. These results demonstrate that volunteer-collected data were equivalent to data collected professionally, that the quality of volunteer data can be similar to that produced by NELAC-certified laboratories, and thus that data are adequate for both research and management.

LEVERAGING BENEFITS OF WEB GIS FOR CONNECTING WITH THE PUBLIC CONCERNING INVASIVE PLANT CONTROL

Chad Minteer
Frontier Precision, Jacksonville, Florida

Managing aquatic resources includes controlling invasive plants using environmentally sound practices based on an integrated pest management (IPM). Public education and engaging constituents are also critical

components of an IPM. How can agencies communicate effectively with the public without taking valuable resources needed for control activities?

FieldSeeker GIS for Invasive Plant Control software is a cloud-based system leveraging the Esri ArcGIS Online Platform. It is a complete solution for mapping and reporting Integrated Pest Management Plan activities related to invasive plant control. Examples will include benefits gained from using Web GIS to increase efficiencies, measuring the effectiveness of control activities, and sharing maps and data with contractors and the public.

FREE AND EASY - LAKE WATER QUALITY DATA WHEN YOU WANT IT.

Jerome "Jay" Madigan
Lake Cane Restoration Society, Orlando, Florida

This paper describes how the Lake Cane Restoration Society (LCRS), a swimmer-scientist educational 501(c)3 dedicated to protecting central Florida lakes, engages the community in environmental concerns. Collaborating with Lucky's Lake Swim using a series of fun, athletic, and cultural events LCRS accomplished strategically defined water quality goals using the Water Rangers affordable water testing. By aggregating other similarly situated lake's data through shared testing cohorts, training, protocols and by making data gathering free and quickly available, each participating lake established a baseline from which they can measure progress toward restoration goals.

SEMINOLE COUNTY SERV PROGRAM: INVOLVING CITIZENS IN WATERSHED STEWARDSHIP

Elizabeth Stephens
Seminole County Watershed Management Division, Sanford, Florida

The Seminole Education, Restoration, and Volunteer (SERV) Program of Seminole County Public Works, Watershed Management Division (WMD), has involved citizens in aquatic resource management for over 20 years. In that time, the program has held over 2,450 volunteer and education events and has connected with over 16,500 volunteers. Volunteers are trained to reduce polluted run-off in the County's watersheds through stormdrain marking and litter clean-ups. Participants learn how to improve water quality by revegetating shorelines, and how to reduce the threat of invasive species in waterways by removing harmful plants. SERV educational outreach efforts help citizens minimize pointless personal pollution by identifying connections between daily activities and waterway health. The SERV Program also provides enrichment opportunities for students to work directly with WMD biological staff at volunteer events and via staff shadowing, thereby encouraging future careers in watershed stewardship. All SERV Program activities contribute to the fulfillment of NPDES requirements for Seminole County, and reflect the mission of WMD to protect, conserve, and restore the County's valuable water resources.

Session A2: Lake Management
Moderator: Harvey Harper Ph.D.
Wednesday, September 1, 2021. 1:30 pm to 2:45 pm

WINTER HAVEN LAKES REPORT: A MORE COMPREHENSIVE LAKE HEALTH EVALUATION AND MANAGEMENT TOOL

Devon Moore & Savannah Winstanley
Natural Resources Division, City of Winter Haven, Winter Haven, Florida

Known as the 'Chain of Lakes City', the City of Winter Haven works with multiple agencies to manage over 35 public lakes within its municipal limits. In 2017, the City began development of a monitoring, reporting, and planning document to improve the effectiveness of its lake management and public outreach efforts—known as its Annual Lakes Report. The current iteration of this report incorporates a multi-metric lake evaluation methodology, development of data-driven and trackable management goals, and the creation of a public education tool targeting both technical and general audiences. In addition to the static report is an interactive online StoryMap created using Tableau and ESRI tools. Over the last four years, the City has observed an exponential increase in viewership and public engagement as well as positive reception from its various partnering agencies. City staff are dedicated to continually improving upon the scope and format of the report and dashboard; incorporating the latest data collection and analytical methods to ensure its lake management programs remain effective.

WATER QUALITY, SEDIMENT, AND ECOLOGICAL IMPACTS FROM 25 YEARS OF ALUM ADDITIONS TO LAKE HOLDEN

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

Lake Holden is a 263-acre land-locked urban lake located in Orlando, Florida. The 741 acre watershed is densely developed with industrial, commercial, and residential land use. Continued inputs of untreated stormwater runoff over many years caused severe water quality degradation in Lake Holden with hyper-eutrophic conditions characterized by elevated nutrient concentrations, severe algal blooms, and fish kills. During the early 1990s Lake Holden ranked second only to Lake Apopka as the most polluted lake in Central Florida.

Alum stormwater treatment was initiated during 1995 for the 3 major runoff inflows which reduced in-lake TP concentrations by approximately 50%. Alum sediment inactivation projects were conducted during 2005-2006 and 2010, further reducing inlake TP concentrations to 10 ppb and converting the lake to oligotrophic conditions. Since 1995, approximately 875,000 gallons of alum have been added to Lake Holden, equivalent to an areal dose of 187 g Al/m2.

Sediment core samples were collected during 2003, 2007, 2008, 2012, and 2020 which show a reduction in available sediment P and increases in aluminum-bound P. A wide variety of submerged vegetation has blanketed the lake bottom to depths of 10 ft or more. A 2012 study by the Florida DEP concluded that Lake Holden has an extensive, stable, and healthy plant community, dominated primarily by native beneficial aquatic plants. Phytoplankton data indicate stability and balance in the algal community with a low potential for armful algal blooms. Macroinvertebrate data suggest stability and balance in the benthic community, which is composed of macroinvertebrates usually associated with good water quality.

SEEPAGE METERS: A WINDOW INTO THE INNER WORKINGS OF A LAKE

James Preston, Lance Lumbard, Andrew Hood, Robert Sheridan and Craig Duxbury
Wood Environment & Infrastructure Solutions, Inc. Altamonte Springs, Florida

Water quality within lakes is influenced by many internal and external factors. Lake managers focus on stormwater runoff as the primary source of potential contaminants. However, seepage or surficial groundwater movement into a lake, is often overlooked because it is generally unseen and can be difficult to measure. Seepage contributions can have a profound impact on water quality depending on potential sources of upgradient groundwater contamination ranging from fertilizer use to application of reclaimed water. Seepage inputs are often estimated using literature values but can also be directly measured empirically using a seepage meter. Seepage meters are relatively simple devices consisting of an open-bottom chamber that is driven into the lake bottom. The top of the chamber is equipped with a port which connects to a collection bag that is filled as a result of seepage pressure from the sediment. While simple in theory and design, installation and long-term deployment of seepage meters is often challenging. With proper design, planning and assessment of lake bottom conditions, many of the potential pitfalls associated with seepage meters can be avoided to ensure the best possible chance for successful seepage sample collection. Accurate measurement of groundwater seepage can improve nutrient and hydrologic budgets, providing important information for better management of waterbodies. Wood routinely uses seepage meters to identify sources of upgradient groundwater nutrient contamination and has identified contributions to the total nitrogen budget as high as 49%. Seepage contribution to the total phosphorus budget is generally only a minor portion of the total budget.

PHOSPHORUS FILTRATION: A PROACTIVE MANAGEMENT TOOL FOR FLOWING WATER

Rory Roten Ph.D.
SePRO, Lakeland, Florida

Rising populations have led to substantial increases in nutrient input to aquatic systems from both urban and agricultural runoff. While watershed management techniques can limit this input, they have largely failed to keep up with ever-increasing nutrient loading. This presentation provides case studies and an overview of EutroSORB®, a novel new phosphorus filtering technology, which is designed for use in flowing waters and may serve as an effective buffer to limit nutrient input from runoff. EutroSORB® is an all-natural formulation which rapidly and selectively binds phosphate from many types of water and is very effective at short contact times across various flow rates. EutroSORB® can effectively remove more than 10 mg of phosphorus per gram of material (> 1%) which allows small filter bags to treat large volumes of water or waters with high phosphorus concentrations. EutroSORB® media can also be used as a soil amendment to enhance the quality of soils after the phosphorus binding capacity has been exhausted. Since nutrients are a key driver of eutrophication in freshwater systems, and as inflow or "recharge" of nutrients is a key factor limiting longevity of in-lake controls, intercepting nutrients in these inflows is a critical need in water resource management.

Session A3: Nutrient Evaluation and Reduction
Moderator: Mary Szafraniec Ph.D.
Wednesday, September 1, 2021. 3:30 pm to 4:30 pm

USE OF PEROXYACETIC ACID (PA)/HYRDROGEN PEROXIDE IN FRESHWATER CYANOBACTERIAL CONTROL-CASED STUDY OF LAB SCALE TRAILS AND TREATMENTS IN RELATION TO FLORIDA TREATMENT SITE

Tom Warmouth
BioSafe Systems, East Hartford, Connecticut

Peroxide based algaecide have been shown effective in selective treatments for cyanobacteria. Lab scale trails of liquid Peroxyacetic acid (PAA)/hydrogen peroxide and solid SCP (sodium carbonate peroxyhydrate) on Microcystis aeruginosa give direction on developing effective dosing in field applications for cyanobacterial harmful algal blooms (cHAB). Monitoring prior to treatment the bloom density and distribution provide guidance for effective timing and method/technique of application adjusting for cell density at depth with algaecide concentration. various partnering agencies. City staff are dedicated to continually improving upon the scope and format of the report and dashboard; incorporating the latest data collection and analytical methods to ensure its lake management programs remain effective.

IN-LAKE PHOSPHORUS MITIGATION FOR THE RESTORATION OF IMPAIRED LAKES

Scott Shuler
EutroPHIX, Carmel, Indiana

Water Quality in the United States is significantly impaired driving increasing frequency and severity of harmful algae blooms (HABs). Approximately 48,000 lakes in the United States are impaired for phosphorus pollution, the primary cause of HAB events. As the primary limiting nutrient for productivity of freshwater systems, a single pound of phosphorus can drive the growth of up to 500 pounds of algae. HABs can cause acute water quality issues, toxin production, taste and odor issues, aesthetic impacts, as well as impacts to recreational uses and property values. Harmful algal toxins can have significant acute impacts to pets, wildlife, and human health. The Clean Water Act has worked to improve the condition of lakes since it was enacted in 1972 and has significantly reduced point source pollution over the last 50 years. Additional efforts are improving watersheds and curtailing non-point source pollution. A relatively small effort has been made for in-lake water quality improvement. Given the investment needed to restore watersheds and the time required for implementation and positive water quality impacts at the lake level – additional in-lake management should be considered to accelerate water quality improvement. Phosphorus internal-load mitigation and external load filtration technologies are viable management strategies to restore waterbodies and improve designated uses. Case studies will be provided along with a summary of technologies used in these restoration projects.

USING ADVANCEMENTS IN POLLUTANT SOURCE TRACKING TO HUNT FOR HOT SPOTS IN MIXED-USE WATERSHEDS

Mary Szafraniec Ph.D.
Wood Environment & Infrastructure Solutions, Inc. Tampa, Florida

Mixed-use watersheds make it challenging to identify localized pollutant hot spots where there are multiple intermingling and layered potential sources (e.g., septic, fertilizer, wastewater discharges). We will present advancements in pollutant source tracking methods where we have used a combination of analytical tools, and a lines-of-evidence approach, for several waterbodies in Central Florida to differentiate between natural background nutrient sources (e.g., due to regional geology and soils) and anthropogenic sources. Methods to identify nutrient sources and their relative magnitude and distribution have been advancing in terms of innovative chemical analyses (i.e., stable isotopes and wastewater tracers) and state-of-the-art statistical frameworks to investigate the sub-basins most strongly contributing nutrient loads at the monitoring station scale. With a robust nutrient source tracking study design, nutrient hot spots can be identified, and complex relationships can be detected and quantified using statistical analyses such as machine learning methods (i.e., random forests) to rank sub-basins with respect to their influence on nutrient loads, and mixed effects models to test detected associations between subbasins and monitoring stations for statistical significance. Results from this ever-evolving analytical framework are used to work toward the development of focused water quality improvement projects throughout the basins to address impairments.

Session A4: UAVs in Water Resources
Moderator: Serge Thomas Ph.D.
Wednesday, September 1, 2021. 4:30 pm to 5:30 pm

UNMANNED AIRCRAFT SYSTEMS AS PART OF AN INVASIVE PLANT MANAGEMENT PROGRAM

Bill Reynolds
Leading Edge, Port Orange, Florida

Unmanned Aircraft Systems (UAS) have been exploding in growth and utilized in diverse market segments ranging from public safety, law enforcement, agriculture, vector control, and surveillance applications. This presentation will provide participants far reaching uses of UAS and operational applications for invasive/noxious weed control. In addition to the aerial applications, aerial imagery used to identify noxious weeds will be presented. Agencies throughout the United States and worldwide struggle to control non-native plant invasions that reduce the quality and quantity of preferred habitats for native plants. As part of an IWM program, managers use herbicides to control invasions, but it may be difficult to find effective application methods. Manned aircraft cover large patches, but aerial use is limited by high costs, weather conditions, and overspray. Many studies indicate detecting and controlling small patches provides better control and faster regrowth of preferred plants. Ground applications from vehicles or on foot may target smaller patches, but effectiveness may be limited by accessibility, labor costs, applicator health and safety concerns. Unintentionally, technicians and vehicles also can spread invasives during ground treatments. More than 21 states and 33 agencies are applying herbicide with UAS, commonly referred to as drones. With a payload of 25 pounds and effective, user selectable swath widths between 4-20 feet, the UAS flies at low elevation (10-15 feet) and applies materials with surgical precision. An aerial imagery drone with remote sensors is able to detect emerging invasive weeds and produce classifications of the target weed. From the georectified imagery, precision flight plans are wirelessly transferred to the UAS application aircraft for autonomous applications. A Real Time Kinetic (RTK) base station provides the ability to spot treat weeds within 4cm of accuracy or treat multiple rows or paths of invasive weeds.

DO DRONES SWIM? HOW CCI TEAMED-UP UNMANNED AERIAL SYSTEM AND BATHYMETRIC SONAR TO HELP RESTORE LAKE CANE

Jerome "Jay" Madigan
Lake Cane Restoration Society, Orlando, Florida

This paper describes how the Lake Cane Restoration Society (LCRS), a swimmer-scientist educational 501(c)3 dedicated to protecting central Florida lakes, engages the community in environmental concerns. Thanks to CCI Engineering, LCRS now has an innovative bathymetric precision digital model of Lake Cane performed using an Unmanned Aerial System (UAS) and Bathymetric Sonar technology that will provide an accurate baseline of the Lake's complete topography (above and below water), vegetation and wildlife. Unlike typical UAS photography services that focus on producing publication worthy videos and photos,

precision digital modeling is a data-focused, multi spectral approach to data collection that gave LCRS a tool to identify the sources of pollutants and design effective remediation solutions.

DOES LUSH GREEN VEGETATION EQUATE TO GREEN STORMWATER PONDS?

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

Bonita Bay is a gated community located in Bonita Springs, Lee County, Florida. Developed in the eighties, it encompasses 2,400 acres of land and includes 1,400 acres of natural landscape including preserves and parks. Urban development ranges from "cozy coach homes" to individualized homes and villas, townhomes, and tall buildings which have access to amenities ranging from golf courses, tennis courts, a state-of-the-art fitness center, spa, and a clubhouse. The community is well-connected to water bodies such as the Outstanding Florida Water (OFW) Estero Bay via the Imperial River and Spring Creek to its southern and northern borders, respectively. It encompasses over 90 manmade urban ponds, two of which are Resource Conservation Systems (RCS) ponds providing reclaimed water to irrigate the lawns, greenscapes, and for surface water inputs to some of the ponds. The Bonita Bay Community Association (BBCA) and the Bonita Club oversee the golf courses and grounds. Since March 2021, BBCA initiated community-based participatory research with the Water School at Florida Gulf Coast University. Part of the research involves water quality, sediment mapping and characteristics, nutrient source tracing, hydrogeology, and best management practices assessment, as well as land characterization and elevation to better assess the water quality. With the focus on tracking eutrophication sources, a DJI Phantom 4 Pro equipped with a Micasense RededgeTM 3 multispectral camera (spectral bands in the blue, green, red, red edge, near IR) was flown over the ponds, their immediate watershed, and shoreline to measure how the normalized difference vegetation index (NDVI) correlated to the water quality of each pond.

Session A5: Nutrient Studies
Moderator: Eesa Ali
Thursday, September 2, 2021. 10:45 am to 12:00 pm

DIVING INTO THE LAKE FROM THE LAB: SCALING UP SEDIMENT TREATMENT ALTERNATIVES ANALYSIS FROM BENCH SCALE TO IN-SITU MESOCOSM

Francesca Lauterman.
Wood Environment & Infrastructure Solutions, Inc., Tampa, Florida

There are limited data tracking the improvements gained from sediment nutrient management. Prior to conducting a large scale and costly restoration project that may include sediment removal or chemical inactivation to improve water quality in a waterbody, it is important to understand how the action may affect the overlying water column and downstream water bodies after implementation. Laboratory bench scale assessments evaluate alternatives such as sediment capping by applying chemical, physical or biological

treatments to the cores to answer the question as to what extent the alternatives would reduce the rate of nutrients (orthophosphate and ammonia-nitrogen) releasing into the water column. By enclosing a portion of a lake using a limnocorral, sediment treatment alternative analyses can be scaled up from bench scale to in-situ mesocosm. Wood will demonstrate the implementation of an in-situ mesocosm scale assessment on two hyper-eutrophic lakes in Central Florida, to confirm the performance and cost-effectiveness of select treatment alternatives prior to applying the product at full scale. The results obtained from this project can be used to assist with watershed restoration planning as sediment nutrient removal or chemical/biological amendments can be compared against other aquatic system restoration BMPs along with costs to develop long-term plans. More specifically, the results can be used in the prioritization of removal or chemical inactivation of sediment types, and to quantify the potential beneficial impacts of sediment nutrient management on water quality.

NITROGEN REMOVAL FROM STORMWATER WITH BIOSORPTION ACTIVATED MEDIA; HOW DOES IT ACUTALLY HAPPEN AND WHY DOES IT MATTER?

Andrew Charles Hood, PhD, EI
Wood Environment & Infrastructure Solutions, Inc., Altamonte Springs, Florida

Nitrogen is often the limiting nutrient for marine systems and its removal is a common primary target for stormwater best management practices (BMPs) (Cripps, 1995). Upflow filters utilizing biosorption activated media (BAM) placed underground offer a small footprint alternative to traditional stormwater ponds or can be used in conjunction with traditional BMPs, such as ponds, to increase performance of the treatment train.

This study compares three different BAM mixtures in a bench scale, upflow filter configuration for the parameters of permeability, total nitrogen (TN), ammonia (NH_3), nitrate/nitrite (NO_x), and others. This research simulated stormwater that had already been treated for solids removal; thus, the TN in the influent was assumed to be mostly non-settable suspended solids or dissolved. The columns were run at both 22-minute and 220-minute Empty Bed Contact Time (EBCT). Furthermore, through nitrogen balance and polymerase chain reaction (PCR) amplification of target Anammox DNA, it was sought to determine if denitrification was primarily accomplished via anoxic chemoheterotrophic means or by endogenous denitrification and/or Anammox.

The best performing BAM mixture was able to achieve TN removal efficiencies of 23% and 50% at EBCTs of 22-minute and 220-minute respectively. This BAM mixture also had the highest permeability constant, meaning it experienced the least amount of head loss. It was found that there was insufficient organic carbon consumption for heterotrophic denitrification utilizing influent supplied organic carbon substrate to account for the observed nitrogen removal. Furthermore, the PCR analysis confirmed the presence of Anammox bacteria in all BAM types. Based on a detailed nitrogen mass balance, Anammox and endogenous denitrification were found to both be significant contributors to biological nitrogen removal, with Anammox being the dominant mechanism. The revelation that Anammox can be a major player in dentification has design implications when choosing which BAM type to use based on the stormwater nitrogen makeup.

NUTRIENT RECYCLING IN WETLAND SOILS FOR CROP PRODUCTION IN SOUTHWEST FLORIDA: A WETLACULTURE™ EXPERIMENT

Hannah Hartzler and William J. Mitsch
Everglades Wetland Research Park, The Water School, Florida Gulf Coast University, Naples, Florida

A conspicuous environmental issue today is the loading of excess nutrients into aquatic ecosystems. This loading can lead to eutrophication, increases in widespread harmful algal blooms (HABs), decreased water quality, and deleterious human health effects. One of the major contributors to this excessive nutrient loading is urban and agricultural fertilizer runoff. Wetlaculture™ attempts to solve this issue at the source by allowing nutrients captured in wetland soils to later become available to crops, potentially reducing the need for fertilizers. This landscape-level ecological engineering experiment is an investigation of the ecosystem services of wetlands and their ability to improve water quality and recycle nutrients for crop production. The wetlaculture™ study in subtropical Florida uses treatment wetland mesocosms, shown to capture nutrients from Naples stormwater in a previous study, to investigate the success of wetland rotation to agriculture. Sixteen three-year-old wetland mesocosms were drained, tilled and planted with sweet corn. Nutrient recycling is estimated with hydrological analyses as well as soil and plant tissue analyses. Results will be compared to previous studies at the site to develop an understanding of four years of biogeochemical transformations through the wetlaculture™ process. Results from the present study will not only provide an understanding of the nutrient recycling capabilities of wetlaculture™ but also provide insight into its overall ecological success. Data will be presented to demonstrate the effectiveness of wetlaculture™ at improving water quality while providing a crop yield, and practical uses of such ecological engineering in subtropical regions.

CHALLENGES IN QUANTIFYING LACUSTRINE GROUNDWATER FLUX

Daniel Canfield
Florida Gulf Coast University, Fort Myers, Florida

Groundwater is one of the major components of lake water budgets. Many important limnological processes, such as denitrification, occur across the sediment-water interface (SWI), where groundwater flux occurs. Despite the importance of groundwater flux for lake water budgets and ecological processes, measuring groundwater flux across the SWI is notoriously difficult due to the highly heterogeneous hydraulic conductivity across the SWI. Discussed are the sources of variability across the SWI, shortcomings of current technology, and future research directions.

Session A6: Aquatic Vegetation in Water Resources Management
Moderator: Ron Hart
Thursday, September 2, 2021. 1:30 pm to 2:45 pm

ESTABLISHING VEGETATION UNDER HARSH CONDITIONS USING ANIONIC POLYACRYLAMIDE

Eddie Snell
Applied Polymer Systems, Orlando, Florida

Establishing vegetation as a final soil stabilization measure can be very difficult in poor soils or harsh weather conditions. Until the vegetation becomes fully rooted and expansive, the soil erosion can occur and lead to failure. Employing anionic polyacrylamide (PAM) along with new vegetation can increase plant survival dramatically.

FIGHTING NUTRIENT POLLUTION WITH THE AQUATIC PLANT VALLISNERIA AMERICANA; TAPE GRASS

Brondum Krebs
James Douglass Coastal Watershed Institute, Florida Gulf Coast University, Fort Myers, Florida

Vallisneria americana is a submerged aquatic plant in the family Hydrocharitaceae. It occupies fresh to oligohaline waters and was once abundant in low salinity parts of SW Florida's Caloosahatchee River Estuary (CRE). The current status of V. americana in the CRE is poor due to altered flow regimes, declining water quality, and other anthropogenic pressures. However, efforts to restore V. americana are increasing. An impetus of these efforts is the notion that aquatic plants like V. americana have ecological benefits such as providing food and habitat for wildlife, improving water quality, and controlling erosion. We tested the water quality benefits of Vallisneria americana with a factorial manipulation of plant presence and nutrient enrichment in
aquatic mesocosms at FGCU's Emergent Technologies Institute. Nutrient addition caused severe algal blooms in the mesocosm tanks, but final algal and nutrient levels were lower in treatments with Vallisneria americana. Plant tissue and water column nutrient concentration data indicate that competitive nutrient uptake by the plants was partially responsible for their reduction of the algal blooms. These findings emphasize the value and urgency of restoring V. americana in the CRE, an estuary plagued with high nutrient concentrations and frequent algal blooms.

STATUS UPDATE ON SUBMERGED AQUATIC HABITAT IN LAKE APOPKA

Jodie Slater[1] *and James Preston*[2]
[1] St. John's River Water Management District, Palatka, Florida
[2]Wood Environment & Infrastructure Solutions, Inc., Altamonte Springs, Florida

Submerged aquatic habitat (SAH) was extirpated in Lake Apopka and has slowly been recolonizing since 1995. Poor water quality and persistent algal blooms have been historically detrimental to the reestablishment and persistence of submerged aquatic vegetation. Various agencies have been working cooperatively to encourage native recruitment and enhance the restoration of submerged aquatic habitat to improve water quality, stabilize sediment, and provide forage and structure for aquatic fauna. Past restoration efforts have included successful plantings of emergent floating leaved plants (Nuphar lutea, Nelumbo lutea, and Nymphaea spp.). Monitoring the natural expansion of SAH and the success of restoration plantings in Lake Apopka quantifies restoration progress and measures the amount of SAH available for aquatic fauna, specifically sport fish. Although much improved, present environmental conditions in Lake Apopka still pose unique challenges to SAH restoration, requiring innovative methods matched with a careful understanding of local environmental stressors. Most recently, the St. Johns River Water Management District has conducted a three-year study with the University of Florida to identify the best methods, locations, ecotypes, and condition specifications. This study was used to inform a larger-scale 2021 restoration planting of up to 24 acres of eelgrass (Vallisneria americana) and Illinois pondweed (Potamogeton illinoensis) to maximize the survival and persistence of restoration plantings. These restoration plantings enhance the naturally established beds of SAH, while also providing additional genetic variability and seed sources. Overall, SAH at Lake Apopka has improved dramatically over the last 5 years and include the presence of vegetation along most of the shoreline. As water quality continues to improve, depth limitations due to light restrictions should decrease and allow natural recruitment to spread to depths previously unavailable.

THE ECOLOGY OF SUBMERSED AQUATIC VEGETATION COMMUNITIES UNDER MANAGEMENT IN SELECT FLORIDA LAKES

Jacob Thayer
Center for Aquatic and Invasive Plants, University of Florida, Gainesville, Florida

Submersed aquatic vegetation (SAV) is a major ecological component of Florida's shallow lake systems. Hydrilla (Hydrilla verticillata [L.F.] Royle) is a nonnative SAV dominating many of these lakes and is often observed to be growing in large monotypic cultures exclusive to other native SAV community members. This invasive species is the number one priority for aquatic plant management in the state of Florida with desired outcomes to conserve native SAV diversity. We are studying the effects on SAV community ecology from selective hydrilla management activities. This investigation is being conducted in two mesotrophic systems, Lake Sampson (804 hectares) in Bradford County and Lake Mann (107 hectares) in Orange County. Surveys have been conducted before and after selective herbicide treatments that were administered in early spring of 2021. Data on species and abundance were recorded with point intercept, hydroacoustic, and airborne imagery surveys on monthly intervals offering community structure data with high spatial and

temporal resolution. Here, we present on some of the basic attributes in community ecology consisting of native and nonnative patch networks along with local and lake-level diversity indices to describe patterns of environmental filtering and competitive exclusion. Furthermore, replacement series competition experiments were conducted in mesocosms between native and invasive species as a complement to the field trials. Selective hydrilla management should enhance local composition of native SAV communities.

Session A7: Algal Evaluation and Control
Moderator: Rob Burnes
Thursday, September 2, 2021. 3:15 pm to 4:30 pm

UNDERSTANDING THE PHYSIOLOGICAL IMPACT OF GLYPHOSATE ON CYANOBACTERIA AND GREEN ALGAE IN A COMPETITION EXPERIMENT

Barry Rosen Ph.D.
Florida Gulf Coast University, Fort Myers, Florida

Harmful cyanobacterial blooms (cHABs) are increasing in their frequency, duration and intensity on a global scale, posing a serious threat to human health and the environment. The current trend in cyanobacterial prevalence is influenced by nutrient enrichment, watershed modification and global climate change, however these factors alone do not adequately describe bloom formation. The role that common agrochemicals play in modifying phytoplankton communities remains
poorly understood, but the literature suggests that these compounds may play an important role in cHABs. To understand if there is a differential effect of the herbicide glyphosate on the members of a freshwater phytoplankton community, a dose-dependent response was explored on a simulated phytoplankton community using a single species cultures of the cyanobacterium Microcystis aeruginosa and the green alga, Haematococcus pluvialis. This study found that Microcystis outcompeted Haematococcus at 1.0 mg L-1 glyphosate but lost out to Haematococcus at 10 mg L-1 and 100 mg L-1. Multiple lines of evidence point to physiological stress, including the production of excessive mucilage and photosynthetic impairment in Microcystis at these higher glyphosate concentrations.

FARM FIELD REDUCTION OF PHOSPHORUS LOSSES FOR PROACTIVE LAKE HABS MITIGATION

Ed Weinberg P.E.
ESSRE Consulting, Richboro, Pennsylvania

ESSRE RePleNish treatment solution for dissolved Phosphorus (P) reduction, which is readily integrated with stormwater or agriculture Best Management Practices, including shoreline erosion/protection, and is applicable to all surface water sources and pathways of nutrient pollutant P within a watershed. ESSRE

RePleNish can be safely applied to Phosphorus impaired lakes, ponds or small streams without the need for chemicals and can be applied in-situ or ex-situ.

Progress in protecting Florida lakes is not keeping up with the intensifying impacts of climate change, population growth, and nutrient pollutant overloads from agricultural activities and wastewater treatment plant discharges. Loss of dissolved phosphorus (P) from agricultural, horticultural, urban, and recreational lands to water bodies contributes to Harmful Algal Blooms and promotes eutrophication. Hence, nutrient pollutant Phosphorus is the focus of multiple efforts by Florida DEP, the Blue-Green Algae Task Force, various Water Management Districts, FLMS, Universities & Water Research Institutions, The Everglades Foundation, and numerous Citizen Action Groups.

This presentation will focus on dissolved P losses from agriculture and the use of Nano-enhanced Phosphorus Adsorptive Media (NEPAM) integrated with Best Management Ag Conservation Practices (BMPs). Two types of highly porous media enhanced with iron oxide and hydrous iron oxide particles are being used to reduce surface run off and tile drainage dissolved P. The media are regenerable for reuse many times over, which makes them long-lasting and lowers overall product cost. Also, regeneration is the key to nutrient recovery and reuse. However, the quantities of dissolved P are too dilute, so the regenerations for the field demonstration will serve to accurately quantify to the milligram of dissolved P removed in this highly variable flow and concentration non-point source application.

The site is located in two farm field plots in Canada: within the First Nation, Chippewa reservation; and the second at farm in Woodstock, ON. The first site contains two surface Hickenbottom® tubes; each has a conventional filter sock ring to remove particulate, sediment and associated particulate P and an inner ring of PO4 Sponge, supplied by Metamateria, Columbus, OH or SmartSpongeHM, supplied by AbTech Industries, Phoenix, AZ.

The projects were set up for three years of demonstration of the NE-PAM; however, Covid-19 restrictions, including the closing of the Canada-US border severely hampered sample collection and data results. The limited information has been tabulated in terms of costs per acre and cost per pound of dissolved P removed. Unique, P-Flux Monitoring techniques were used in place of Flow Weighted Mean Concentration (FWMC) values and Sample Event Concentration data and will be presented. The cost estimates generated are compared to BMPs that remove only particulate P.

The lowest-cost scenario for this project work is surface runoff treatment at the Hickenbottoms, which shows economic promise for scale up to hundreds of acres to meet the P reduction goals internationally set for Lake Erie. Similar ag non-point source application of PAMs at "Big Sugar" farmlands could be scaled up to help address HABs occurrences in S. Florida

INVESTIGATION OF UNUSAL ALGAL BLOOMS WITHIN LAKE MINNEOLA

Lance Lumbard[1], *Craig Duxbury*[1], *Jason Danaher*[2]
[1]Wood Environment & Infrastructure Solutions, Inc., Altamonte Springs, FL
[2]Lake County Water Authority, Tavares, FL

Lake Minneola is a 1,890-acre (765 hectare) lake in central Florida located within the Clermont Chain-of-Lakes. During 2020, Lake Minneola experienced a significant cyanobacteria bloom that resulted in the cancellation of significant sporting events and prompted action from several agencies including the Lake County Water Authority (LCWA) and the St. Johns River Water Management to identify potential causes and address future algal blooms.

The Clermont Chain-of-Lakes receives a large part of its total hydrologic input from the Green Swamp which drains to Lake Louisa, the first lake in the Clermont Chain-of-Lakes, via Big and Little Creeks. The Clermont Chain-of-Lakes is normally a tannic system with color ranging from around 50 to 400 platinum cobalt units (PCU). Total phosphorus (TP) and total nitrogen (TN) concentrations within the Clermont Chain-of-Lakes are typical of tannic waters with TP ranging from about 10 to 90 µg/L and TN ranging between 300 and 2,000 µg/L. Normally, high-color limits light availability and the potential for significant cyanobacteria blooms. Several theories have been postulated to explain the unusual cyanobacteria blooms in Lake Minneola including reduced color, nutrient pulses from the Green Swamp, and local sources of external or internal nutrients.

As part of ongoing research conducted by the LCWA, Wood evaluated potential sources of stormwater discharge and seepage inputs to Lake Minneola. Preliminary findings, including tracer studies using sucralose, suggest that there are no unusual sources of local nutrient inputs to Lake Minneola although sediment flux has not been evaluated. Interestingly, algal blooms reported during 2021 have also occurred throughout the Clermont Chain which suggests that sources of nutrient pollution are likely to be occurring upstream of Lake Minneola.

HYDROGEN PEROXIDE IN SUBTROPICAL AQUATIC SYSTEMS AND ITS APPLICATION FOR CYANOBACTERIAL BLOOM CONTROL

Hidetoshi Urakawa Ph.D.

Florida Gulf Coast University, Fort Myers, FL

Hydrogen peroxide is the most stable reactive oxygen species in natural waters. Its high reactivity in mediating redox transformations can affect aquatic ecosystem functions including primary production. However, environmental interactions between hydrogen peroxide and photoautotrophs, particularly cyanobacteria, are poorly understood. We aimed to understand the ecological relevance between cyanobacterial blooms and hydrogen peroxide dynamics in southwest Florida. We also tested hydrogen peroxide treatment to control cyanobacterial blooms. We examined multiple water bodies to determine

baseline hydrogen peroxide concentrations and found that subtropical aquatic systems contain high levels of hydrogen peroxide. The concentrations were higher at bloom sites compared to the no bloom sites and higher at locations exposed to sunlight compared to shaded areas. We also determined microscale depth profiles (10-60 mm) of hydrogen peroxide and found the highest concentrations in the topmost layer of lakewater in cyanobacterial blooms. On April 12, 2021, we found a minor shoreline bloom of *Microcystis aeruginosa* at Franklin Lock and Dam (S-79) in the Caloosahatchee River. We sprayed 3% hydrogen peroxide to a 400 m^2 area to control cyanobacteria on April 14, 2021. The hydrogen peroxide concentration dosed (16.7 mg/L, 0.0015%) was within those previously reported (2 to 100 mg/L). Before and after spraying, hydrogen peroxide level in surface water was monitored every 15 min in the first hour then days 1, 3, 7, and 14. The hydrogen peroxide level decreased within one hour and returned to baseline on the next day. The succession of algal populations was observed within two weeks; relative abundance of *Microcystis* and *Dolichospermum* declined while other specific phytoplankton populations increased. Overall, we determined the natural abundance of hydrogen peroxide in southwest Florida waters and found relevance between hydrogen peroxide dynamics and cyanobacterial blooms. We also demonstrated the effectiveness of hydrogen peroxide treatment for cyanobacterial bloom control in southwest Florida.

Session A8: Resource Management
Moderator: Patrick Goodwin
Friday, September 3, 2021. 9:00 am to 10:00 am

DISTRIBUTION AND CONCENTRATION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH'S) IN SOUTHWEST FLORIDA SURFICIAL SEDIMENTS

James Javaruski, Trinity Allen, Puspa L. Adhikari
The Water School, Department of Marine and Earth Sciences, Florida Gulf Coast University, Fort Myers, Florida

Polycyclic Aromatic Hydrocarbons (PAHs) are ubiquitous organic contaminants known to be toxic, carcinogenic and mutagenic. Due to this threat to human health, select PAHs are EPA listed priority pollutants and are regularly monitored in various environmental matrices. PAH's enter into the coastal-marine environments via atmospheric deposition, river discharge, coastal erosion, oil spills and natural oil seeps. Despite significant environmental problems in this area, the studies to report organic contaminants in the Southwest Florida are rare. With Florida experiencing oil and gas exploration expansion, increased vehicular activity and large spills such as the 2010 BP oil spill, it is important to establish a baseline for the distributions and concentrations PAHs and other emergent contaminants along our coastline. The aim of this project is to determine the types and relative concentrations of contaminants present along our coastline in sediments from beaches, marine waters, and ponds. Samples were taken from 20 sites distributed across the Southwest Florida coast (Lee and Collier County), upriver, and in ponds. They sediment samples were solvent extracted and a quantitative analysis was performed for 43 PAHs and 29 alkanes using a Gas Chromatography/quadrupole mass spectrometry (GC-MS/MS). The concentrations of total PAHs ($\sum PAH_{43}$) vary between 1.6 to 14,632.9 ng g^{-1} of dry sediments (avg. 1,069 ng g^{-1} ± 3270) with the higher concentrations being present in both the freshwater lakes and furthest upriver. The distribution of PAHs

were dominated by the PAHs from pyrogenic sources. The concentration of total alkanes ($\sum Alkane_{29}$) varies from 234.6 to 3465.3 ng g^{-1} dry sediment (avg. 722 ng g^{-1} ± 804). The results from the present study provide us with valuable information on concentrations of organic contaminants in the Southwest Florida area, and will be invaluable for policy and decision-making.

WHAT'S POPPIN': THE IMPACT OF NANOBUBBLES ON MICROCYSTIS FOR THE CHEMICAL-FREE CONTROL OF HARMFUL ALGAE

Christian Ference
Applications Engineer, Moleaer Inc., Carson, CA

Nanobubble injection has been demonstrated as a next generation method for hypolimnetic oxygenation as well as for the chemical-free control of harmful algae. The unique properties of the nanoscopic bubbles include an extremely high oxygen transfer efficiency (> 85%) and a mild oxidative impact, providing a sustainable alternative to chemical treatment. While the control of harmful algae has been demonstrated through numerous field installations and academic papers, there is still a need for additional research to determine the mode-of-action for algae cell damage. To deepen this understanding, the response of Microcystis aeruginosa exposed to water containing nanobubbles generated with various gases was investigated.

Microcystis cultures were propagated in 10L flasks and then dosed with nanobubbles composed of air, oxygen, and ozone gas compositions over a period of up to 14 days to simulate nanobubble treatment. After treatment, the Microcystis cells were evaluated for physiological and morphological changes via microscopy. The quantity of Microcystis was measured by Imaging Flow Cytometry and the microcystin algae toxin concentration was determined through immunoassay (ELISA) testing. Data from this testing on the direct impact of nanobubbles on cyanobacteria cells will be presented to discuss nanobubbles as a chemical-free treatment method for increasingly widespread harmful algae blooms.

USING PAM TO BUILD AND MAINTAIN ARTIFICIAL PONDS

Eddie Snell
Applied Polymer Systems, Orlando, Florida

Building and maintaining artificial ponds suspends sediment and small particles (turbidity and particulate) into the water. These materials cause many negative impacts within a water body. Water soluble anionic polyacrylamide (PAM) technologies can be utilized to enhance Best Management Practices (BMPs) to mitigate many of these issues.

Session A9: Lake Management Tools
Moderator: Dan Schmutz
Friday, September 3, 2021. 10:35 am to 11:35 am

A GENERAL APPROACH TO HYDROLOGIC RECOVERY METRIC DEVELOPMENT WITH APPLICATION TO GEOGRAPHICALLY ISOLATED WETLANDS AND LAKES IN XERIC LANDSCAPES

Dan Schmutz
Greenman-Pederson (GPI), Inc., Tampa, Florida

Hydrologic recovery of wetlands and lakes impacted by water table drawdown due to groundwater production involves improvements to hydropatterns. How much improvement is sufficient to declare a system recovered? We propose a general approach to establishing a recovery metric and demonstrate a specific application for freshwater, geographically isolated sites.

Our approach involves

- identifying sufficient replicate sites,
- collecting adequate monthly water level data,
- categorizing the sites into two ecological condition groups—stressed and unstressed,
- calculating median water level offsets relative to the long-term 3 percent exceedance (PE03) elevation at each site,
- performing a "crossing point" empirical distribution analysis to minimize misclassification errors in separating the offsets of the two groups.

There are known differences between sites in xeric versus mesic vegetation dominated landscapes. We developed a hydrologic recovery metric using data from 62 stressed and 64 unstressed water level time series (7 year segments) taken from 89 xeric-associated systems. Stress classifications were developed using ground truthed ecological condition data and random forest statistical predictions. A hydrologic recovery metric of -3.7 feet (relative to the PE03) was determined for xeric-associated wetlands and lakes in the Northern Tampa Bay Area (Florida), with only 16% of truly unstressed sites expected to have long-term median levels lower than this metric.

USING POLYALUMINUM CHLORIDE (PACL) FOR PHOSPHORUS REMOVAL IN LAKE REMEDIATION

Brad Key
Chemtrade, Tampa, Florida

The purpose of this study is to look at PACL for phosphorus removal in lakes. There will be a comparison with PACL and alum and which will show strengths and weaknesses of both products. It will include an

overview of actual jar testing of the products before start-up with an actual PACL application at a project in Florida.

SELF FUNDING NUTRIENT MANAGEMENT AND CARBON SEQUESTRATION

Kyle Jensen
Kyle Jensen Architect, Orlando, Florida

I propose to develop tiny but strategic areas of Sovereign Submerged Land into Sustainable Marinas for mooring high quality Floating Homes. I propose to use the Lease revenue to completely fund construction and operation of large-scale Surface Water improvement projects with significant CO2 sequestration attributes in Florida and eventually the World.

It's common knowledge that surface water is largely polluted with fertilizer. Micro algae outcompete all plants for nutrients and logarithmically reproduce turning the water green. This condition causes ecosystem instabilities and reduction in species diversity.

There exists a fantastic opportunity with this algae-laden green water. There are sustainable non-chemical ways to remove the microscopic algae and its nutrients from the water at large scale and use them as fertilizer on terrestrial crops. Specifically, the Bamboo species phyllostachys heteroclada, also known as Solid Bamboo. This species flourishes in wet conditions, has superior structural characteristics and manufacturing potential.

When applied with flood irrigation, these "algae and algae fertilized bamboo" sequester CO2 constantly. C02 Sequestration alone is desirable. When the process vastly improves surface water quality at the same time, there are multiple sustainable synergistic benefits. Carbon sequestered in Bamboo can stay bound for a century or more. When the planktonic algae is removed, the water is as clear and pristine as a remote mountain stream.

When all this is accomplished without burdening taxpayers one has to ask themselves, why is this not done. Here's why.....

Poster Session
Moderator: Rob Burnes
Wednesday, September 1, 2021. 6:00 pm to 8:00 pm

FLORIDA SPECIES AND HABITAT MONITORING PROGRAMS CATALOG (TERRA-CAT)

Amanda Christiansen
Florida Fish and Wildlife Conservation Commission, Tampa, Florida

The Florida Species and Habitat Monitoring Programs Catalog (aka Terra-CAT) is a user-friendly and publicly accessible website that catalogs habitat- and species-related monitoring efforts within Florida. The purpose of the online catalog is to ensure that all monitoring agencies know about monitoring activities in Florida, including: who (organization or individual carrying out monitoring); what (medium and habitat type being monitored); where (geographic location of monitoring activities); and when (the period of record for sampling efforts, frequency of sampling, etc.) of all monitoring efforts. This ongoing project supports the maintenance of the catalog and the website to ensure that it remains up-to-date and accessible to all users.

EVALUATING WATERWAY QUALITY VIA MICROBIAL COMMUNITY MONITORING

Michael Kratz
Florida Gulf Coast University, Fort Myers, Florida

Using biological indicators for contamination/pollution can be helpful in evaluating aquatic ecosystem health. Our year long study evaluated microbial communities along three waterway transects in Southwest Florida. Using high-throughput sequencing, we were able to view core and non-core microbial taxa along these waterways and how these taxa fluctuate with nutrient loading and physiochemical parameters.

TAXONOMIC ASSESSMENT AND COMPOSITION ANALYSIS OF CYANOBACTERIA PRESENT IN LAKE OKEECHOBEE FRESHWATER SAMPLES

Julia Davis
Florida Gulf Coast University, Fort Myers, Florida

The primary objective of this research was to establish an algal culture collection sourced from Lake Okeechobee and its waterways. Unialgal cultures were produced and maintained using various isolation and purification procedures. We morphologically and genetically studied isolated algae.

FISH PREDATION OF MICROCYSTIS AERUGINOSA BLOOM OBSERVED IN THE CALOOSAHATCHEE RIVER, FLORIDA

Taylor Hancock
University of South Florida, Tampa, Florida

During the 2018 Microcystis aeruginosa bloom in the Calooshatchee River, we observed the presence of numerous bright green fecal packages at the water's surface as well as distinct behavioral changes in nonnative Pterygoplichthys disjunctivus (Vermiculated Sailfin Catfish). Using a combination of traditional and molecular ecology methods examining fecal packets amongst the bloom, we identified two M. aeruginosa bloom fish grazers, one nonnative (P. disjunctivus) and one native (Eucinostomus harengulus, Tidewater Mojarra). Analysis of E. harengulus gut microbiota indicated a relative increase in pathogens correlated to consumption of the bloom.

MICROCYSTIS AERUGINOSA GROWTH INHIBITION BY THREE CHEMICAL TREATMENTS- INSIGHT FOR ECOLOGICAL MITIGATION METHODS

Elizabeth Dahedl
Florida Gulf Coast University, Fort Myers, Florida

Three chemical treatment methods for the rapid suppression of Microcystis aeruginosa were explored using L-lysine, an amino acid, hydrogen peroxide and the novel use of combined treatments of both L-lysine and hydrogen peroxide in laboratory culture conditions. These chemical treatments may offer more ecologically friendly solutions in comparison to other chemical treatment methods where bioaccumulation and biomagnification can cause serious harm to the ecosystem. Other cyanobacteria genera and eukaryotic algae were examined and growth inhibition was not as severe, showing treatments may be species-specific.

USING MULTISPECTRAL IMAGERY IN NATURAL RESOURCE MANAGEMENT

Rex Ellis Ph.D., Steve Miller, Ali Simpson, Kim Ponzio, Andy Canion Ph.D., Charles Jacoby Ph.D.
St. Johns River Water Management District, Palatka, FL

The St. Johns River Water Management District (District) has been exploring the use of multispectral satellite imagery as an effective tool for managing natural resources in estuarine and freshwater habitats. Presented here are projects using multiple types of satellite imagery (Landsat, and Sentinel 2, and WorldView 2,3,4,) to map algal blooms and wetland vegetation. Freely available multispectral imagery, Landsat and Sentinel 2, were used to track the spatio-temporal dynamics of algal blooms in the Indian River Lagoon. Algorithms were developed specifically for these estuarine waters, allowing for a rapid and accurate large-scale view of blooms. With acquisitions every few days, this approach provided an almost instantaneous (within a day of acquisition) assessment of conditions at times when algal blooms intensified and spread much quicker than routine monthly sampling of surface water could detect. WorldView-2 imagery was used to map expansion of cattails in the Blue Cypress Water Management Area. Compared to traditional manual interpretation of aerial photography, this pixel-based classification captured a similar level of spatial complexity and yielded a comparable classification accuracy for cattail, but at reduced cost and effort. We determined the 2016 distribution of Phragmites, an invasive plant along the SJR river channel, to assess its invasion pattern and the impacts of herbicide treatments to restore the marsh. We are working to streamline the process of mapping plant communities over a vast array of habitats on District lands. We hope to apply the models developed in these early projects to assess other lakes (algal blooms) and aquatic habitats in the District. These projects highlight the efficiency and effectiveness of using both commercially and freely available multispectral imagery for managing natural resources.

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See you next year!!

Florida Lake Management Society

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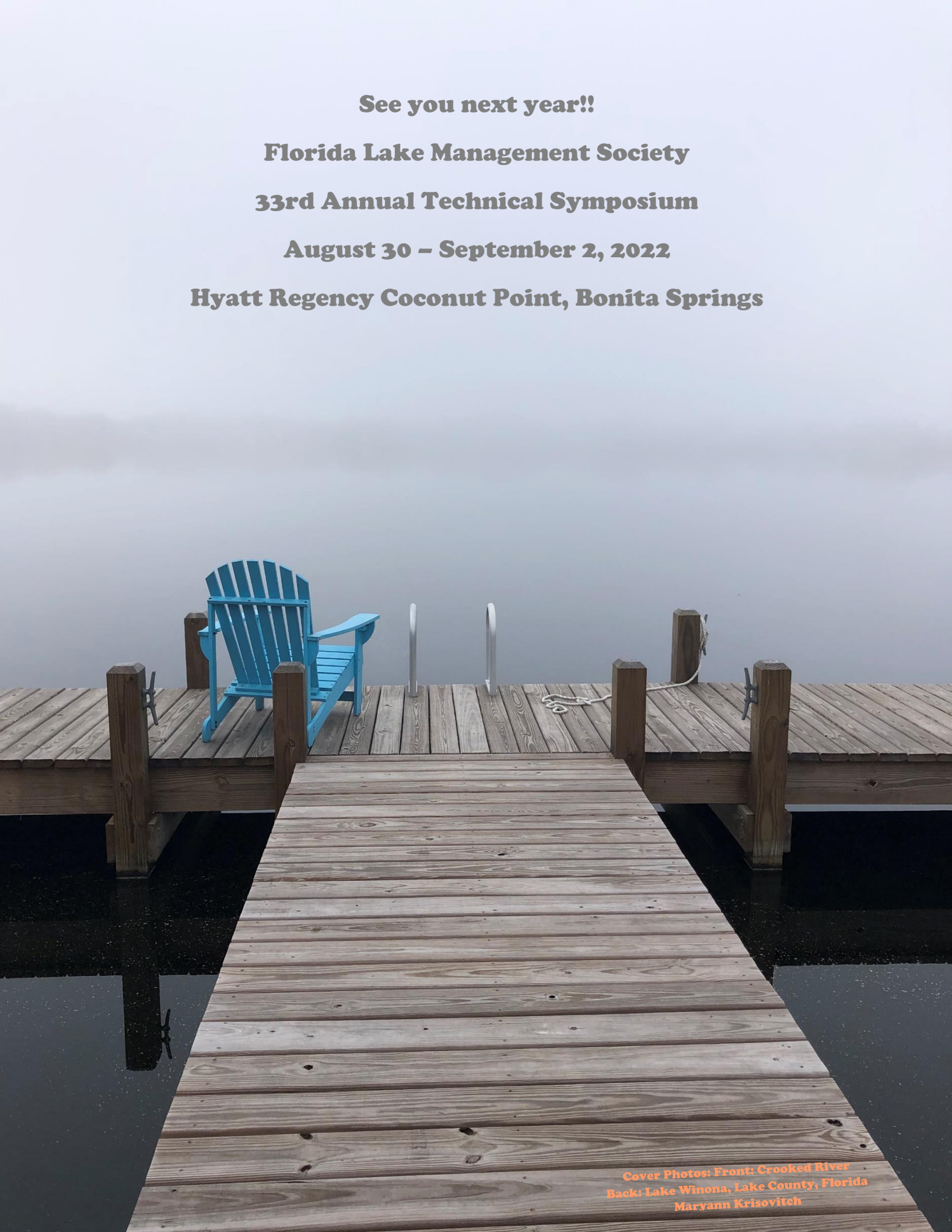

Cover Photos: Front: Crooked River
Back: Lake Winona, Lake County, Florida
Maryann Krisovitch