Florida Lake Management Society
26th Annual Technical Symposium

&

NALMS Southeast Lakes & Watersheds
24th Annual Conference

June 8-11, 2015
Naples, Florida

Program Theme: Lake, Spring, Stream and Coastal Science, Technology and Volunteer Programs

SYMPOSIUM PROGRAM

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Celebrating Lake, Stream, Groundwater and Coastal Volunteers!

Welcome!

MONDAY - JUNE 8, 2015 – WORKSHOPS

8:00 AM – 5:00 PM	**Check-In and Registration**- Orchid Atrium

8:15 – 11:45 AM **Morning Workshop 1:** ***Macro invertebrate surveys to diagnose aquatic ecosystem conditions in wetlands, streams, canals, and lakes of South Florida*** - David Ceilley, Senior Ecologist - Johnson Engineering Inc. and Graduate Faculty at Florida Gulf Coast University (Chokoloskee J, 2nd floor)

9:45 - 10:00 AM	**MORNING BREAK** – Fakahatchee Foyer
12:00 - 1:15 PM	**LUNCH** (*provided with full-day Workshop registration*) **Fakahatchee Foyer**
2:30 – 2:45 PM	**AFTERNOON BREAK** – Fakahatchee Foyer

1:30 – 5:00 PM **Afternoon Workshop 2:** ***Overview of DEP SOPs for Surface Water Sampling: Focus on Volunteer Monitoring Programs*** **– Jennifer Claypool & Meghann Neisen,** Florida Department of Environmental Protection (Chokoloskee K, 2nd floor)

1:30 – 5:00 PM **Afternoon Workshop 3:** ***Past, Present, and Future: Using Climate Data and Models to Inform Lake Management in Florida*** – Sam Arden, Dept. of Environmental Engineering Sciences, Engineering School of Sustainable Infrastructure & Environment, University of Florida (Chokoloskee J, 2nd floor)

TUESDAY - JUNE 9, 2015 MORNING – SYMPOSIUM

(* - Denotes student paper)

7:30 AM – 5:00 PM	**Check-In and Registration** (Orchid Atrium)
7:00 AM – 8:30 AM	**Breakfast** (Exhibit Hall - River of Grass Ballroom)

Opening Program (Mangrove Ballroom)

"Celebrating Lake, Stream, Groundwater and Coastal Volunteers"

8:30 – 9:00 AM **Welcome & Opening Remarks:** Lawrence Keenan, Outgoing FLMS President
Ron Hart, Symposium Chair
John Walkinshaw, Program Co-Chair

9:00 – 9:45 AM **Keynote Speaker –** Judy Ott, CHNEP Senior Scientist

9:45 – 10:15 AM	**MORNING BREAK** (Exhibit Hall – River of Grass Ballroom)

Track A: Technical Symposium (Mangrove Ballroom)

Session A1: Water Resource Management, FTSI, NNC, WQBEL, Water-Cat and other Mysterious Acronyms
Moderator: Serge Thomas

10:15 - 10:20 AM	Session Introductions – Serge Thomas
10:20 - 10:35 AM	Numeric Nutrient Criteria – The rest of the story – Dan Canfield
10:35 - 10:50 AM	An alternative to meeting Numeric Nutrient Criteria, applying the WQBEL option in Sweetwater Branch – Jan Mandrup-Poulsen
10:50 - 11:05 AM	Florida Water-CAT: Making it easier to share metadata about chemical, physical and biological water monitoring activities – Shawn Landry
11:05 - 11:20 AM	The Death of the FTSI and how to deal with it – Clell Ford
11:20 - 11:35 AM	Seminole County's Watershed Management Program; maximizing partnerships and resources- Shannon Carter Wetzel
11:35 - 11:50 AM	Restoration of Palatlakaha System by modified Twin Radial Gate Dams (TRGD) – Ron Hart
11:50 - 12:15 PM	Panel Discussion – Serge Thomas

TUESDAY – JUNE 09, 2015 AFTERNOON

12:15 – 1:30 PM	**LUNCH** (Exhibit Hall - River of Grass Ballroom)
12:45 – 1:15 PM	**Special Lunch Speaker -** Beacham Furse, Biological Administrator, Florida Fish and Wildlife Conservation Commission

Session A2: Lake Systems Science and Restoration Techniques
Moderator: Harvey Harper

1:30 - 1:35 PM	Session Introduction – Harvey Harper
1:35 - 1:50 PM	Assessing the strength of the phosphate bond formed by lanthanum modified clay (PHOSLOCK) – Michael Shaner
1:50 - 2:05 PM	Impacts of Recreational Boating on Water Quality in Lakes – Harvey Harper
2:05 - 2:20 PM	New NALMS policy supports an adaptive systems approach to freshwater management – Ken Hudnell
2:20-2:35 PM	In lake floating treatment wetlands could provide algae control through unsuspected mechanisms – Dana Dettmar*
2:35-2:50 PM	Pairing water chemistry data with phytoplankton: Does collection method really matter? – Lori McCloud
2:50-3:05 PM	Longevity of Sediment Inactivation Treatments in Florida Lakes: Analysis of Controlling Factors– Harvey Harper
3:05-3:25 PM	Panel Discussions – Harvey Harper

AFTERNOON BREAK 3:25-3:55 PM (Exhibit Hall - River of Grass Ballroom)

TUESDAY – JUNE 09, 2015 AFTERNOON – Cont.

Session A3: Water Resource Restoration Science and Management
Moderator: Bradley Fontaine

3:55 - 4:00 PM	Session Introduction – Bradley Fontaine
4:00 - 4:15 PM	Testing a new IPM approach for hydrilla management: an update – James Cuda
4:15 - 4:30 PM	Production of SAV SOD for lake and stream restoration and habitat enhancement – Lyn Gettys
4:30 - 4:45 PM	Dissolved Oxygen in Florida Wetlands: characterization, possible drivers and regulatory context – Sam Arden*
4:45 - 5:00 PM	Influence of sediment characteristics on SAV distribution in Lake Apopka, Florida – Dean Dobberfuhl
5:00 - 5:15 PM	Historic overview of habitat degradation and habitat restoration: the effects on Florida bass recruitment and fishery – Bradley Fontaine
5:15 - 5:35 PM	Panel Discussions - Bradley Fontaine

TUESDAY – JUNE 09, 2015 EVENING

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

6:00 - 8:00 PM **Session A4: Poster Session** (Exhibit Hall – River of Grass Ballroom)
Session Lead: Sergio Duarte

- Short-term dynamic changes in submersed aquatic vegetation in Lake Apopka – Tiffany Trent
- Seasonal erodibility of cohesive mixed-muddy sediments and bioturbation in the Caloosahatchee River estuary of Southwestern Florida - David Kluesner
- The hidden rules in the Florida numeric nutrient criteria - Daniel Canfield, Jr.
- Investigating the nutrient and water loading in Lake Trafford, FL, USA - Mark Lucius*
- The SJRWMD method for determining minimum levels at lakes: Lake Kerr case study – Robert Freese
- Dose response evaluation of contaminated sediments on growth and survival of a freshwater amphipod - Jennifer Sagan
- The limnology of Lake Trafford prior and post dredging (1997-2012 period) – Serge Thomas

WEDNESDAY – JUNE 10, 2015 MORNING

(* - Denotes student paper)

7:30 AM – 5:00 PM	**Check-In and Registration** (Orchid Atrium)
7:00 AM – 8:30 AM	**Breakfast** (Exhibit Hall – River of Grass Ballroom)

Morning Program (Mangrove Ballroom)

8:30 - 8:35 AM	Announcements: John Walkinshaw, Program Co-Chair
8:30 - 9:10 AM	Keynote Speaker: Mark Hoyer, Director LAKEWATCH
9:10 - 9:25 AM	Question Period

9:25 - 9:55 AM	**MORNING BREAK** (Exhibit Hall – River of Grass Ballroom)

Program Track B: Celebrating Lake, Stream, Groundwater and Estuary Volunteers (Mangrove Ballroom)

Session B1: Lake and Pond Volunteer Programs
Moderator: Mark Hoyer

10:00 - 10:05 AM	Session Introduction – Mark Hoyer
10:05 - 10:20 AM	Lake June-in-Winter: When citizen activism clashes with scientific practice – Clell Ford
10:20 - 10:35 AM	Using Data Collected by Volunteers in Relationship with Lee County Fertilizer Ordinance - Ernesto Lasso de la Vega
10:35 - 10:50 AM	Developing conservation modules for stormwater retention pond owners and volunteers - Ernie Franke
10:50 - 11:05 AM	Trends, growth, and future direction of the TrophyCatch citizen-science program – Andrew C. Dutterer
11:05 - 11:20 AM	Evaluation of Florida's trophycatch program - Andrew C. Dutterer
11:20 - 11:35 AM	Citizen scientists protecting Florida's aquatic systems – Mark Hoyer
11:35 - 11:50 AM	Panel Discussion – Mark Hoyer

Track C: Volunteer Technology and Techniques Hands on Training (Chokoloskee Room, 2nd floor)

10:00 – 12:00 PM	C1 – Coastal Restoration Program Workshop – Rachel Gwin
10:00 – 12:00 PM	C2 – LCAM CEU Workshop: Understanding Waterway Management – Rose Bechard-Butman

WEDNESDAY – JUNE 10, 2015 AFTERNOON

12:00 –1:50 PM	**BANQUET LUNCH/FLMS ANNUAL MEETING** (Exhibit Hall – River of Grass Ballroom)

Program Track B: Celebrating Lake, Stream, Groundwater and Estuary Volunteers (Mangrove Ballroom)

Session B2: Watershed Volunteer Programs

Session B2 Moderator: Jim Reed

2:00 - 2:05 PM	Session Introduction – Jim Reed
2:05 - 2:20 PM	Building Watershed Awareness – The Seminole Education, Restoration and Volunteer Program (SERV) – Elizabeth Stephens
2:20 - 2:35 PM	FWC Highland Lakes Volunteers – Jim Reed
2:35 - 2:50 PM	Firm foundations for soft BMP's. Key factors for getting the most out of public involvement – John McGee
2:50 - 3:05 PM	Quality assurance considerations and incorporating volunteer data into watershed assessment process – Kevin O'Donnell
3:05 - 3:20 PM	Panel Discussion – Jim Reed

Track C: Volunteer Technology and Techniques Hands on Training (Chokoloskee Room, 2nd floor)

1:00 – 2:00 PM	C3 – LCAM CEU Workshop: Lake Maintenance: Controlling Weeds, Algae and Aquatic Pests – Rose Bechard-Butman
2:30 – 3:30 PM	C4 – LCAM CEU Workshop: Water Quality Fountains and Aeration – Andy Roberts

3:20 - 3:50 PM	**AFTERNOON BREAK** (Exhibit Hall – River of Grass Ballroom)

WEDNESDAY – JUNE 10, 2015 AFTERNOON – Cont.

Program Track B: Celebrating Lake, Stream, Groundwater and Estuary Volunteers (Mangrove Ballroom)

Session B3: Coastal Monitoring and Restoration Programs
Moderator: Alison McDowell

3:50 - 4:05 PM	Session Introduction – Alison McDowell
4:05 - 4:20 PM	Citizen Scientists of the Choctahatchee Watershed – Brandy Foley
4:20 - 4:35 PM	AmeriCorps NWF Environmental Stewards: Volunteers supporting watershed education, restoration and monitoring goals - Darsey Kelly
4:35 - 4:50 PM	Strengthening an estuary with the power of citizen scientists: community-based restoration, research and monitoring on intertidal oyster reefs and living shoreline in the Indian River Lagoon, Florida - Kathryn Brown
4:50 - 5:05 PM	Citizen Science and stakeholder engagement in Goliath Grouper fishery management – Jessica Sutt
5:05 - 5:20 PM	Volunteers are vital to the success of the Charlotte Harbor estuaries volunteer water quality monitoring network -Melynda Brown
5:20 - 5:35 PM	Panel Discussion – Alison McDowell

Track C: Volunteer Technology and Techniques Hands on Training (Chokoloskee Room, 2nd floor)

4:00 - 5:30 PM	C5 – Pond and small lake restoration techniques workshop – John McGee

5:45 – 6:15 PM	**FLMS BOARD MEETING** (Goodland Room, 2nd floor)

THURSDAY – JUNE 11, 2015 MORNING

8:00 AM – 12:00 PM	**Check-In and Registration** (Orchid Atrium)
7:00 AM – 8:30 AM	**Breakfast** (Exhibit Hall – River of Grass Ballroom)

Program Track D: Florida Water Resource Technology and Management

8:30 - 8:35 AM Announcements: John Walkinshaw, Incoming FLMS President

Session D1: Lake and Stream Restoration and Monitoring Technology (Mangrove Ballroom)
Moderator: Patrick Goodwin

8:35 - 8:40 AM	Session Introduction – Patrick Goodwin
8:40 - 8:55 AM	A Holocene Sediment Record of phosphorus accumulation in shallow Lake Harris, Florida (USA) offers new perspectives on recent cultural eutrophication – William Kenney
8:55 - 9:10 AM	Managing Canal Water Quality in Florida Keys – Lance Lumbard
9:10 - 9:25 AM	Reducing herbicide application rates of an alternative herbicide for control of Fluridone resistant Hydrilla – Leif Willey
9:25 - 9:40 AM	Improving Management of Groundwater Augmentation for 15 Lakes and Wetlands in Northern Tampa Bay Area – Dan Schmutz
9:40 - 9:55 AM	Aeration's effect on algal abundance and assemblage – Patrick Goodwin
9:55 - 10:10 AM	The Use of State of the Art Aerial Imaging Techniques for Aquatic Applications - Stuart Clough
10:10 - 10:30 AM	Panel Discussion – Patrick Goodwin

Session E1: Septic System Drainfield Science (Chokoloskee Room, 2nd floor)
Moderator: Gurpal Toor

8:35 - 8:40 AM	Session Introduction – Gurpal Toor
8:40 - 8:55 AM	Mass balance of nitrogen in septic system drainfields - Mriganka De*
8:55 - 9:10 AM	Mass balance of phosphorus in septic system drainfields -Sara Mechtensimer *
9:10 - 9:25 AM	Fate of pharmaceuticals and hormones in septic system drainfields - Yun-Ya Yang*
9:25 - 9:40 AM	Transport of nitrogen from septic systems to shallow groundwater - Mriganka De*
9:40 - 9:55 AM	Transport of phosphorus from septic systems to shallow groundwater - Sara Mechtensimer*
9:55 - 10:10 AM	Pharmaceuticals and organochlorine pesticides in sediments of an urban river in Florida - Yun-Ya Yang*
10:10 - 10:30 AM	Panel Discussion – Gurpal Toor

THURSDAY – JUNE 11, 2015 MORNING – Cont.

10:30 – 10:45 AM	**MORNING BREAK** (Exhibit Hall – River of Grass Ballroom)

Session D2: Groundwater, Spring and Spring Run Science and Restoration Techniques (Mangrove Ballroom)

Moderator: Rob Mattson

10:45 – 10:50 AM	Session Introduction –Rob Mattson
10:50 – 11:05AM	Relationship between nitrate concentration and discharge in springs within the St. Johns River Watershed Management District, Florida, USA – Jian Di
11:05 – 11:20 AM	Comparing velocity conditions in spring runs using long-term flow records – Fay Baird
11:20 – 11:35 AM	Algal Community Characteristics in Selected Spring Run Streams in the St. Johns River Basin - Robert A. Mattson
11:35 – 11:50 AM	A Systems Model Approach to Understanding Algae Growth in Florida Springs: Moving towards Whole-Ecosystem Restoration - Angelique Bochnak
11:50 – 12:05 PM	Panel Discussion – Rob Mattson

Session E2: The S's! Stormwater, Sequestration, Swamps and Soils (Chokoloskee Room, 2nd floor)
Moderator: Drew Liddick

10:45 – 10:50 AM	Session Introduction – Drew Liddick
10:50 - 11:05 AM	Factors Affecting Effectiveness of Stormwater Detention Ponds at Sequestering Nutrients As Implemented in South Florida: A Case Study in Lee County, Florida - Drew Liddick
11:05 - 11:20 AM	Soil carbon sequestration in mangrove ecosystems of southwest Florida - Daniel A. Marchio, Jr*
11:20 – 11:35 AM	Methane emissions from freshwater swamp soils with different hydroperiods - Andrea Pereyra*
11:35 – 11:50 PM	TBD
11:50 – 12:05 PM	Panel Discussion – Drew Liddick

12:05 – 12:15 PM	**Student Awards and Closing Remarks**	2015- 2016 FLMS President – John Walkinshaw
12:15 –1:00 PM	**LUNCH** (Solarium North)	

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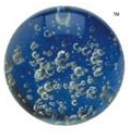

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Dr. Lisa Beaver

The Marjorie Carr Award *- 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

Dr. Thomas J. Whitmore

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 SCOTT DRIVER AWARD

Clyde Butcher

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 at the time of his death.*

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Meet the Guest Speakers

Tuesday Keynote Speaker

Judy Ott, *CHNEP Senior Scientist*

Ms. Ott has been the Program Scientist for the Charlotte Harbor National Estuary Program (CHNEP) since June 2008. The Charlotte Harbor NEP is located in Southwest Florida and is managed through a partnership working to improve water quality and ecological integrity using a technically sound, consensus based decision-making process. Judy assists local partners with implementing the CHNEP Comprehensive Conservation and Management Plan through staff support of the Technical Advisory Committee, reviewing and managing scientific grants, and participating in research, monitoring and restoration projects which protect and restore submerged, intertidal, wetland and upland habitats throughout the study area. Prior to 2008, Judy worked for the FL Department of Environmental Protection as an Aquatic Preserve Manager for the Charlotte Harbor Aquatic Preserves and her activities focused on estuary resource management and research and education, including developing and implementing water quality and seagrass monitoring, permit application reviews and educational wading trips. She developed the Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network and Charlotte Harbor Aquatic Preserve Seagrass Transect Monitoring program. Judy has an MS in Water Resources Management from the University of Wisconsin and a BS in Biology, Earth Science and Secondary Education from Central Michigan University. Her professional experience includes watershed management for the Wisconsin Department of Natural Resources, Great Lakes water quality field and laboratory work for the US Environmental Protection Agency and teaching middle school science in Costa Rica and summer camp marine science in the FL Keys. She has co-authored over 20 publications and technical documents relating to watershed management and water quality, seagrass monitoring and oyster restoration.

Tuesday Special Luncheon Speaker

Beacham Furse, *Biological Administrator*

Kissimmee-Okeechobee-Everglades Aquatic Resource Management
Aquatic Habitat Restoration and Enhancement Sub-Section, Division of Habitat and Species Conservation
Florida Fish and Wildlife Conservation Commission

Mr. Furse received his Bachelors degree in Biology from Georgia Southern College and Masters degree in Fisheries from the University of Georgia. He has worked for FWC since 1991. Beacham worked as a biologist conducting fisheries research on the Kissimmee River and Lake Okeechobee until 1997. He served as the FWC's Project Manager for aquatic resource management on Lake Istokpoga and the Southern Lake Wales Ridge lakes until 2006. Beacham currently works for the Aquatic Habitat Restoration and Enhancement Sub-Section overseeing aquatic habitat project management teams within the Kissimmee-Okeechobee-Everglades region of Florida (freshwater bodies from Osceola County south).

Wednesday Keynote Speaker

Mark Hoyer, *Director LAKEWATCH*

Mr. Hoyer is currently the Director of Florida LAKEWATCH at the University of Florida. He received a Bachelor of Science in Fisheries and Wildlife Biology from Iowa State University and his Master of Science in Limnology from the University of Missouri, Columbia. Mark has been with the University of Florida for 32 years participating in many research projects on streams, lakes and estuaries throughout the state Florida. Mark has been active in FLMS since the early 1990's and with the Mother Ship NALMS including a NALMS Presidential term from 2009 – 2011. Mark is also an active member of the American Fisheries Society (AFS) and Aquatic Plant Management Society (APMS) and serves on the Florida Water Resources Monitoring Council initiating a working group for long-term trend analyses of Florida's aquatic resources.

Workshops

Monday Workshop #1

Macro invertebrate surveys to diagnose aquatic ecosystem conditions in wetlands, streams, canals, and lakes of South Florida

David Ceilley
Senior Ecologist - Johnson Engineering Inc.
Graduate Faculty at Florida Gulf Coast University

The macroinvertebrate workshop will include an overview on the use of macroinvertebrates in the biological assessment of aquatic habitats in South Florida including wetlands, streams, lakes and canals. This will be followed by a field sampling exercise where participants will conduct a rapid assessment of a lake littoral zone or a wetland depending upon availability of inundated habitat. Sampling will include using dip nets and shallow sorting pans or trays to collect and sort organisms and transfer them to the lab where they will be identified using stereo microscopes and taxonomic keys. Species lists will be used to calculate diversity metrics but also to compare community structure with reference sites for Everglades restoration projects.

The discussion on the use of macroinvertebrates will include:

1. Important trophic linkages (CERP models) & multiple functional feeding groups
2. History as stream condition & WQ indicators (Florida SCI, IBI, Bio-recon)
3. Community sensitivity: hydrology and habitat change
4. Indicator species: (WQ, hydroperiod, habitat)
5. Cost-effective, simple & repeatable methods

Monday Workshop #2

Overview of DEP SOPs for Surface Water Sampling: Focus on Volunteer Monitoring Programs

Florida Department of Environmental Protection

Who: This training is intended for anyone who collects or plans to collect water quality data from Florida surface waters and provide those data to the Florida Department of Environmental Protection (DEP). Specific attention will be paid to the specific challenges faced by volunteer monitoring programs and resources available to them.

What: This workshop will give participants an overview of the DEP Standard Operating Procedures (SOPs) within the DEP Quality Assurance Rule (62-160, F.A.C) and teach them how to collect and preserve surface water samples in accordance with DEP SOPs. The class will also provide instruction in the proper calibration and verification of field instruments used to measure common field-testing parameters in water samples (pH, DO, conductivity). The course consists of a classroom session to review the relevant SOPs and perform instrument calibrations and verifications, and a hands-on segment outdoors for sample collection. Questions and discussion about "real-world" scenarios encountered in the field are welcomed. Relevant SOPs will be provided.

Topics to be covered include:

- General quality assurance considerations (SOPs FA 1000, FC 1000, FM 1000)
- Documentation requirements (SOP FD 1000)
- Surface water sampling, including use of equipment (SOPs FS 1000, FS 2000, FS 2100)
- Quality control samples (FQ 1000)
- Field testing procedures, including calibration and verification of meters (SOP FT 1000)
- Incorporation of DEP SOPs into volunteer sampling manuals

Why: Resource managers and consultants that wish their data to be evaluated by DEP for the assessment of Water Quality Standards, including Numeric Nutrient Standards, must comply with the SOPs and QA requirements, and also must understand the context in which the data will be interpreted, so that the data can be used appropriately.

Monday Workshop #3

Past, Present, and Future:
Using Climate Data and Models to Inform Lake Management in Florida

Sam Arden, P.E.
Dept. of Environmental Engineering Sciences
Engineering School of Sustainable Infrastructure & Environment
University of Florida

Climate and weather are primary drivers of the structure and function of lake ecosystems. For lake managers, a thorough understanding of how climate and weather affect lake ecosystems—and how these drivers have changed over time—is critical for setting protective and feasible management goals. In the first part of the workshop, participants will distinguish between climate and weather and review how each impact important lake characteristics (hydrology, water quality, biology). Participants will then learn where to find historical climate data relevant to their systems and how these data can be used to understand historical water quality and ecological trends. Finally, participants will review available climate projections and discuss the ways in which these predictions are (and are not) useful for future planning.

Wednesday Workshop #1
UNDERSTANDING WATERWAY MANAGEMENT (2 Hours=2 CEU Credits)
Course Number: 9625544

Rose Bechard-Butman - Allstate Resource Management

Objectives:

To understand the requirements for Federal, State and County Regulators while educating and keeping your homeowners satisfied. This segment will cover managing lakes and their ecosystems and familiarize property managers with current industry standards for waterway management including equipment, plants, fish and aquatic weed control.

Agenda:

- What today's educated consumer should look for in a water management company. Lake Management: Aquatic weed and algae control, fish stocking, water quality monitoring, debris removal and aquatic pest control. (25 minutes)
- Mitigation is the re-vegetation of beneficial native wetland plant species in a disturbed area that is required by jurisdictional agencies. Discussion will cover littoral shelves, wetland preserves and upland preserves. Topic will cover the replenishment of natural areas within urban communities. Specific beneficial native aquatic plants and exotic invasive plant species will be identified. (25 minutes)
- Aeration benefits lake ecosystems by increasing circulation and destratification which helps to control undesirable bacteria. Types of aeration equipment including fountains will be discussed. (25 minutes)
- Stormwater systems, inspections, stormwater maintenance and erosion will be presented and discussed. (25 minutes)
- Understanding the benefits of wildlife, beneficial plants versus invasive and exotic, which helps the property manager to better understand the ecological balance of waterways. This knowledge is helpful in explaining an often misunderstood area to homeowners. Plants and wildlife will be discussed. (25 minutes)

Wednesday Workshop #2
COAST RESTORATION PROGRAM

Rachel Gwin – Choctawhatchee Basin Alliance

Who: This training is intended for anyone who is interested in coastal restoration projects. Specific attention will be paid to the permitting process and commonly used restoration techniques used by CBA.

What: This workshop will give participants an overview of the Choctawhatchee Basin Alliance's coastal restoration project techniques, the permitting process of different restoration projects, and other coastal restoration techniques not currently used by CBA. The class will be a combination of a presentation on CBA's projects including techniques for high energy, medium energy, and low energy sites, as well as a hands-on demonstration of the products used and where to acquire them. Questions and discussions about coastal restoration sites and projects are welcomed.

Techniques to be covered include, but are not limited to:

- Fossilized and recycled oyster shell breakwaters
- Coir logs
- Native Shoreline Grass plantings
- Oyster domes

Wednesday Workshop #3
LAKE MAINTENANCE: CONTROLLING WEEDS, ALGAE AND AQUATIC PESTS (1 Hour=1 CEU)
Course Number: 9625875

Rose Bechard-Butman - Allstate Resource Management

Objectives:

To become familiar with the types of aquatic weeds and their EPA approved treatments as well as beneficial aquatic plants. Recommended water testing and how it relates to application of herbicides. How fish stocking and aeration helps to control undesirable plant growth and aquatic pests.

Agenda:

- Licenses and certifications. Weather conditions and water testing as it relates to herbicide applications. (15 Minutes)
- Herbicides, Larvicides and their proper application situations. (15 Minutes)
- Beneficial vs. Undesirable Plants and their identification. (10 Minutes)
- How fish stocking and aeration can benefit lake quality. (15 Minutes)

Wednesday Workshop #4
WATER QUALITY, FOUNTAINS & AERATION (1 Hour=1 CEU)
Course Number: 9625823

Andy Roberts - Allstate Resource Management

Objectives:

To become familiar with the components of water quality and recommended testing. Aspects of poor water quality will be discussed to include prevention and remedies. Various types of aeration equipment and their purposes will be described.

Agenda:

- Water Quality (15 Minutes)
- Thermal Stratification and Nutrient Cycling (20 Minutes)
- Types of Aeration Systems (15 Minutes)
- Fountains (10 Minutes)

Wednesday Workshop #5
POND AND SMALL LAKE RESTORATION TECHNIQUES

John McGee, Hillsborough County Lake and Stream Management

Who: This training is intended for anyone who is interested in environmentally sound restoration processes for stormwater ponds and small lakes. This session is primarily targeted to homeowners and property managers working in a residential context.

What: This workshop will provide participants with the basis for developing a site-specific restoration and management strategy for a stormwater pond or small lake. Techniques are drawn from the Hillsborough County Adopt-A-Pond and Lake Management programs which have guided residents through restoration and management of these systems for over 20 years. Participants will leave with an understanding of:

- How to find relevant background information on their waterbody
- How to assess conditions of the waterbody
- How to develop an adaptive management strategy
- Principles of restoring and managing small waterbodies
- How to sustain the process

Why: Many waterfront residents are not prepared to manage their ponds and lakes. This results in lack of management, mismanagement, and increased development of problems. The effects of mismanagement not only impact the waterfront community, but have a direct impact on downstream properties and on the condition of surface waters in the region surrounding that waterbody. Over many years, the Adopt-A-Pond and Lake Management Program have developed a clear and effective process to educate and empower homeowners and property managers to efficiently and responsibly manage the water resources in their community.

Session Abstracts

Session A1: Water Resource Management, FTSI, NNC, WQBEL, Water-Cat and other Mysterious Acronyms

Moderator: Serge Thomas
Tuesday, June 9, 10:15 am to 12:15 pm

NUMERIC NUTRIENT CRITERIA: THE REST OF THE STORY

Daniel E. Canfield Jr
Fisheries and Aquatic Sciences, School of Forest Resources and Conservation,
University of Florida, Gainesville, Florida

Development of a Numeric Nutrient Criteria (NNC) acceptable to the USEPA and the State of Florida was not an easy process and compromise was needed to achieve passage. In developing the compromise, lakes could be removed from FDEP's *VERFIED LIST* of impaired waters if "values exceeding the criteria are not due to pollutant discharges or reflect natural background conditions, including seasonal or other natural variations, the water shall not be listed on the *VERIFIED LIST*. In such cases, the Department shall note for the record why the water was not listed and provide the basis for its determination that the exceedances were not due to pollutant discharges" (**Rule 62-303.420, Florida Administrative Code)**. Natural background conditions are defined in **Rule 62-302.200(19) Florida Administrative Code**. Grassy Lake, a named Florida lake (GNIS 283322) in west-central Polk County (Township 29s, Range 25e, Section 2), was declared impaired by FDEP for nutrients due to elevated Trophic State Index (TSI) during the January 1, 2002 to June 30, 2009 verified period as part of FDEP's Group 3, Cycle 2 review. In 2013, Atkins North America using the new NNC evaluated FDEP's Final *VERIFIED LIST* of impaired Polk County waters and concluded Grassy Lake was impaired for total nitrogen. Atkins, however, did not specifically considered issues raised in **Rule 62-303.420** to determine if Grassy Lake should be removed from the final *VERFIED LIST*. Information is presented to support the conclusion that under **Rule 62-303.420** Grassy Lake is not an impaired lake and FDEP should remove the lake from their VERIFIED LIST of impaired Polk County waters.

AN ALTERNATIVE TO MEET NUMERIC NUTRIENT CRITERIA, APPLYING THE WQBEL OPTION TO SEETWATER BRANCH

Jan Mandrup-Poulsen and Russell Frydenborg
Dynamic Solutions, LLC, Tallahassee, Florida
Frydenborg Ecologic, LLC, Tallahassee, Florida

The City of Gainesville Regional Utilities' Main Street Water Reclamation Facility (MSWRF) was faced with the possibility of having to spend millions of dollars to upgrade its treatment train to comply with Florida's recently adopted Numeric Nutrient Criteria that apply to Sweetwater Branch, i.e., Total Nitrogen = 1.87 mg/L and Total Phosphorus = 0.3 mg/L (as annual geometric mean concentrations not to be exceeded more than once in any three calendar year period). Four options were considered for complying with NNC for Sweetwater Branch: 1) construction of a pipeline to by-pass Sweetwater Branch; 2) assessing if the water conveyance ("ditch") exception from stream NNC applied; 3) reclassifying Sweetwater Branch as a Class III-Limited waterbody; and 4) adopting Level II Water Quality-Based Effluent Limitations. Based on input from staff and the stakeholders, the WQBEL approach was selected. A Plan of Study was drafted and

approved by the Florida Department of Environmental Protection. The WQBEL approach requires a demonstration that the nutrients being discharged by the MSWRF at concentrations in excess of the applicable NNC will not harm the flora or fauna in Sweetwater Branch and provide reasonable assurance of downstream protection. A QUAL2K model was set up and run to test for worst-case conditions (maximum permitted discharge under full range of ambient flows) to evaluate the expected impacts to chlorophyll and periphyton in the segment of Sweetwater Branch extending from the outfall going downstream to a recently created Enhancement Wetland treatment system. A Stressor Identification Study, using historical and current data, concluded that the flora were healthy, and that the fauna were affected by factors other than nutrients (i.e., habitat and hydrologic alterations). This presentation will report the outcomes of the study.

FLORIDA WATER-CAT: MAKING IT EASIER TO SHARE METADATA ABOUT CHEMICAL, PHYSICAL AND BIOLOGICAL WATER MONITORING ACTIVITIES

Shawn Landry and Jan Allyn
USF Water Institute, University of South Florida, Tampa, Florida

The State of Florida has over 7,700 lakes, more than 11,000 miles of rivers/streams, more than 2,000 miles of tidal shoreline, and it sits atop one of the most plentiful aquifers in the United States. Water resource monitoring is vitally important so that water resource managers can ensure that this water meets the needs of the human population and ecosystems of Florida. Monitoring activities are carried out by hundreds of individual organizations, including: local, state and federal environmental agencies, educational and research institutions, environmental consultants and volunteer monitoring groups. In order to make it easier to coordinate monitoring efforts and share data, the Florida Water Resource Monitoring Catalog (Water-CAT) was developed as a publicly accessible online searchable database of metadata about water resource monitoring activities in Florida. The Water-CAT was developed by the USF Water Institute in partnership with the Florida Water Resource Monitoring Council (FWRMC) and launched in 2014 with metadata extracted from Florida STORET.

Since the release of the Water-CAT, the project partners have been working with data providers to acquire metadata, populate the online database, and refine the application. The effort to obtain comprehensive metadata is being balanced with the reality that data providers can only dedicate a minimal amount of time towards metadata documentation. For example, most data providers (out of 97 contacted) indicated that a lack of time or budget would made it difficult for them to assemble supplementary metadata. The FWRMC also revisited the Water-CAT design and made changes, including: making it optional to provide a few formerly required metadata elements, redesigning the design to allow flexibility between data providers, and accommodating biological and ecological monitoring activities. This presentation discusses the future of the Water-CAT and the lessons learned during the first year of efforts to obtain metadata and manage the website.

THE DEATH OF FTSI AND HOW TO DEAL WITH IT

Clell Ford
Highlands County Natural Resources Department, Sebring, Florida

The Florida Tropic State Index (FTSI) was a staple of lake water quality determinations and comparisons for many years. Trophic State Index metrics, with their roots in the 1970s and 1980s, combine nutrients and chlorophyll-a into one unitless number and then compare that to a standard. The FTSI was calibrated to Florida conditions, comparing the results

for a given lake to natural watershed factors including ambient soil nutrients and tannins. Many hours of calculation and analysis were expended on understanding, maintaining and interpreting these unit-less numbers, and the results were used by FDEP as an important tool in determining lake health. A weakness in relying on pelagic nutrient and chlorophyll-a values to assess lake quality is that littoral zone organisms which are also a critical factor in lake ecosystem health are not in the equation. Without this near-shore biological information, the relative usefulness of FTSI in some of our shallow subtropical lakes proved tenuous.

Now state regulations call for surveys of lake vegetation to calculate a Lake Vegetation Index (LVI); those results are then combined with water chemistry values to evaluate lake health. At present, though encouraged, there is no mandate to also determine the health of the benthic macroinvertebrate community as well. Does the LVI actually tell us more about lake health than the old FTSI did? Is just estimating plant habitat and measuring nutrients really enough? Does LVI give the ecological overview of lakes that FTSI cannot? Are additional metrics needed in order to truly determine lake impairment? This talk will look at the pros and cons of the FTSI versus LVI-nutrient assessments of lake quality.

SEMINOLE COUNTY'S WATERSHED MANAGEMENT PROGRAM: MAXIMIZING PARTNERSHIPS AND RESOURCES

Shannon Carter Wetzel
Seminole County Public Works, Watershed Management Division, Sanford, Florida

The Watershed Management Division is responsible for watershed monitoring and assessment throughout Seminole County. The Water Quality and Lake Management Programs, two major components of the division, aim to protect, conserve and restore Seminole County's water resources. Both programs are able to accomplish these goals through leadership, sound science and a collaborative, comprehensive process.
The Water Quality Program (WQP) was initiated in 1997 to meet federal and state National Pollution Discharge Elimination System (NPDES) stormwater permits and the Total Maximum Daily Loads (TMDL) regulatory requirements. This is achieved through coordinated water chemistry and biological monitoring programs, providing formal water resource assessments, public education and volunteer programs, and by providing technical assistance to residents, other agencies and local governments. Long term monitoring and biological assessments are used to analyze the health of County waterbodies and determine whether they have declining, stable, or improving water quality trends. All of this information, as well as data and information from many other sources, is stored in the Seminole Watershed Atlas (www.seminole.wateratlas.usf.edu), which is a user friendly, online database of water resource data and stormwater educational information accessible to the public.

The Lake Management Program (LMP) was initiated in 2006 primarily to address the regulatory requirements of the state and federal Total Maximum Daily Load program of the Clean Water Act. The overall goal of the program is to achieve regulatory compliance through the restoration of "impaired" waterbodies to their natural state, meeting their designated uses. The program works directly with lake front homeowners and homeowner associations, and focuses resources and activities on lakes and waterbodies most immediately impacted by the state's TMDL implementation schedule. The LMP concentrates efforts on in-lake assessments and restorations, as well as targeted watershed education and source reduction through the contracted Florida Yards and Neighborhoods (FYN) Program for these priority waterbodies.
In order to accomplish all of these tasks the Division has used a variety of volunteer based programs, grants, cost share agreements, and extensive inter-department resource sharing and cross training.

RESTORATION OF PALATLAKAHA SYSTEM BY MODIFIED TWIN RADIAL GATE DAMS (TRGD)

Ronald L. Hart
Lake County Water Authority, Tavares, Florida

The Florida Legislature created the Lake County Water Authority (LCWA) in 1953 with the primary purpose of improving the lakes, streams and canals. One of the projects the LCWA immediately began implementing was the channelization of the Palatlakaha. When the project was halted in 1983, it included 6 small dams and 8.2 miles of canals. The remaining structures and natural areas were never constructed or dredged as the Board became more environmentally focused.

During a visioning session in 1999, the LCWA prioritized future potential programs and listed the restoration of the Palatlakaha as the most important project. However, funding competition with other high profile projects delayed implementation. The financial breakthrough came in 2012 when the Board allocated funding for the design and permitting of the two northernmost dams, M-1 and M-4.

Initial plans for M-4 were to perform complete site restoration, mimicking the site's preconstruction elevations, channels, and vegetation. At M-1, full restoration of the river downstream of the dam was not feasible. This was due to a large marina that depended on the improved channel for navigational access to Lake Harris. Because of the potential impact to the marina, M-1 was proposed to be modified to a fixed weir. This type of structure would prevent further bottom channel erosion upstream while still allowing navigation downstream at the marina.

As the proposed project proceeded to permitting, several road blocks prevented the full restoration to the original conditions at M-4. Most notably was a change in wetland hydroperiod from the original preconstruction water levels to the post restoration levels. These changes no longer made the complete restoration feasible. The project was able to proceed by maintaining the hydroperiod through the utilization of another fixed weir structure. These modified structures with fixed weirs were constructed in 2013. The project continues to progress with funds allocated this year for permitting similar designs at structures M-5 and M-6.

Session A2: Lake System Science and Restoration Techniques

Moderator: Harvey Harper
Tuesday, June 9, 1:30 pm to 3:25 pm

ASSESSING THE STRENGTH OF THE PHOSPHATE BOND FORMED BY LANTHANUM MODIFIED CLAY (PHOSLOCK)

Michael Shaner[1], Patrick Van Goethem[1], Said Yasseri[2],
[1]SePro Corporation, Orlando, Florida
[2] Institut Dr Nowak, Ottersberg, Germany

Both nitrogen and phosphorus (p) are important nutrients for all living organisms in aquatic ecosystems. In most fresh water systems however, it is phosphorus that is the limiting nutrient, and its concentration is critical in the determination of the trophic level of a water body. In many lakes, the release of phosphorus from sediments (internal p loading) is a key driver of eutrophication and controlling this internal p load is an important step in the restoration of eutrophic

lakes. A variety of methods aimed at controlling internal p loading have been used by lake managers over the years, including the applications of sediment capping materials such as lanthanum modified clay (phoslock®), aluminium sulfate and ferric chloride. In this study, we examined the forms by which phosphate is bound by lanthanum modified clay and assessed the potential for phosphate to be re-released under various enviro-chemical conditions. The analysis was performed by fractionating sediment treated with the lanthanum modified clay according to the psenner method. This method, which was adapted from soil science and is commonly used by limnologists, involves the sequential extraction of phosphorus from aquatic sediments in order to determine the forms by which phosphorus is bound. The results from our studies show that phosphorus bound to lanthanum modified bentonite is strongly bound and unlikely to be released under any naturally occurring environmental condition. We also compare these findings to the stability of the iron or aluminium bonds to phosphorus, based on differences in electro-negativity and the respective solubility products of the phosphorus molecules formed. Results from laboratory and lake trials will be discussed.

IMPACTS OF RECREATIONAL BOATING ON WATER QUALITY IN LAKES

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

Florida has approximately 8,000 lakes and leads the nation in boat registrations with more than 1 million registered recreational boats. Recreational boating and ancillary businesses are a multi-billion dollar industry in Florida alone. However, few studies have been conducted to evaluate the impacts of boating on water quality in lakes. One of the first studies to address the issue of boating impacts by boating was conducted by Yousef, et.al. (1977) which indicated that repeated boating activity using 90 - 135 HP outboard motors, which were some of the largest available at the time, disturbed bottom sediments as deep as 10 feet and significantly increased water column concentrations of turbidity, TSS, and total P compared with control chambers. Substantially larger boat engines are available today as well as boats designed specifically to provide an enhanced wake.

A more recent study of boating impacts was conducted by ERD in the Butler Chain-of-Lakes, a series of 11 oligotrophic lakes in southwest Orange County, during 2004. ERD correlated water quality in the lakes with the number of active boats in operation during routine monitoring events and found statistically significant relationships between the number of boats and water column concentrations of particulate N, total N, SRP, particulate P, total P, and TSS. Statistically higher concentrations of particulate N, total N, and total P were observed on weekend days compared with weekdays. A linear regression model was developed to evaluate boating impacts as a function of lake bathymetry, and significant correlations were observed between boating impacts, water depth, and flushing rate. Boating impacts can be minimized by limiting full speed boating activities to water depths appropriate for the type of water craft in use.

NEW NALMS POLICY SUPPORTS AN ADAPTIVE SYSTEMS APPROACH TO FRESHWATER MANAGEMENT

Ken Hudnell[1], Steve Beeman[2], Van McClendon[3]
[1]Medora Corp., New Bern, North Carolina
[2]Beemats, LLC, New Smyrna Beach, Florida
[3]Due Diligence, LLC, Little Rock, Arkansas

Positions recently specified by the North American Lake Management Society (NALMS) call for four changes in U.S. Environmental Protection Agency policy for the restoration and protection of impaired and at-risk lakes and reservoirs.

- Use a whole-system approach that views waterbodies and watersheds as one system, and does not *a priori* privilege intervention in one part of the system over another
- Fully implement the Clean Water Act (CWA) to support waterbody treatments on an equal basis with the currently emphasized point-source and watershed controls
- Support systematic and rigorous scientific analyses to identify the direct and secondary causes of water quality impairment and interventions to control them
- Support systematic and rigorous cost-benefit analyses of all potentially beneficial interventions – point and non-point pollutant input controls and waterbody treatments – to select interventions that improve water quality as quickly and inexpensively as possible

NALMS reviews revealed, and this talk describes, the following factors supporting full implementation of the CWA with an Adaptive Systems Approach (ASA).

- A majority of US lakes and reservoirs are impaired, and impairment, particularly eutrophication, is increasing in spite of large expenditures of money and time
- Current water quality assessments and management strategies often neither identify all direct and secondary causes of impairment nor address them
- The degradation of lake and reservoir water quality imperils health, aquatic ecosystems, water supplies, and the economies dependent on them

Cost-effective and timely water-quality improvements require an ASA. An ASA considers water quality to derive from interactions between freshwater, its abiotic physical, chemical, and hydrological frame, its biota, and inputs from its watershed's surface, groundwater, and atmosphere. Only rigorous science and economics applied with an iterative process can identify optimal restoration and protection systems and substantially improve water quality. Initial results from an investigation of ASA development and implementation for large reservoirs will be presented.

IN LAKE FLOATING TREATMENT WETLANDS COULD PROVIDE ALGAE CONTROL THROUGH UNSUSPECTED MECHANISMS

Dana L. Dettmar, Dr. Serge Thomas & Dr. Hidetoshi Urakawa
Florida Gulf Coast University, Fort Myers, Florida

Cultural eutrophication has been negatively impacting both artificial and natural water bodies by triggering (at times harmful) algal blooms. These blooms are typically controlled by algaecides, which can collaterally affect aquatic organisms thus further damaging the system. Preventing point and non-point nutrient sources may not be sufficient since internal nutrient loading is generally high. Internal loading can however be reduced, often at great expense, through i) demucking, ii) chemical treatment, and iii) hypolimnetic aeration. Floating Treatment Wetlands (FTWs) are a new type of green technology being used to remediate eutrophic systems. Plants grown hydroponically on a floating mat uptake

water nutrients from their roots. The nutrients become tied up in the young growing plants, which are then harvested before fully mature to remove the excess nutrients from the system to reduce internal loading. Nutrient removal performed by these FTWs is limited unless 5-10% of the water body is covered. However, even with a surface coverage as low as 3%, FTWs seem to provide algae control through poorly understood or identified mechanisms. A 2-year investigation was thus led in three subtropical ponds (Pond A, Livingston Pond and Collier Pond) of about an acre and are located within the City of Naples, FL to examine whether the dense root network from FTWs' plant would i) have allelochemicals able to control algae, ii) offer diurnal zooplankton protection against predation so that nocturnal grazing would be intensified and iii) harbor beneficial bacteria able to remove water nutrients. For the allelopathy experiments, two methods were used: a liquid culture assay as well as an agar diffusion assay, both in which wells containing algae were inoculated with allelochemical methanolic extracts. Zooplankton presence/absence studies were completed by performing vertical tows underneath the FTW and in the open water both during the day and night to explore their nycthermeral migrations. Root microbial communities were characterized by extracting DNA from root samples using the phenol-chloroform extraction method. The purified DNA was used for fingerprinting (denaturing gradient gel electrophoresis, DGGE) and high-throughput DNA sequencing. Results showed that chemicals present in the two plants examined (*Juncus effuses* and *Canna flaccida*) could either control algae (especially cyanophycea) but in some cases also enhance algae growth (especially chlorophycea). The agar diffusion assay displayed stronger inhibition than the liquid culture assay due to the fact the extracts were not diluted as they were in the liquid culture assay. In Livingston Pond and Collier Pond, it was determined that zooplankton did not utilize the root systems of FTWs. We did not find any horizontal nycthemeral zooplankton migrations between the FTW and the open water; however vertical migrations were found. Zooplanktorivores minnows were found in great numbers with the roots of the FTWs at night. It is speculated that the lack of zooplankton in Pond A would be explained by the heavy use of copper which collaterally controlled the zooplankton and thus removed natural phytoplankton control through grazing. The bacterial community of Pond A FTWs was typical of oxic as well as anoxic and even anaerobic environments despite the presence of DO and ORP in the water underneath the AFIs. Based on the microbial community composition, it is hypothesized that the microbial biofilm growing on the root changed from oxic, to anoxic and anaerobic from its surface to its basal layer. Thus, all biologically mediated reactions could potentially occur within this biofilm and especially denitrification. However no denitrifiers were found in the biofilm, but paradoxically nitrogen fixers were present thus potentially adding nitrogen to the system. Based on the results of this study it appears that FTWs have potential mechanisms to control algae growth aside from nutrient uptake. Allelopathy and a microenvironment prone to denitrification were such mechanisms but more investigation should be conducted to fully understand the net algal control and impact on nutrient cycling.

PAIRING WATER CHEMISTRY DATA WITH PHYTOPLANKTON: DOES COLLECTION METHOD REALLY MATTER?

Lori McCloud and John Hendrickson
St. Johns River Water Management District, Palatka, Florida

The current state, or status, of a waterbody, as well as long term trends, are often measured through a variety of metrics to answer multiple objectives simultaneously: does the waterbody meet its designated use, has there been a response to implemented management activities, can impacts from anthropogenic sources be identified, and are those changes manifested through a biological endpoint? Data quality objectives are a useful tool that helps to clearly identify primary and secondary objectives of a monitoring program, and require managers to consider frequency and location of sampling, as well as method of collection. Often, managers carefully consider all components of a monitoring network, but give little thought to sample collection method, preferring to default to a standard half-meter grab sample due to the low cost of implementation and ease of reproducibility. The objective of this study is to demonstrate that careful evaluation of all objectives should be undertaken prior to collection method selection; otherwise, your characterized environment may not truly represent your focal study area.

Water quality samples have been collected at benchmark sites throughout the lower basin of the St. Johns River using multiple sampling methods since 1994 to meet multiple study objectives. We examined laboratory results of samples collected with different collection devices and found significant differences to exist based on collection device. Data evaluation fell into three categories: 1) collection events that were staggered over time but occurred at the same location; 2) paired collection events using multiple collection devices at the same location and time; and 3) a general evaluation of water quality relationships with calculated constituents.

While differences obtained between collection devices may or may not be significant for long-term trend assessments, small time-step events like plankton blooms occurring over days or weeks may be sensitive to different environmental characterizations provided by different collection devices.

Longevity of Sediment Inactivation Treatments in Florida Lakes: Analysis of Controlling Factors

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

Sediment phosphorus inactivation using metal salts was introduced in Florida during 1981 in a pilot project on Lake Eola in Orlando. Since that time, more than 35 sediment inactivation projects have been conducted. Surface areas for treated lakes have ranged from 8-920 acres. The majority of applications were conducted using alum only, with approximately 25% requiring supplemental buffering agents such as sodium aluminate or lime. Application rates for projects conducted prior to 1990 were based on available water column alkalinity. During 1992, a phosphorus speciation procedure was developed to quantify available sediment P (defined as the sum of saloid plus iron bound P), and dosage calculations for all projects conducted since then have been based on concentrations of available sediment P. Molar Al:P (available sediment P) ratios have ranged from 2 in early projects to 10 in recent projects, with areal application rates ranging from 5.6-215 g Al/m^2.

Long-term pre- and post-treatment water quality data are available for 15 of the treated lakes with applications conducted from 1995-2010. Each of the lakes exhibited both immediate and long-term improvements in water quality, and post-treatment water quality has remained better than pre-treatment in all lakes. Trend analyses were conducted to evaluate the magnitude and rate of changes in water quality in the 15 lakes. Each of the applications resulted in stable water quality improvements for a minimum of 5 years before signs of decreasing effectiveness, while some lakes have maintained stable post treatment water quality for 10-20 years. Regression analyses were conducted to identify significant factors in regulating inactivation longevity. The most significant factors regulating longevity appear to be the significance of internal recycling as a nutrient source, sediment concentrations of available P, and the areal alum application rate. The data suggest that properly conducted sediment inactivation applications can maintain improved water quality for a minimum of 10 years in most cases. Sediment inactivation is an extremely low-cost method of eliminating phosphorus loadings to receiving waters. Phosphorus mass removal costs for sediment inactivation are generally less than $50/kg compared with stormwater BMPs which generally range from $500-1000/kg.

Harvey Harper is currently President of Environmental Research & Design in Orlando, Florida. Dr. Harper is a former faculty member in the Department of Civil and Environmental Engineering at the University of Central Florida and has over 30 years of experience in limnology, water quality, and stormwater management. He has extensive experience in the use of alum for sediment inactivation and pioneered the use of alum for treatment of stormwater. He has directed more than 30 sediment inactivation projects in Florida. Dr. Harper is a former NALMS Director and has attended 29 of the 30 NALMS annual conferences.

Session A3: Water Resource Restoration Science and Management

Moderator: Bradley Fontaine
Tuesday, June 9, 3:55 pm to 5:30 pm

TESTING A NEW IPM APPROACH FOR HYDRILLA MANAGEMENT: AN UPDATE

James P. Cuda[1], Judy F. Shearer[2], Emma N.I. Weeks[1], and Julie Baniszweski[1]
[1]Entomology & Nematology Department, University of Florida, Gainesville, Florida
[2]Environmental Laboratory, U.S. Army Engineer Research & Development Center, Waterways Experiment Station, Vicksburg, Mississippi

In 2004, resistance to the herbicide fluridone was confirmed in several populations of the aquatic weed hydrilla (*Hydrilla verticillata*) in Florida, USA. This is a serious problem because fluridone is one of the most widely used EPA registered systemic herbicides labelled for use in aquatic systems. In this study, we tested a reduced-risk approach for hydrilla control by integrating selective insect herbivory with a disease organism or low concentrations of a new herbicide recently registered for aquatic use. Two rates of the fungal pathogen *Mycoleptodiscus terrestris* (Mt) and the acetolactate synthase inhibiting herbicide imazamox, and two densities of the hydrilla tip mining midge *Cricotopus lebetis* alone and in combination were randomly applied to aquaria containing established hydrilla plants and replicated three times. Hydrilla shoots in each tank were harvested ~30 days after the treatments were applied. The number of shoot tips and biomass (grams dry weight) produced were compared. Results showed that combining the hydrilla tip mining midge *C. lebetis* with either the Mt fungus or the herbicide imazamox significantly reduced hydrilla growth and the effects were synergistic. Furthermore, *C. lebetis* was compatible with the herbicide imazamox; adult emergence of *C. lebetis* was higher in some of the aquaria treated with imazamox compared with the controls not treated with imazamox. Incorporating proven biological controls like Mt and the hydrilla tip mining midge into an integrated weed management strategy could reduce overreliance on herbicides and provide a more sustainable solution to the hydrilla problem.

PRODUCTION OF SAV SOD FOR LAKE AND STREAM RESTORATION AND HABITAT ENHANCEMENT

Lyn A Gettys[1], Carl J Della Torre III[1], Ed Hayes[2] and William Haller[3]
[1]University of Florida IFAS FLREC, Davie, Florida
[2]Florida Fish and Wildlife Conservation Commission, Eustis, Florida
[3]University of Florida IFAS Center for Aquatic and Invasive Plants, Gainesville, Florida

Lake restoration projects can be challenging due to the limited availability of native submersed aquatic vegetation (SAV), the difficulty of installing plants in an underwater environment and the instability of many submersed sediments. We developed a novel technique for producing SAV "sod" which is grown in mesocosms, easily installed in the field and results in an instant population of submersed native vegetation that quickly establishes and expands from the transplant site. This presentation will outline the iterative process used to identify optimum matrix and anchoring materials and will also cover the importance of ecotype evaluation and selection for restoration projects.

One-line summary: This presentation will outline a technique for growing SAV "sod" in mesocosms for field transplantation, which results in instant populations of submersed native vegetation that quickly establishes and expands from the transplant site.

DISSOLVED OXYGEN IN FLORIDA WETLANDS: CHARACTERIZATION, POSSIBLE DRIVERS, AND REGULATED CONTEXT

Sam Arden[1], Robert Compton[1], Kelly C. Reiss[1], Mark T. Brown[1]
[1] HT Odum Center for Wetlands, University of Florida, Gainesville Florida

Florida wetlands are generally characterized as having naturally low dissolved oxygen (DO) due to a number of factors including high organic matter loading, warm temperatures and low flow velocities. However, detailed characterization of DO regimes in these systems is limited and quantitative data are needed to improve monitoring techniques, inform development of appropriate water quality criteria and better understand primary drivers of wetland DO dynamics. This paper presents the results of continuous DO monitoring in coupled riverine and wetland systems across North and Central Florida in the context of recent Florida numeric DO criteria (Florida Administrative Code 62-302.533). It is shown that due to naturally low DO regimes as well as natural diel and seasonal variability, Florida numeric DO criteria may be both inappropriate for Florida wetlands and unable to, on their own, detect ecosystem impairment. A brief discussion of possible drivers of Florida wetland DO dynamics is also provided.

INFLUENCE OF SEDIMENT CHARACTERISTICS ON SAV DISTRUBUTION IN LAKE APOPKA

Dean R. Dobberfuhl, Pamela J. Bowen, James E. Peterson, Michael F. Coveney
St. Johns River Management District, Palatka, Florida

As the historical eutrophication of Lake Apopka subsides, we expect a transition from a turbid phytoplankton dominated condition to a clearer macrophyte dominated condition. It has been hypothesized that flocculent sediments in the lake will hinder, or even preclude, broad scale submerged aquatic vegetation (SAV) colonization. To test this hypothesis, we collected sediment cores in conjunction with our annual SAV sampling. The lake perimeter was sectioned into over five hundred 100-m segments, and 109 transects were randomly selected each year (2012-14) and sampled for species coverage, patch area, and water depth. Additionally, a sediment core was obtained in each SAV patch and bare transects and sediment strata thickness was measured. Sediment type had a significant but small effect on SAV density. Patch area was significantly larger and similar on sand and unconsolidated sediments than other sediment types (consolidated, peat, concrete/rock). Total number of patches was greatest on sand and unconsolidated sediments but a Chi-Square test showed small significant biases toward bare patches in unconsolidated sediments and slight increase in frequency of *Vallisneria americana* in sand. Sediment thickness did not appear to affect SAV patch density or size. In summary, these results do not support the hypothesis and suggest that given an appropriate light field SAV should be able to colonize flocculent sediments in Lake Apopka.

HISTORIC OVERVIEW OF HABITAT DEGRADATION AND HABITAT RESTORATION: THE EFFECTS ON FLORIDA BASS RECRUITMENT AND FISHERY

Brad Fontaine[1], *Jason Dotson*[2], *Kimberly Bonvechio*[3], *Brandon Thompson*[3], *William Johnson*[3], *Nicholas Trippel*[3], *J. Beacham Furse*[4], *Steven Gornak*[4], *Kevin McDaniel*[5], *William Pouder*[6], *Erin Leone*[2]

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[5] Florida Fish and Wildlife Conservation Commission, Kissimmee, Florida
[6] Florida Fish and Wildlife Conservation Commission, Lakeland, Florida

Many of Florida's natural lakes have experienced degradation of habitat resulting from anthropogenic influences, which can impact Florida Bass *Micropterus floridanus* populations. Over the past 40 years, the Florida Fish and Wildlife Conservation Commission (FWC) and cooperating agencies have employed a variety of enhancement strategies to combat these habitat changes. We provide a historical overview of habitat degradation, large-scale habitat enhancement strategies that have been conducted, and resulting effects that these strategies have had on Florida Bass recruitment and fisheries in Florida lakes. We provide a case study evaluation of different large-scale enhancement strategies aimed at improving degraded habitat in four natural systems: (1) extreme lake drawdown conducted at Lake Griffin, Florida; (2) mechanical removal of macrophytes and organic sediment under dewatered conditions at Lake Tohopekaliga, Florida; (3) hydraulic dredging of macrophytes and organic sediment under inundated conditions at Lake Panasoffkee, Florida; and (4) lake-wide herbicide treatment of hydrilla over a 25-year period at Lake Istokpoga, Florida. The Lake Griffin drawdown showed significant increases in Florida Bass recruitment, angler catch, and effort. The Lake Tohopekaliga habitat enhancement project produced at least one strong year-class, which achieved higher growth rates than other cohorts and contributed positively to the fishery after 3 years. The Lake Panasoffkee habitat enhancement project did not show any significant impacts to Florida Bass recruitment, but significant increases in angler catch of Florida Bass were measured. We failed to detect significant relationships between hydrilla coverage and Florida Bass recruitment at Lake Istokpoga, Florida, although hydrilla coverage had significant effects on angler catch and effort of Florida Bass. We show that a variety of habitat enhancement strategies can be utilized to improve habitat and thereby maintain quality or improve declining Florida Bass fisheries.

Session A4: Poster Session

Tuesday, June 9, 6:00 pm to 8:00 pm

SHORT-TERM DYNAMIC CHANGES IN SUBMERSED AQUATIC VEGETATION IN LAKE APOPKA

[1]Tiffany Trent, [1]Pam Bowen, [1]Mike Coveney, [2]James Peterson
[1]St. Johns River Water Management District, Palatka, Florida
[2]St. Johns River Water Management District, Apopka, Florida

Florida's 4th largest lake, Lake Apopka, has a unique history that includes a radical transformation in primary producer community structure. Once the premier bass fishery in the state, this lake experienced a shift of plant to phytoplankton dominance in the 1940s. Aquatic macrophytes disappeared, sport fishes declined, and gizzard shad became dominant in the fish community. Restoration efforts by the St. Johns River Water Management District (SJRWMD) and others began in the 1980s emphasized phosphorus loading reduction and removal of phosphorus stores from the lake. An important metric to track progress of the restoration is the re-growth of submersed aquatic vegetation (SAV). SAV provides essential structure to most aquatic ecosystems as well as organic production, refuge for aquatic species, increased dissolved oxygen, sediment stabilization, and turbidity reduction. As water quality in Lake Apopka improved, SAV patches began to appear around the lake perimeter. In 1995, SJRWMD began mapping these patches using a whole lake mapping method (WLMM); an effort that demanded ever-increasing time and resources with SAV expansion. To reduce overall effort, SJRWMD adopted a stratified random sampling method (SRSM) that incorporates randomly selected 100-meter transects in different stratifications defined by SAV density. This method when compared with traditional WLMM proved to be 98% accurate. Here, we present the results of the SRSM method with data collected between 2011-2014 that include species list, relative SAV abundance, Shannon Index Species Diversity, SAV patches by strata, and relationships of water depth and SAV occurrence.

SEASONABLE ERODIBILITY OF COHESIVE MIXED-MUDDY SEDIMENTS AND BIOTURBATION IN THE CALOOSAHATCHEE RIVER ESTUARY OF SOUTHWEST FLORIDA

David Kluesner and Dr. David Fugate,
Department of Marine and Ecological Sciences,
Florida Gulf Coast University, Fort Myers, Florida
Associate Professor of Marine Science,
Department of Marine and Ecological Sciences,
Florida Gulf Coast University, Fort Myers, Florida

Pollutants and oil spills tend to concentrate in cohesive mixed-muddy sediments in low energy depositional environments. It is important to understand the critical shear stress and erodibility at the river bed, and its relationship with bioturbation of sediments by benthic bioturbators. All to provide a baseline for predicting the movement of pollutants and oil spills in cohesive sediments of the Caloosahatchee River estuary.

Bottom sediments in river estuaries are aggregates of sediment grains and biotic detritus. The sediment grains comprise non-cohesive sands and cohesive mixed silts, muds and clays. Non-cohesive aggregates of grains tend to fall apart versus cohesive aggregates that stick together and are more resistant to erosion e.g., by inter-particle attractions or biological films and glue. Currents and waves generate friction and re-suspend bottom sediments depending on the force and critical shear stress (τ_{cr}) to erode and lift sediments into motion at the river bed.

We are unable to predict the erosion of cohesive mixed silts, muds and clays with models. Furthermore, biological modification effects aggregation, cohesiveness, bed roughness, and flow characteristics. Bioturbation by macro fauna burrowing, feeding, and reworking modifies and mixes sediment effecting the above properties.

The objective is to investigate seasonal variations in critical shear stress τ_{cr} and the erosion of mixed-muddy, cohesive sediments on the river bed at a site near Beautiful Island in the upper Caloosahatchee River estuary, Fort Myers, Florida. The FGCU Gust type laboratory erosion chamber is used to measure critical shear stress and erodibility of sediment cores over two consecutive wet, dry, and transitional seasons.

An additional objective is testing for seasonal variations in bioturbation of the river bed and its effect on critical shear stress and erodibility through placing, coring and counting of inert colored tracer grains redistributed by benthic bioturbators.

THE HIDDEN RULES IN THE FLORIDA NUMERIC NUTRIENT CRITERIA

Daniel E. Canfield Jr., Roger W. Bachmann, Dana Bigham Stephens, Mark V. Hoyer
Fisheries and Aquatic Sciences, School of Forest Resources and Conservation,
University of Florida, Gainesville, Florida

When numeric nutrient criteria were added to the Florida water pollution rules in 2012, the Florida Environmental Regulation Commission recognized that there were regions of Florida where lakes were naturally eutrophic. For this reason, they added two additional rules that seem to have been overlooked in practice. One of the added rules states that lakes cannot be placed on the verified list if the exceedances of the nutrient criteria are due to natural factors.
http://flrules.elaws.us/fac/62-303.420

PART IV

THE VERIFIED LIST

62-303.420 Aquatic Life-Based Water Quality Criteria Assessment.

(1) The Department shall reexamine the data used in Rule 62-303.320, F.A.C., to determine whether water quality criteria are met.

(a) If values exceeding the criteria are not due to pollutant discharges or reflect natural background conditions, including seasonal or other natural variations, the water shall not be listed on the verified list. In such cases, the Department shall note for the record why the water was not listed and provide the basis for its determination that the exceedances were not due to pollutant discharges.

The second addition defined natural background conditions for phosphorus and nitrogen relative to the nutrient zones described by Bachmann et al. (2010).
http://flrules.elaws.us/fac/62-302.200

62-302.200 Definitions.

(19) "Natural background" shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody, historical pre-alteration data, paleolimnological examination of sediment cores, or examination of geology and soils. When determining natural background conditions for a lake, the lake's location and regional characteristics as described and depicted in the U.S. Environmental Protection Agency document titled Lake Regions of Florida (EPA/R-97/127, dated 1997, U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Corvallis, OR), which is incorporated by reference herein, shall also be considered. The lake regions in this document are grouped according to ambient total phosphorus and total nitrogen concentrations in the following lake zones:

(a) The TP1 phosphorus zone consists of the USEPA Lake Regions 65-03, and 65-05.

(b) The TP2 phosphorus zone consists of the USEPA Lake Regions 75-04, 75-09, 75-14, 75-15 and 75-33.

(c) The TP3 phosphorus zone consists of the USEPA Lake Regions 65-01, 65-02, 75-01, 75-03, 75-05, 75-11, 75-12, 75-16, 75-19, 75-20, 75-23, 75-24, 75-27, 75-32 and 76-03.

(d) The TP4 phosphorus zone consists of the USEPA Lake Regions 65-04, 75-02, 75-06, 75-08, 75-10, 75-13, 75-17, 75-21, 75-22, 75-26, 75-29, 75-31, 75-34, 76-01and 76-02.

(e) The TP5 phosphorus zone consists of the USEPA Lake Regions 75-18, 75-25, 75-35, 75-36 and 76-04.

(f) The TP6 phosphorus zone consists of the USEPA Lake Regions 65-06, 75-07, 75-28, 75-30 and 75-37.

(g) The TN1 nitrogen zone consists of the USEPA Lake Region 65-03.

(h) The TN2 nitrogen zone consists of the USEPA Lake Regions 65-05 and 75-04.

(i) The TN3 nitrogen zone consists of the USEPA Lake Regions 65-01, 65-02, 65-04, 75-01, 75-02, 75-03, 75-09, 75-11, 75-15, 75-20, 75-23, 75-33 and 76-03.

(j) The TN4 nitrogen zone consists of the USEPA Lake Regions 65-06, 75-05, 75-06, 75-10, 75-12, 75-13, 75-14, 75-16, 75-17, 75-18, 75-19, 75-21, 75-22, 75-24, 75-26, 75-27 and 75-29, 75-31, 75-32, 75-34 and 76-02.

(k) The TN5 nitrogen zone consists of the USEPA Lake Regions 75-07,75-08, 75-25, 75-28, 75-30, 75-35, 75-36, 75-37, 76-01 and 76-04.

The Lake Regions document may be obtained from the Department's internet site at http://www.dep.state.fl.us/water/wqssp/swq-docs.htm or by writing to the Florida Department of Environmental Protection, Standards and Assessment Section, 2600 Blair Stone Road, MS 6511, Tallahassee, FL 32399-2400.

As a guide to natural background conditions the following 2 tables summarize the distributions of TP and TN in the respective nutrient zones.

Table 1. Percentile distributions of total phosphorus concentrations in each of the 6 phosphorus zones and percentile distributions of total nitrogen in the 5 nitrogen zones. These are based on the data used to establish the Florida nutrient zones (Bachmann et al. 2010). For example in zone TP2, 95 percent of the lakes had a total phosphorus concentration of 34 µg/L or less.

	Phosphorus zones						Nitrogen zones				
Percentiles	TP1	TP2	TP3	TP4	TP5	TP6	TN1	TN2	TN3	TN4	TN5
95	11	34	64	127	393	557	479	795	1367	1620	3260
90	9	22	45	93	280	359	472	663	1099	1375	2708
85	7	18	34	72	224	337	456	618	968	1233	2406
80	6	16	30	60	163	284	440	576	878	1141	2243
75	5	15	27	53	139	250	400	535	822	1086	2032
50	4	11	17	33	73	141	239	362	616	830	1394
25	3	7	12	20	43	76	105	229	459	647	969
10	2	5	8	14	26	27	98	143	341	510	726
5	2	4	7	11	20	16	98	122	255	453	647

In our opinion lakes with concentrations of total phosphorus or total nitrogen below the 95th percentile for their respective nutrient zones would be considered to be in the range of natural background conditions and those above should be studied and, if appropriate, verified for the impaired waters list.

Reference

Bachmann, R. W., Bigham, D. L., Hoyer, M. V., and Canfield Jr, D. E. 2012. Factors determining the distributions of total phosphorus, total nitrogen, and chlorophyll *a* in Florida lakes. Lake and Reservoir Management, 28:10-26. [Contact rbach@ufl.edu for a copy]

INVESTIGATING THE NUTRIENT AND WATER LOADING IN LAKE TRAFFORD

Mark Lucius, Serge Thomas and Jon-Yeop Kim
Florida Gulf Coast University, Fort Myers, Florida

Water and nutrient budgets quantify all hydrological and nutrient inputs and outputs of a hydrosystem. The ability to determine the dominant sources of water and nutrients into these systems can be quite valuable. This is particularly true for Lake Trafford. Lake Trafford is a natural shallow polymictic lake located near the city of Immokalee in SW Florida. Like most hydrosystems in Florida, Lake Trafford has been impacted by cultural eutrophication, which lead to the invasion of *Hydrilla verticillata*. The subsequent herbicide treatment of this plant beginning in the 1970's resulted in a regime shift to a hypereutrophic state plagued by recurrent phytoplankton blooms and excess organic sediment. A

twenty-one million dollar dredging effort removed 6.3 million cubic yards of sediment by the end of 2010. Despite dredging, native rooted vegetation planting by FGCU and the FWC, and efficient chemical treatment of *Hydrilla* and other exotics by FWC, the lake water quality has not significantly improved. FDEP thus awarded FGCU to create a water and nutrient budget for L. Trafford. In 2015, the balance between water and nutrient influxes (i.e. rainfall, dead end canals, groundwater and atmospheric dry deposition) as well as effluxes (i.e. evaporation and seepage) will be measured. Two unknown influxes left aside will be the determination of nutrient internal loading (e.g. sediment) and runoff. Surface water loading will be assessed bi-weekly by measuring the water discharge form each of the five canals with a SONTEK™ IQ and ISCO 4500 combination. Rainfall will be measured and sampled onsite with a Davis Vantage Pro weather station. Groundwater influx and seepage will be measured biweekly with twenty seepage meters: fourteen evenly spaced around the lakes periphery and six meters covering the open water.

Groundwater will be sampled with wells adjacent to each meter. Atmospheric dry deposition and evaporation will be measured in pans and with a net radiometer. Water volume changes in the lake will be determined from lake level variations logged with a SOLINST™ sensor. Water column nutrients will be sampled biweekly and analyzed with all other aforementioned water samples for total phosphorus, total nitrogen and all dissolved nutrients. Water conductivity will also be recorded in all water samples and will be used to calibrate the water nutrient budget developed. It is hoped that such a budget will allow for the determination of nutrient sources entering Lake Trafford and the creation of a predictive model for ambient nutrient concentrations.

THE SJRWMD METHOD FOR DETERMINING MINIMUM LEVELS AT LAKES: LAKE KERR CASE STUDY

Robert Freese, St. Johns River Water Management District, Palatka, Florida

Minimum Flows and Levels (MFL) define a minimum hydrologic regime that protects lakes, rivers, and springs from ecologic harm caused by groundwater and surface water withdrawals. SJRWMD uses water budget models to simulate long-term, historic stage levels at an MFL water body. Frequency analysis of simulated hydrologic data predicts probabilities of flooding and dewatering events at key elevations. Key elevations for hydrologically sensitive features such as upland edge, wetlands, edge of open water, hydric soils, and organic soils are a basis for developing MFL criteria. Key elevations are associated with durations and return intervals of events that protect ecologic functions from insufficient flooding or excessive dewatering. Durations are generally derived from scientific literature while return intervals are either estimated from reference data collected at similar water bodies or from historic hydrologic data from the MFL water body.

Regional groundwater flow models are used to assess changes in potentiometric surface of the Floridan aquifer near MFL water bodies due to proposed groundwater withdrawals. Output from the groundwater model is then used to adjust the seepage component of surface water budget model and to predict changes in probabilities of MFL events. MFLs are ultimately enforced through the consumptive use permitting process.

Four MFLs are proposed for Lake Kerr. The infrequent high (IH) is a 30-day flooding event with 25-year return interval, which maintains the upland edge. The frequent high (FH) is a 14-day flooding event with a two-year return interval, which maintains wetlands. The minimum average (MA) is a 180-day dewatering event with a 1.7-year return interval that protects organic soils from excessive drying and oxidation. The frequent low (FL) defines a 120-day dewatering event with a 5-year return interval that prevents frequent dewatering of deep marshes. The IH, FH, and FL all produce similar estimates (0.7-0.8 feet) of the allowable decline in the Floridan aquifer near Lake Kerr. The MA is less sensitive and would allow a larger decline of 1.7 feet before that MFL is violated. The most sensitive level sets the limit on groundwater withdrawals.

DOSE RESPONSE EVALUATION OF CONTAMINATED SEDIMENTS ON GROWTH AND SURVIVAL OF A FRESHWATER AMPHIPOD

Jennifer Sagan, Pamela Bellotti, Katherine Deliz, William Tucker
Amec Foster Wheeler, Gainesville, Florida

Amec Foster Wheeler performed a dose response evaluation on sediment samples from the Compost Stormwater Retention Pond (CSWRP) in the United States Department of Agriculture's (USDA) Beltsville Agricultural and Research Center (BARC). Historically, this tract of land was used for various types of disposal operations including the placement and burial of unspecified chemicals. In the late 1970s/early 1980s, the area was re-purposed for use in large-scale composting operations. The composting activity, which ended in 1987, led to the creation of the CSWRP as a run-off collection/erosion control measure. Drainage ditches through which run-off reaches the CSWRP exist to this day and drain parts of this Area of Concern (AOC). Although bermed, the CSWRP is not contained and is constructed with an overflow system that discharges at threshold water levels into a riverine waterbody.

This study aimed to identify physical and chemical stressors that are significantly adversely associated with the growth and survival (selected endpoints) of the amphipod, *Hyalella azteca*, and to estimate the threshold associated with a statistically and ecologically significant adverse effect on the endpoints.
Endpoints with statistically significant adverse effects were investigated further to identify relationships between adversely affected endpoints and potential chemical stressors. Concentrations of contaminants of Potential Ecological Concern (COPEC) are correlated across samples, limiting attribution of causation, but chemicals with the strongest statistical association indicate sediments are likely to exhibit adverse effects.

Concentrations of these indicator COPECs associated with a 20 percent reduction from the reference condition (EC20) were estimated. Barium and 4,4'-DDD exhibited the strongest relationships with adverse effects. In addition, cadmium, chromium, copper, lead, nickel, zinc, 4,4'-DDE, 4,4'-DDT, Total DDT and Total PCBs are also significantly associated with site-specific impacts.

THE LIMNOLOGY OF LAKE TRAFFORD PRIOR AND POST DREDGING (1997-2012 PERIOD)

Serge Thomas[1], Edwin M. Everham III[1], David Ceilley[2], John A. Ferlita II[1], Nenad Iricanin[3], Mark Lucius[1].
[1]Florida Gulf Coast University, Fort Myers, Florida
[2]Johnson Engineering Inc., Fort Myers, Florida
[3]South Florida Water Management District, West Palm Beach, Florida

Lake Trafford is a eutrophic to hypereutrophic circular 650 ha shallow subtropical seepage lake located in SW Florida near the town of Immokalee. It is the largest lake south of L. Okeechobee and likewise, it has been subjected to cultural eutrophication. Water became more turbid until *Hydrilla verticillata* colonized the system in the late 60ies, thus directly competing with *Vallisneria americana* and *Potamogeton illinoensis*. The lake water clarity then improved and the beds of Hydrilla benefited the bass fishery. However, when Hydrilla covered most of the lake, its navigation and recreational fishing were altered. The lake was subsequently treated with various herbicides thus resulting in the accumulation of a 0.74m thick organic sediment layer over the lake bed thus i) reducing lake water volume, ii) increasing BOD, iii) yielding recurrent (harmful at times) algae blooms which iv) led to massive fish kills and v) quickly drew public attention. This dystrophic state of the lake led the Army Corps of Engineers sharing costs with the Big Cypress Basin ad valorem funds, the Florida Fish and Wildlife Conservation Commission and Collier County Tourist Development Council to sign in 2000 a $21,359,619 Project Cooperation Agreement with the SFWMD to i) dredge L. Trafford organic sediment, ii) deposit the

sediment in a spoil area 1 mile north of the lake, iii) restore native fisheries and the lake ecosystem to its prior to cultural eutrophication condition and iv) develop a watershed protection plan to reduce cultural eutrophication. From 2006 to November 2010, a total of 4.8 10^6 m^3 of sediment was thus deposited in the north spoil area. Since 2010, a Lake Trafford Management Team which meets 3-4 times a year and which encompasses entities from FWC, FDEP, Collier County Pollution Control and the academia allows the coordination of all restoration and research efforts conducted on the Lake. Here, we present and interpret limnological data collected between 1997 and 2012 from Collier County Pollution control and FGCU as well as describe efforts to help the lake reverse to its original state.

Overall, when the entire time series from 1997 to 2012 are considered, the data collected during the dredging and two years after it does not show that dredging drastically changed Lake Trafford water characteristics. However, when data are examined at a smaller time scale and reduced to the pre-dredging period (1/1/2004-11/3/2005), Phase I (11/4/2005-4/25/2006), Phase II (12/1/2006-4/25/2006), Phase III dredging (6/1/2009-12/28/2010) and post-dredging (1/1/2010-12/31/2012), differences are found. Water TP and SRP concentrations decreased by 78% and 97% respectively. During that same short time period, TN, chlorophyll *a* and specific conductance increased by 22%, 37% and 48% respectively. More data need to be gathered to confirm that dredging impacted the hydrosystem over a large temporal scale.

Limnetic trends over the 1997-2012 period however show that TP increased after major tropical climatic events generating a significant increase in water level in the lake. After such events when TP peaked, TP would return to lower levels (40-50 ppb) unless another rain generating major climatic event happened. The SRP/TP ratio was close to 1 when TP peaked thus suggesting that most phosphorus was SRP from mainly external (e.g. runoffs) SRP loading.TN was not linked to climatic events but it decreased from 1997 to 2009 and increased from 2010-2012. This late increase in TN rendered the lake phosphorus limited (2010-2012) when one refers to the Redfield TN/TP ratio. TN drove the chlorophyll *a* and chlorophyll *a* year to year comparisons for a given month showed a decrease. Specific conductance increased over time but with no real net increase rate during or after dredging. Secchi disk depth was inversely correlated with total suspended solids which TSS were inversely correlated with Lake water level. Thus, turbidity likely has various origins ranging from lake sediment resuspension to phytoplankton.

To reduce such a turbidity occurring in the littoral zone, parallel to and post to dredging, submerged aquatic vegetation (SAV; *V. americana* and *P. illinoensis*) as well as emergent plants (*Paspalidium* grass, *Schoenoplectus californicus*, jointed spikerush) were planted by FGCU and FWC respectively. It is hypothesized that a set goal of 30% of combined native SAV and emergent plants within the littoral zone would warrant a stable recovery of the system to its original state. Although emergent planting efforts appeared promising, SAV planting was plagued with Hydrilla encroachment despite its precise, high spatial resolution, chemical control by FWC. To date, Lake Trafford continues to be a eutrophic lake but with noticeably less fish kills and a better recreational fishery prior to the Hydrilla chemical control. Currently, water and SAV are still being monitored, emergent plants are being planted while a water and nutrient budget is being developed and the watershed is being delineated.

Session B1: Lake and Pond Volunteer Programs

Moderator: Mark Hoyer
Wednesday, June 10, 10:00 am to 11:50 pm

LAKE JUNE-IN-WINTER: WHEN CITIZEN ACTIVISM CLASHES WITH SCIENTIC PRACTICE

Clell Ford
Highlands County Natural Resources Department, Sebring, Florida

Lake June-in-Winter is a 3600 acre lake located adjacent to the Town of Lake Placid in Highlands County. Because of its advantageous hydrologic location downstream from Lake Placid (a 3300 acre lake), it generally has water levels that are considered favorable by residents. The lake is in the Southern Lake Wales Ridge Lakes Region and its watershed is naturally low in nutrients. From 2007 to 2013, annual geometric mean transparencies fell 0.4 m and chlorophyll-a levels almost doubled (from 7.5 to 12.6 µg/L). Following a drought that ended in 2012 and dropped the lake level to more than 2 feet below normal, *Potamogeton illinoensis* became established throughout approximately1200 acres of the lake. As lake levels rose, the *P. illinoensis* grew and by spring 2013 had become topped out, dominating the lake's littoral zone and impeding navigation in parts of the lake. This precipitated an outcry from citizens concerned about an infestation of *P. illinoensis*, and other "invasive" aquatic plants that had been introduced and were taking over the lake. The local government response was that *P. illinoensis* is part of the native flora of Lake June, and though it may hamper navigation in some areas for short periods, it is a plant essential for a healthy aquatic ecosystem; herbicides were used to ensure that lake access points such as swim areas and launch ramps were open. That response was not received well and the citizens pursued other agencies in an effort to have the threat of topped out weeds in the lake eliminated. This presentation will review the actions taken due to the citizen requests, the short-term results, look at what may actually impacting plant growth and nutrient levels, and what the long-term prognosis is for Lake June-in-Winter.

USING DATA COLLECTED BY VOLUNTEERS IN RELATIONSHIP WITH LEE COUNTY FERTILIZER ORDINANCE

Ernesto Lasso de la Vega [(1)] and James Ryan [(2)]
[(1)]Pond Watch Program – Lee County Hyacinth Control District, Lehigh Acres, Florida.
[(2)]Pond Watch Volunteer, Peppertree Point Association, Fort Myers, Florida.

Research and qualitative observations suggest that a major contributor to algae growth in storm water ponds is nitrogen (N) and phosphorus (P) contained in the fertilizers that enters the pond via runoff from lawns and impervious surfaces. In May 2008, the Lee County Board of Commissioners enacted a Fertilizer Ordinance (Lee County Ordinance 08-08) with the stated objective of lessening loads (and concentrations) of nutrients in storm water ponds. It specifically prohibits the application of fertilizers containing N and P during the four wet summer months (June 1 through September 30). The Pond Watch Program is a citizen volunteer monitoring program that helps in the understanding and management of community ponds. This study examines Pond Watch data to compare N, P and chlorophyll A levels in similar urban storm water ponds during the wet months of 2004 through 2008 (prior to the Fertilizer Ordinance enforcement) compared to 2009 through 2013 (after enactment). The results showed a statistical significant difference in reduction of levels between the pre and post ordinance for phosphorus and chlorophyll A. That was not the case for nitrogen. The results of the study suggest that the Fertilizer Ordinance may have had a positive effect on the reduction of nutrient concentrations in some storm water ponds which may have contributed to the reduction of the relative abundance of planktonic algae.

DEVELOPING CONSERVATION MODULES FOR STORMWATER RETENTION POND OWNERS AND VOLUNTEERS

Ernie Franke
The Shores of Long Bayou Condominiums, St Petersburg, Florida

Over the past six years of attending and presenting at Lake/Pond Education Days in Pinellas and Hillsborough, we have noticed several groups seeking instructions for rejuvenating their retention ponds in an urban environment. These Tampa Bay groups are home-owners and condominium owners with a common retention pond, seeking solutions to their problems on a limited budget. Special problems faced in the urban environment are esthetics, multiple ownership, condo cooperation and a "non-yardwork attitude". Because the owners are not bio-engineers, they are seeking specific, step-by-step, illustrated instructions.

The Tampa Bay Estuary Program (TBEP) recently awarded The Shores of Long Bayou Condominiums a mini-grant to develop several conservation modules. Much of the information is available on the internet, but hasn't been collected together and applied to the urban retention pond. Because we have nine retention ponds and two lakes on our 77-acre campus of The Shores of Long Bayou Condominiums, we have field-tested and documented techniques of hydrilla control, Brazilian Pepper tree removal, muck removal, habitat restoration and conservation awareness. In addition to the Adopt-A-Pond programs and Lake and Pond Education Days, these conservation modules are tools in the pond owner's arsenal.

Conservation modules are web-posted PowerPoint / PDF presentations. We have chosen this easily-editable format, to allow future experiences to be added. These modules provide a retrievable, paper-less reference, available for posting on State, County and Local websites, vetted by the website owners. We have also posted our modules on our condominium website, which informs, co-ordinates and invites volunteers. Just as community blogging and U-Tube instructional videos have blossomed over the years, we expect conservation modules to be a useful tools for the Do-It-Yourself owners of stormwater retention ponds for creating conservation-awareness, habitat restoration and pond rejuvenation.

TRENDS, GROWTH, AND FUTURE DIRECTION OF THE TROPHYCATCH CITIZEN-SCIENCE PROGRAM

Christopher Wiley[1], Andrew C. Dutterer[2], Bob Wattendorf[3], William F. Pouder[4], and Jason Dotson[2]
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[3] Florida Fish and Wildlife Conservation Commission, Division of Freshwater Fisheries Management, Tallahassee, Florida
[4] Florida Fish and Wildlife Conservation Commission, Division of Freshwater Fisheries Management, Lakeland, Florida

Largemouth Bass (*Micropterus salmoides)* fisheries have high recreational, economic, and social value. Anglers in Florida place a high value on trophy-sized bass, thus the Florida Fish and Wildlife Conservation Commission (FWC) emphasized a commitment to research and management practices that enhance opportunities for angler catch of these rare and valuable individuals during adoption of the state's comprehensive Black Bass Management Plan in 2011. During October 2012, the FWC launched TrophyCatch, an incentive-based citizen-science program that relies on anglers to document the catch-and-release of trophy-sized bass (≥ 3.63 kg). One of the primary goals of the program is to establish a long-term record of spatial and temporal characteristics of trophy bass catches, relying on the state's numerous anglers to alleviate difficulties associated with the collection of these data using traditional sampling techniques. During two and a half years of operation, anglers have documented the catch-and-release of more than 1,900 trophy-sized bass using the

TrophyCatch program. TrophyCatch participation has experienced substantial growth with a 468% increase in approved submissions from year one to year two of the program. This growth was linked to increased awareness of the program within the angling community and simplification of the submission process following year one. TrophyCatch has utilized an adaptive management approach, altering submission guidelines and advertisement strategies based on feedback from program users. Feedback from stakeholders will continue to be utilized to help guide the program into the future. Information gathered via TrophyCatch will help identify long-term and landscape-level patterns in the catch of trophy-sized Florida Bass, aiding in future management of the species.

EVALUATION OF FLORIDA'S TROPHYCATCH PROGRAM

Andrew C. Dutterer
Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Gainesville, FL

TrophyCatch is a new fishery-dependent, citizen-science program operated by the Florida Fish and Wildlife Conservation Commission (FWC) for documenting catch and release of trophy-sized bass (≥8 lbs; *Micropterus floridanus*, *M. salmoides*, and intergrades) in Florida. The program aims to promote catch and release for trophy bass and establish a dataset of where and when trophy bass are caught in Florida to aid fisheries research and management. To evaluate the efficacy of *TrophyCatch* to meet these objectives and to ground-truth the program's data, a multi-year, reward-based tagging study for trophy-size bass was initiated in 2011 (one year prior to *TrophyCatch*). The tagging study was designed to measure annual state-wide catch, exploitation, and release rates of trophy-sized bass during initiation and growth of the program. The tagging study also provides an independent mechanism for measuring awareness and participation levels of *TrophyCatch* among Florida's anglers. Through four years of operating the tagging study, FWC biologists have tagged over 600 trophy-sized bass, across more than 100 public waterbodies within the state. During the first three years (with year-4 ongoing), we estimated that mean annual catch of trophy-sized bass ranged from 13–27% and annual exploitation ranged from 2–5%. Low annual exploitation rates were due to high voluntary release rates (77–91%), suggesting that catch and release for trophy bass was widely practiced among most of Florida's bass anglers. We measured low participation rate for *TrophyCatch* during year-1 (6%), but it showed substantial improvement during its second year (24%), suggesting that the program is gaining support among anglers. Furthermore, knowledge of anglers' participation rate in *TrophyCatch* can be coupled with program totals to produce state-wide estimates of trophy bass catch and abundance in Florida. The tagging study has been useful for understanding the effects and potential for growth of *TrophyCatch* and will be continued for at least five years in tandem with the program.

CITIZEN SCIENTISTS PROTECTING FLORIDA'S AQUATIC SYSTEMS

Mark V. Hoyer, Dana L. Bigham, Roger W. Bachmann and Daniel E. Canfield, Jr.
University of Florida, School of Forest Resources and Conservation,
Fisheries and Aquatic Sciences, Gainesville, Florida

Florida LAKEWATCH is a successful example of a long-term volunteer water quality-monitoring program that started in 1986. Working with thousands of volunteers, these dedicated citizen scientists have collected reliable long-term water quality data for over 1100 lakes, 175 coastal sites, 120 rivers, and 5 springs. These data encompass water resources in 57 Florida counties. This manuscript describes the start and evolution of LAKEWATCH, including discussions of the following two major (of the many) hurdles to the continued success of the program: 1) demonstrating to professional groups that trained volunteers are capable of collecting credible (research and regulatory quality) data, and 2) maintaining consistent long-term funding. Funding is especially critical because trained and committed core staff is needed to work along with

volunteers. Quality staff members are also important to provide direction, ensuring consistent data are collected and enough sites are monitored to answer statewide questions such as how geology impacts water chemistry in Florida. Examples are also provided on how LAKEWATCH data have been used to address lake management issues (i.e., "fixing" the problem) in the State of Florida. We hope the Florida LAKEWATCH experience assists other groups who have a vast army of citizen scientists waiting to get involved and then to best develop a successful monitoring program.

Session B2: WATERSHED VOLUNTEER PROGRAMS

Moderator: Jim Reed
Wednesday, June 10, 2:00 am to 3:20 pm

BUILDING WATERSHED AWARENESS – THE SEMINOLE EDUCATION, RESTORATION AND VOLUNTEER PROGRAM (SERV)

Elizabeth L. Stephens, Marie Lackey
Seminole County Public Works, Watershed Management Division, Sanford, Florida

Since its inception in 2010, the Seminole Education, Restoration, and Volunteer (SERV) program has used a multifaceted approach to build watershed awareness in Seminole County, Florida. This program was created to engage the community in protecting and restoring our local waterways through volunteer projects and educational outreach. Strong relationships with local teachers, community groups, and families facilitate volunteer recruitment and provide opportunities for educational presentations. Volunteers can participate in whole lake restoration events by installing native plants and removing invasive aquatic species; litter clean-ups, stormdrain marking, and Adopt-A-River and Adopt-A-Road activities complement lake restorations by reducing and preventing waterway pollution. Educational efforts help inform the public about the two most serious threats to our water bodies: polluted stormwater run-off and invasive species. All SERV Program activities contribute to the fulfillment of NPDES requirements for Seminole County, and reflect the mission of the Watershed Management Division to protect, conserve, and restore Seminole County's valuable water resources.

FWC HIGHLAND LAKES VOLUNTEERS

Jim Reed
FWC Volunteer Coordinator, Lake Placid, Florida

Florida Fish and Wildlife Conservation Commission (FWC) fisheries and habitat restoration projects are multi-faceted, providing control of invasive plants, data on fishing and hunting results, information for determining fish or game limits and regulations, monitoring public use of fisheries resources, and many other activities. FWC activities are personnel-limited and most projects require two or more persons. Using a trained volunteer instead of a second biologist frees up FWC staff.

To provide better service, in November of 2010 FWC authorized a volunteer group in Highlands County, the Highlands Lakes Volunteers, with emphasis on Lake Istokpoga. The volunteers operate during the primary fishing season, from September to June. While most of the activities are done assisting an FWC biologist, one bass tournament team operates independently and has gained the respect of tournament anglers. The Highlands Lakes Volunteers work in four main areas:

- Angler surveys
- Biological data at bass tournaments
- Sample collection via electroshocking and trawl netting
- Biological sample evaluation, primarily otolith extraction

Among the program's successes are:

- Bass tournament monitoring, which provided data on over 3000 tournament fish. This data was used in proposals for new state-wide bass length regulations.
- Electroshock sampling, providing data on fish stocks with lessened requirements for biologist hours.
- Trawl netting, collecting crappie samples as a part of the data used in proposing a minimum length for crappie fishing.
- Crappie evaluations, in which volunteers did all of the work, removing and recording otoliths from scores of crappie samples collected from local lakes.
- Most importantly, the volunteer program created a cadre of anglers who were better informed on lake management issues and able to provide intelligent comments in public discussions.

The Highlands Lakes Volunteers program was recognized as the division "Volunteer Program of the Year" for the 2012-2013 season.

FIRM FOUNDATIONS FOR SOFT BMPS – KEY FACTORS FOR GETTING THE MOST OUT OF PUBLIC INVOLVEMENT

John McGee
Hillsborough County Environmental Services, Tampa, Florida

Many organizations desire public involvement programs as a way to extend reach and influence. But too many programs fail or stagnate into ineffective burdens for lack of preparation and understanding. This leads many to believe that such programs are inherently flawed. However, with proper preparation and management, public involvement programs and other so-called soft BMPs can be very effective, and at times, the most effective option. This presentation will translate key psychological and social science concepts in a way that is understandable and useful to help environmental managers better prepare and implement volunteer/public involvement programs and obtain measurable results. Whether your goal is to create a program from the ground up, revive a languishing program, or gain more public support for other projects you have, an understanding of these concepts will enable you to better understand the root principles guiding the function of your most challenging environmental system: the public.

QUALITY ASSURANCE CONSIDERATIONS AND INCORPORATING VOLUNTEER DATA INTO WATERSHED ASSESSMENT PROCESS

Kevin O'Donnell
Florida Department of Environmental Protection, Tallahassee, Florida

The Florida Department of Environmental Protection is the lead agency for assessing Florida's waterbodies to determine whether water quality standards is or is not being met. To meet this objective the Department implements a watershed

approach for using water quality and biological data from numerous monitoring networks. Volunteer monitoring networks are included in the datasets used by the Department to make these assessment determinations. In order to make the greatest use of the data provided to the Department, certain quality assurance considerations are needed to produce reliable and consistent measurements. Data quality considerations should be designed to follow DEP quality assurance Standard Operating Procedures (SOPs) and the Department's Quality Assurance Rule, Chapter 62-160, Florida Administrative Code (F.A.C.).

By meeting these data quality considerations, the data can be used for multiple purposes including: determining background conditions, evaluating changes in hydrology, establishing trends in water quality, or just monitoring for monitoring the health of a local waterbody of concern. The Department can also use this data to supplement strategic monitoring data needs, use the data for the development of total maximum daily loads (TMDL), or for determining if a TMDL has been met through as part of a basin management plan (BMAP).

Currently, there are over 10,000 monitoring stations available to the Department which are monitored by over 26 different volunteer data organizations in Florida. Of those 26, there are 9 data providers that submit data to Florida STORET, the statewide water quality database. As the Department continues to monitor and assess Florida's waterbodies, volunteer monitoring data will continue to be a critical dataset.

Session B3: Coastal Monitoring and Restoration Programs

Moderator: Allison McDowell
Wednesday, June 10, 3:50 pm to 5:35 pm

CITIZEN SCIENTISTS OF THE CHOCTAHATCHEE WATERSHED

Brandy Foley, Monitoring Coordinator
Choctawhatchee Basin Alliance, Santa Rosa Beach, Florida

In celebration of the appreciation of citizen scientist volunteers, Brandy will discuss how the Choctwhatchee Basin Alliance (CBA) is able to advance scientific knowledge of the Choctawahtchee watershed with the assistance of citizen scientists. Established in 1996, in conjunction with the Florida LAKEWATCH program, CBA's volunteer water quality monitoring program was intended to collect critical baseline information about the Choctawhatchee watershed. Almost 20 years later, CBA citizen scientists are still collecting monthly water quality data from sampling stations across the watershed and, in so doing, contributing to an increased understanding of the condition of the watershed. Data collected by CBA volunteers has been used to establish Total Maximum Daily Loads (TMDLs) for Choctawhatchee Bay, identify and prioritize areas in need of ecological or stormwater restoration, and monitor the results of these projects. This program has made pivotal advancements in management development practices used by local and state officials. Through the efforts of CBA's volunteer citizen scientists, large amounts of hydrologic data are collected monthly. Not only are the citizen scientists collecting information, they are also learning innovative practices and spreading awareness throughout the community.

AMERICORPS NWF ENVIRONMENTAL STEWARDS: VOLUNTEERS SUPPORTING WATERSHED EDUCATION, RESTORATION AND MONITORING GOALS

Darsey Kelly,
AmeriCorps NWF Environmental Steward, Santa Rosa Beach, Florida

This presentation highlights the service-based partnership between AmeriCorps Northwest Florida Environmental Stewards--a component of the National Commission on Volunteerism and Community Service--and Choctawhatchee Basin Alliance (CBA)--a non-profit watershed organization. The CBA/AmeriCorps collaboration has been growing steadily in scope and effectiveness since its inception in 2010. OAs part of this partnership, CBA offers a venue and framework for AmeriCorps members to engage with community service, while AmeriCorps members offer their time and energy to accomplish CBA environmental and educational initiatives. Speaker Darsey Kelly, an AmeriCorps member assigned to CBA, will describe the role of AmeriCorps in implementing and supporting CBA's educational programs, ecosystem restoration initiatives, and water quality monitoring. Ms. Kelly will discuss the partnership's funding structure, and the synergy that allows both AmeriCorps and CBA to amplify respective program outcomes. In addition, Ms. Kelly will touch on her own experiences as an AmeriCorps member serving the community by improving the environment.

STRENGTHENING AN ESTUARY WITH THE POWER OF CITIZEN SCIENTISTS: COMMUNITY-BASED RESTORATION, RESEARCH AND MONITORING ON INTERTIDAL OYSTER REEFS AND LIVING SHORELINE IN THE INDIAN RIVER LAGOON

Kathryn Brown, Jody B Palmer, Sammy Anderson
Brevard Zoo, Melbourne, Florida

Through many partnerships and grants, Brevard Zoo has been able to facilitate community-based restoration programs to increase the number of live oysters (*Crassostrea viriginica*) in the Indian River Lagoon (IRL) and build a multi-tiered natural resilience to shoreline destruction. Oysters offer unique ecological functions to the IRL system including filtration, habitat, food sources, and sediment stabilization. Citizen scientists work together to construct oyster restoration mats and shell bags to use as building blocks for restored reef substrate. Filter feeding oysters have the potential to improve the water quality and overall health of the IRL. The complexity of the degraded state of the IRL requires multiple responses of action. Citizen scientists also participate in education-focused programs to foster mangroves and grasses that are later planted across the shoreline. Mangroves, grasses, and oyster reefs grow with sea level rise and offer beneficial ecological functions to the ecosystem. Various monitoring strategies provide continuous data collection which is interpreted, logged and used for reporting to grant providers, local government, current and potential partners, citizens and academia in order to improve methodologies, site selections, and foster sustainable public engagement in estuarine restoration. It is the mission of Brevard Zoo to work with the community to learn the solutions to environmental problems and act on behalf of those solutions; "Wildlife Conservation through Education and Participation."

CITIZEN SCIENCE AND STAKEHOLDER ENGAGEMENT IN GOLIATH GROUPER FISHERY MANAGEMENT

Jessica Sutt[1], Bryan Fluech[2], Joy Hazell[3], Martha Monroe[4], Kai Lorenzen[5]
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Harvest of goliath grouper, *Epinephelus itajara,* was prohibited in United States waters in 1990 due to significant declines in population abundance attributed to fishing pressure and loss of habitat. With protection, the goliath grouper population of South Florida has been rebuilding. Goliath grouper now frequently interact with fishers through incidental catch and depredation on hooked or speared fish. Contention has arisen among stakeholders who believe the moratorium should be lifted to better manage a growing population and those stakeholders who believe the moratorium should remain for continued conservation of a vulnerable species. This conflict is often expressed as disagreement about the level of population recovery and fisher observations vs. formal science, though underlying it are divergent stakeholder interests and poor platforms for citizen participation in the decision-making process. We present insights from a three-pronged approach to resolving this conflict through the Great Goliath Grouper Count citizen science program, a stakeholder survey, and a stakeholder workshop. In 2014, participants in the Great Goliath Grouper Count assessed 44 sites and recorded 194 individuals. The online stakeholder survey provided information on patterns of fisher-goliath interaction, measures taken to minimize such interactions, and attitudes about current fishery management. The survey also revealed that fishers who perceived fewer opportunities to participate and who reported less participation in decision-making processes were more likely to disagree with the existing moratorium. Facilitated with conflict management and social learning techniques, the workshop provided in-depth understanding of fishery perceptions and management preferences of sixteen highly engaged goliath grouper stakeholders. The impact of social learning on shared understanding and management acceptance was explored through process evaluations and participant interviews, revealing significant gains in shared understanding among stakeholders with divergent interests. These efforts to engage citizens and better understand stakeholders provide an example application of a human dimensions focus for fisheries management.

VOLUNTEERS ARE VITAL TO THE SUCCESS OF THE CHARLOTTE HARBOR ESTUARY VOLUNTEER WATER QUALITY MONITORING NETWORK

Melynda Brown
Florida Department of Environmental Protection,
Charlotte Harbor Aquatic Preserves, Punta Gorda, Florida

The Florida Department of Environmental Protection, Charlotte Harbor Aquatic Preserves office manages a long term volunteer water quality monitoring program aptly named the Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network (CHEVWQMN). This program was established in 1998, and consists of 46 fixed sites located throughout six aquatic preserves in southwest Florida. Nineteen different water quality parameters are taken once a month at sunrise by volunteers at each of the sampling stations. Synoptic sampling allows for a uniform snapshot look in water quality each month across southwest Florida which would not be possible without citizen scientists. In order to ensure the quality of data, volunteers are initially trained one on one, and are required to attend biannual quality assurance sessions. Volunteers and partnering agencies, such as the Charlotte Harbor National Estuary Program, Charlotte Harbor Environmental Center and the Estero Bay Aquatic Preserve office are the crux of this program. Their assistance has saved the state over a million dollars in time and resources. The data continues to be used for a wide variety of purposes, including

establishing baseline water quality conditions, educating the public, and for regulatory purposes such as setting impaired waterbodies and forming regional numeric nutrient criteria. The data is managed by Charlotte Harbor Aquatic Preserves staff, and is also uploaded into the Charlotte Harbor Water Atlas and STORET.

Session D1: Lake and Stream Restoration and Monitoring Technology

Moderator: Patrick Goodwin

Thursday, June 11, 8:35 am to 10:30 am

A HOLOCENE SEDIMENT RECORD OF PHOSPHORUS ACCUMULATION IN SHALLOW LAKE HARRIS

William F Kenney[1], Mark Brenner[2], Jason H Curtis[2], Elliott T Arnold[3], Claire L Schelske[2]

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[3] School of Natural Resources and Environment, University of Florida, Gainesville, Florida

We studied a complete Holocene sediment record (LH-6-13) from shallow (zmax = 9.7 m) Lake Harris, Florida (USA) to gain insights into the ontogeny of the lake and its current eutrophic status. We used 210Pb and 14C to date the 5.9-m sediment core (LH-6-13) and determined accumulation rates for bulk sediment, organic matter, calcium carbonate, phosphorus fractions and biogenic silica fractions. The chronology of changes in sediment characteristics for LH-6-13 is consistent with the general paleoenvironmental framework established from core studies of Florida lakes. Lake Harris began to fill with water in the early Holocene, ca. 10,680 cal a BP. A shift from carbonate-dominated to organic-rich sediments ca. 5,540 cal a BP indicates a transition to wetter climate in the middle Holocene. A rapid increase in diatom biogenic silica concentrations and accumulation rates ca. 2,600 cal a BP signals that the lake had deepened to its modern limnetic state. In LH-6-13, an up-core decrease in rates of accumulation for several sediment variables indicates time-course oligotrophication of the lake through the Holocene. In near-surface sediments, abrupt increases in the accumulation rates of these same variables indicate progressive cultural eutrophication after ca. AD 1900. Comparison of the modern state of Lake Harris to its condition 50-100 years ago provides a measure of the impact of recent cultural eutrophication. If, however, the pre-disturbance trajectory of this lake were one of oligotrophication, then the true impact of cultural eutrophication is even greater than what is inferred from the changes over the past century.

MANAGING CANAL WATER QUALITY IN FLORIDA KEYS

Lance Lumbard

AMEC Foster Wheeler Environment & Infrastructure, Inc., Orlando, Florida

The Florida Keys are renowned for both an abundance of marine life and environmental impacts from human activity. Hundreds of residential canals provide easy access to the Keys' aquatic ecosystems, but are also conduits for many sources of water quality pollution. Elevated nutrient concentration and low dissolved oxygen concentration are the primary concerns within the canals. To address these concerns, the Florida Keys Reasonable Assurance Document (FKRAD) was developed and approved by the Florida Department of Environmental Protection (FDEP) in 2008 and the Environmental Protection Agency (EPA) in 2009. The FKRAD established a significant load reduction target of approximately 300 tons of total nitrogen (TN) and 90 tons of total phosphorus from the Monroe County, in cooperation with a multitude of others, has undertaken a massive effort to achieve these reductions through planning, prioritization, de-

sign, and construction of various structural and non-structural projects. In addition to the FKRAD, a Canal Management Master Plan (CMMP) was developed in 2013 by the Canal Restoration Advisory Subcommittee to provide a vision for long-term restoration activities, many of which are now being implemented. One of the most significant projects is the upgrade of thousands of on-site sewage treatment and disposal systems with centralized sewer. Improvements to stormwater conveyance systems are also underway. Other innovative water quality projects including canal backfilling, strategic removal of organic sediments, installation of culverts, installation of weed gate air curtains, and a concerted effort to educate canal-front residents on best management practices (BMPs).

REDUCING HERBICIDE APPLICATION RATES OF AN ALTERNATIVE HERBICIDE FOR CONTROL OF FLURIDONE RESISTANT HYDRILLA

Leif Willey[1], Bo Burns[2]
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Fluridone resistant hydrilla has been a concern of many private applicators in Florida in recent years due to the increasing presence of these biotypes and the high cost of alternative herbicides that can be used for long-term, selective control of this plant. In 2011, a new active ingredient received EPA registration for use in aquatics. Tradewind herbicide (ai: Bispyribac-sodium) is an ALS inhibiting herbicide that offers an alternative to fluridone for hydrilla control, and a lower application rate compared to contact type herbicides. However, due to cost, it is not feasible for many smaller private companies to use this product at the full label rate. Recently we suspected fluridone resistant hydrilla at a site near Orlando, FL where an initial fluridone treatment had no effect on the hydrilla. In March 2014, bathymetric mapping of the site was conducted to measure water volume as well as plant volume and area coverage. A treatment to assess the efficacy of lower label recommended concentrations (25ppb) was developed. Water samples confirmed that our target concentration of the active ingredient was achieved, and samples were taken monthly to track herbicide degradation. Monthly biomass sampling and quarterly mapping were used to track the effects of the herbicide on hydrilla as well as other species present. Six months post treatment, 85% reductions in hydrilla have been observed in biomass, while an increase in presence of Nitella and Vallisneria have also been documented. Biomass sampling and mapping will continue to monitor the long term effects of the treatment until treatment is necessary again. Laboratory chlorophyll analysis of hydrilla shoots exposed to a range of fluridone concentrations confirmed the plants were a highly fluridone resistant biotype. Results of this study suggest that Tradewind herbicide can be used as an effective alternative to fluridone in systems where resistant hydrilla is present. Furthermore, the effectiveness of this product at rates below the maximum allowed label rate offer improved economics to private applicators.

IMPROVING MANAGEMENT OF GROUNDWATER AUGMENTATION FOR FIFTEEN LAKES AND WETLANDS IN THE NORTHERN TAMPA BAY AREA

Dan Schmutz[1] *and Whitney Kiehn*[2]
[1]*Greenman-Pedersen, Inc., Orlando, Florida*
[2]*Tampa Bay Water, Clearwater, Florida*

Groundwater augmentation of lakes and wetlands is one of the approaches Tampa Bay Water uses to minimize environmental effects associated with public water supply. Direct supplementation of groundwater to surface waters has been implemented selectively in the Northern Tampa Bay Area since the 1970s to successfully mitigate the potentially deleterious effects of lowered groundwater tables in the immediate vicinity of groundwater production wells. In 2011,

Greenman-Pedersen, Inc. (GPI) performed a comprehensive review of augmentation levels and fluctuation schedules to develop improved management plans for compliance with Special Condition 10 of Water Use Permit #20011771.001. GPI field-assessed wetland conditions and compared them to existing management levels and water level records for 15 augmented sites on the Cross Bar Ranch, Cypress Creek, and Eldridge-Wilde Wellfields. Current conditions indicate that augmentation has been highly beneficial: wetland vegetation has been maintained and the sites are heavily utilized by wildlife. However, many sites have not been restored to their historical extents. The formerly permanent pools in the interiors of some of the ponds at the Cross Bar Ranch Wellfield have periodically dried out. At Lost Lake, augmentation levels have not been sufficient to prevent oxidation of deep peat soils. In most augmented sites, water levels do not reach the edges frequently enough to discourage the proliferation of non-wetland and nuisance species. For the purpose of establishing improved water level regimes, GPI reviewed available literature, historical aerial imagery, and water stage data from three marsh and three cypress nonaugmented reference wetlands. Specific augmentation management elevations and fluctuation schedules were developed for the 15 sites that more closely emulate similar natural systems than the current regimes, introducing annual excursions to high and low management levels for two months each (August-September and May-June, respectively), while maintaining water levels near the equivalent median for similar reference wetlands the remainder of the year. Empirical estimates of augmentation rates per acre to achieve the recommended management levels were evaluated for each site to establish a typical rate per acre. At most sites, augmentation quantities for the recent lower groundwater production period (WY2003–WY2011) were substantially reduced from the higher production period (prior to WY2003), partly because of reduced need attributable to regional water table recovery. The overall median augmentation rate per acre for each site under the recent lower groundwater production period was used to derive an estimate of future annual quantity requirements to achieve specific target water level elevations. If fully implemented, the proposed changes in the augmentation levels and fluctuation schedules would require a 26% increase in overall augmentation quantities during a typical year relative to the recent period—from 1.51 to 1.91 MGD annual average—while providing substantial ecological benefit.

AERATION'S EFFECT ON ALGAL ABUNDANCE AND ASSEMBLAGE

Patrick Goodwin
Vertex Water Features, Pompano Beach, Florida

Bottom aeration is a restoration tool commonly used for improving multiple aspects of lake health, including the occurrence of algal blooms and the quality of algal assemblages.

The intense mixing brought about by artificially aerating a lake can affect an algal community by: (i) increasing dissolved oxygen concentrations and changing the lake's water chemistry (pH, carbon dioxide and alkalinity), which can lead to a more desirable shift in an algal community; (ii) reducing levels of internal nutrient cycling within a lake, which reduces the large amount of nutrients used to sustain algal blooms; (iii) decreasing the amount of solar energy available for photosynthesis; (iv) favoring algal species that tend to sink quickly and need mixing currents to remain suspended in the upper water column (e.g. diatoms); and (v) mixing algae-eating zooplankton into deeper, darker waters, thereby reducing their predation by sight-feeding fish, and increasing their ability to graze on algae cells.

This presentation discusses the current literature regarding aeration's effect on lake algal communities and outlines successes and failures associated with this lake management approach, along with the major factors that tend to influence the outcome of any aeration based management strategy.

THE USE OF STATE OF THE ART AERIAL IMAGING TECHNIQUES FOR AQUATIC APPLICATIONS

Dr. Stuart Clough, Director APEM Ltd., Manchester, United Kingdom.
Dr Julia Robinson Willmott, Senior Scientist, Normandeau Associates, Gainesville Florida

Recent advances in airborne digital imaging systems now make it possible to derive a host of vital environmental and ecological information to address a number of water related challenges. APEM have championed the use of this state of the art technology within this sector to enable us to provide our clients with innovative solutions to answer their specific needs. The data collection falls primarily into three categories including; high resolution imagery, photogrammetry and thermography.

Through the acquisition of high resolution aerial imagery we are able to generate spatial data for a variety of aquatic applications. In conjunction with the in house development of the Fluvial Information System (FIS), APEM have developed an automated approach to quantifying and mapping fisheries habitat and sediment distribution along with a number of other fluvial parameters. We have also pioneered the use of high resolution imagery in mapping plant based invasive non-native species (INNS) in lake, river and riparian environments (e.g. Himalayan balsam, Japanese knotweed, floating pennywort etc.).

Advances in aerial image processing now make it possible to generate accurate three dimensional digital terrain models (DTMs) of the earth's surface. This capability has been used to great effect in a number of aquatic applications including the assessment of river restoration schemes, vegetation canopy height, lake/reservoir embankments, scour around lake / coastal moorings and hydrological modelling.

The use of thermographic imaging technology provides the ability to measure parameters not visible in the visual spectrum. This technology has been used extensively to monitor thermal plumes from industrial operations and also to assess the effect of reservoir cooling water discharge on the aquatic environment.

There are many advantages to the use of aerial imaging techniques in the applications discussed here. The technology enables greater data collection and enhanced coverage compared to traditional ground survey techniques. These techniques provide a quantitative and permanent record which can be revisited at any time. Finally, the digital nature of the data enables accurate georeferencing and rapid quantification of these environmental and ecological data which ultimately enhances the efficiency of the survey methodology, and leads to better management decisions.

Session E1: Septic System Drainfield Science

Moderator: Gurpal Toor
Thursday, June 11, 8:35 am to 10:30 am

MASS BALANCE OF NITROGEN IN SEPTIC SYSTEM DRAINFIELDS

Mriganka De and Gurpal S. Toor
Soil and Water Quality Laboratory, Gulf Coast Research and Education Center,
University of Florida, Wimauma, Florida

The contribution of nitrogen (N) from septic systems to shallow groundwater is largely not quantified in most aquifers and watersheds. Our objective was to determine mass balance of N in septic drainfield and estimate N loading from ~2.5 million septic drainfields to Florida groundwater. Three lysimeters (1.5 m long, 0.9 m wide, 0.9 m high, with 1:1 side slope) were constructed using pressure treated wood. Each lysimeter had gravel-sand mixture at the bottom, followed by 0.3 m soil layer, 0.3 m sand layer, a drip tube to disperse septic tank effluent (STE, 9 L per day), and a 0.15 m sand layer. St. Augustine grass was planted at the top and sides of each lysimeter to mimic a residential septic drainfield. From Jan 2013 to Jan 2014, leachate was collected from lysimeters over 67 sampling events (n=15 daily and n=52 weekly flow-weighted). Major inputs (n=67) of water were STE (57%) and rainfall (43%), while outputs were leachate (46%) and evapotranspiration (28%). About 26% of the added water was stored in the drainfield. Each lysimeter (n=67) received 227 g of total N (STE: 99%, rainfall: 1%); of which, 33% was leached, 23% accumulated in soil, and 6% was plant uptake. The remainder of the total N was estimated to be gaseous loss (38%). Based on extrapoliation of study data, 2.29×1011 L of water (STE + rainfall) per year from ~2.5 million septic drainfields could be expected to transport 2.35 million kg to Florida groundwater. The study results can be useful to develop effective management strategies to protect shallow groundwater from N contamination from septic systems.

MASS BALANCE OF PHOSPHORUS IN SEPTIC SYSTEM DRAINFIELDS

Sara Mechtensimer and Gurpal S. Toor
Soil and Water Quality Laboratory, Gulf Coast Research and Education Center,
University of Florida, Wimauma, Florida

The contributions of phosphorus (P) from septic systems to groundwater are not known. The objective of our research was to quantify P contributions of a conventional drip-dispersal septic system drainfield. Three small drainfields (152.4 cm long, 91.4 cm wide and 91.4 cm high) were constructed with a side slope of 1:1 in an aboveground plywood frame. Each drainfield had two distinct layers (30 cm commercial sand and 30 cm samesource soil). A drip line was installed to disperse 9 L per day of septic tank effluent (STE) and was covered with commercial sand and St. Augustine grass to mimic a septic drainfield. Leachate and STE samples were collected (n=67) and analyzed for total P (TP), dissolved reactive P (DRP) and other P (TP – DRP) (assumed to be particulate and organic P). The mean TP in STE was 14±6 mg L-1 (89% DRP; 17% other P) and accounted for 99% of the total 46.86 g of TP input into the drainfield. Mean leachate concentration were 0.08±0.07 mg L-1 and accounted for 0.41 g (0.9% of TP output). Plant samples collected at approximately monthly-intervals were analyzed, accounting for 3.6% TP removal by plant uptake. The remaining 95.5% of TP was stored in the drainfield soil. The drainfield soil was analyzed for water-soluble P, which is considered labile P and has the potential to be leached. Results show 22 to 131% increase in water-soluble P in different parts of drainfield after 1-year of STE application. Although most of the P was retained in the drainfield there is still a concern of longterm build up and potential leaching of P to groundwater if biogeochemical conditions change in the drainfield.

FATE OF PHARMACEUTICALS AND HORMONES IN SEPTIC SYSTEM DRAINFIELDS

Yun-Ya Yang[1], Gurpal S Toor[1], and P. Chris Wilson[2]
[1]Soil and Water Quality Laboratory, Gulf Coast Research and Education Center, University of Florida, Wimauma, Florida
[2]Environmental Toxicoligy/Agroecology Laboratory, University of Florida, Soil and Water Science Department, Gainesville, Florida

Septic systems are used to treat and dispose of relatively small amount of wastewater in suburban and rural areas. In Florida, about 2.5 million OWTS discharge approximately 156 billion gallons wastewater per year. Many trace organic chemicals (TrOC) such as pharmaceuticals, hormones, and personal care products are widely used by daily basis and can enter household wastewater from toilet, sinks, kitchen, and washers. Our objective was to investigate the occurrence, behavior, and leaching of TrOC in septic drainfields. Three replicate drainfields (1.5 m length, 0.9 m wide, 0.9 m height) containing vertically stacked layers of soil (30 cm) and sand (30 cm) were constructed. A drip line dispersed 9 L of septic tank effluent (STE) per day in each drainfield, which was covered with 15-cm sand layer and then St. Augustinegrass was planted to mimic a residential system. Nine selected TrOC including four pharmaceuticals (acetaminophen, carbamazepine, ibuprofen, and sulfamethoxazole), three hormones (estrone, 17β-estradiol, and 17α-ethinyl estradiol), a plasticizer (bisphenol-A), and caffeine were analyzed in STE (N=34) and leachate (N=120) samples. Seven of nine TrOC were detected in STE and leachate. Most frequently detected (>80%) TrOC in STE were caffeine, ibuprofen, estrone, and bisphenol-A, with mean concentrations of 76-11500 ng/L. In leachate, ibuprofen and bisphenol-A were most frequently detected (>45%), with mean concentrations of 12-41 ng/L. Acetaminophen, carbamazepine, and sulfamethoxazole were present in soil samples (0.07-3.73 ng/g) collected at end of the experiment (1-year). Our mass balance calculations show that <5% of applied TrOC in STE were recovered in leachate and 95% either accumulated in soil and/or biodegraded or transformed in the septic drainfields.

TRANSPORT OF NITROGEN FROM SEPTIC SYSTEMS TO SHALLOW GROUNDWATER

Mriganka De and Gurpal S. Toor
Soil and Water Quality Laboratory, Gulf Coast Research and Education Center, University of Florida, Wimauma, Florida

Septic systems can be a major source of nitrogen (N) in Florida's coastal waterbodies as 40% of ~2.5 million septic systems are located in coastal areas. Understanding the fate and transport of nitrogen (N) in and below the vadose zone of septic systems is crucial to protect groundwater contamination. Our objective was to investigate the transport of N in the vadose zone and groundwater below two conventional septic systems (drip-dispersal and gravel trench). We constructed two drainfields (3.7 m2 each) to mimic typical Florida residential drainfields. Each drainfield received 120 L of septic tank effluent (STE), equivalent to maximum allowable rate 3 L ft-2 day-1 for Florida's sandy soils. Samples were collected over 64 sampling events (May 2012-Dec 2013) using suction cup lysimeters (installed at 0.3, 0.61, and 1.1 m depth below drip line) and piezometers (installed at 3.1-3.4 m depth below drip line). Mean (n=64) pH, EC, and chloride were greater in STE than soil-water and groundwater. In STE, mean (n=64) total N was 66±9 mg L-1 (NH4-N: 89%, organic N: 11%, NOx-N: 0.2%). In lysimeters, the dominance of NOx-N (28-45 mg L-1) indicated that nitrification was the major mechanism in 0.3-1.05 m depth of drainfields. This resulted in elevating NOx-N (17-23 mg L-1) in the groundwater. Organic N was also mobile in the drainfields (5-6 mg L-1) due to the lack of mineralization, which increased organic N in groundwater (~3.5 mg L-1). Data suggested that nitrification controlled N evolution in drainfield and subsequent transport to groundwater. We conclude that elevated concentrations of NOx-N in groundwater may pose a health haz-

ard for the populations obtaining drinking water from wells in the vicinity of drip-dispersal and gravel trench systems. In the long-running septic systems, N contaminated plumes can move to surface waters and cause eutrophication.

TRANSPORT OF PHOSPHORUS FROM SEPTIC SYSTEMS TO SHALLOW GROUNDWATER

Sara Mechtensimer and Gurpal S. Toor
Soil and Water Quality Laboratory, Gulf Coast Research and Education Center,
University of Florida, Wimauma, Florida

Non-point sources such as septic systems have gained attention in recent decades as sources of groundwater contamination and the eutrophication of aquatic systems. Our objective was to investigate phosphorus (P) dynamics in two most common septic drainfields: drip-dispersal and gravel trench (6.1 m long, 0.61 m wide). A drip line was installed to disperse 9 L per day of septic tank effluent (STE). Three lysimeters were installed in the unsaturated zone at 30.5, 61 and 106.7 cm and one piezometer was installed in the shallow groundwater at >300 cm. One piezometer was installed upgradient to collect background groundwater samples (n=15). STE, soil-water, and groundwater samples were collected (n=61; n=10 daily, n=29 weekly, n=17 biweekly, n=5 monthly) and all samples were analyzed for total P (TP), dissolved reactive P (DRP), and other P, assumed to be particulate and organic P (TP – DRP). Mean TP in STE was 13±6 mg L-1 (75% DRP; 25% other P) and decreased to 0.22±18 mg L-1 in the drainfields and 0.3±0.3 mg L-1 in the shallow groundwater. In both drainfields, TP concentrations decreased by >97% and after >1-year of STE application there was no significant increase in P concentrations in groundwater. Although TP concentrations were significantly reduced in drainfield there is still a threat to water quality as TP concentrations of 0.02-0.03 mg L-1 have been shown to stimulate algae growth in aquatic systems.

PHARMACEUTICALS AND ORGANOCHLORINE PESTICIDES IN SEDIMENTS OF AN URBAN RIVER IN FLORIDA

Yun-Ya Yang[1], Gurpal S. Toor[1], and Clinton F. Williams[2]
[1]Soil and Water Quality Laboratory, Gulf Coast Research and Education Center, University of Florida, Wimauma, Florida
[2]USDA-ARS, U.S. Arid Land Agricultural Research Center, Maricopa, Arizona

Sediments (0-10 cm) from a rural to urban gradient along the Alafia River in Florida, United States were collected to determine the risk of environmental contamination with legacy (organochlorine pesticides, OCPs) and new contaminants (pharmaceuticals). Three most frequently detected pharmaceuticals in sediments were carbamazepine (100% of samples), trimethoprim (89% of samples), and pseudoephedrine (63% of samples). While acetaminophen, diphenhydramine, lidocaine, and nicotine were detected in <30% of samples. The detection of caffeine in all sediment samples suggests that domestic wastewater from wastewater treatment plants and/or septic systems may be a contributing source at all the sites. Among the OCPs, endosulfan I was most frequently detected (37% of samples), followed by δ- hexachlorocyclohexane (15% of samples), γ-chlordane and endosulfan II (both in 11% of samples), and dichlorodiphenyldichloroethylene and methoxychlor (both in 7% of samples). The lower concentrations of OCPs (sum: 0-16.1 ng/g) than pharmaceuticals (sum: 0.5-61.9 ng/g) in sediments are probably due to the historic use of OCPs since these were banned for use in the United States in the 1970s, while pharmaceuticals are still used. The variability in detection and concentrations of legacy and new compounds in rural and urban stream sediments is likely due to the different magnitude of input sources, site characteristics, and chemical properties of individual compounds. We conclude that the concentrations of both pharmaceuticals and OCPs in sediments of urban river are relatively lower than existing literature; however, these can still be of environmental concern to aquatic organisms.

Session D2: Groundwater, Spring, and Spring Run Science and Restoration Techniques

Moderator: Rob Mattson
Thursday, June 11, 10:45 am to 1215 pm

RELATIONSHIP BETWEEN NITRATE CONCENTRATION AND DISCHARGE IN SPRINGS WITHIN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Jian J. Di and Robert A. Mattson
St. Johns River Water Management District, Palatka, Florida

The springs of Florida are exhibiting multiple signals of degradation; primarily decreasing flows and water quality degradation in the form of increasing levels of nitrate. We analyzed temporal trends in flow and Nitrate-Nitrite-N (NOx-N) concentration in 22 artesian springs located in the St. Johns River drainage to ascertain the effects of springflows on NOx concentrations. Half of the springs exhibited declining flow trends and most of the remainder had no trend in flow. NOx concentrations varied by two orders of magnitude across the 22 springs (0.01 – 4.28 mg/L NOx-N). Seven springs exhibited increasing NOx concentrations over the past 30 years and six had a decline in NOx levels. Nine springs had no temporal trend in NOx. Fourteen of the springs exhibited a positive correlation between flow and NOx concentration. The results of our analysis, supported by analyses conducted on flow and NOx concentration in Florida springs by other investigators lead to the conclusion that increasing flows will not ameliorate elevated NOx concentrations in Florida springs.

COMPARING VELOCITY CONDITIONS IN SPRING RUNS USING LONG-TERM FLOW RECORDS

S. Fay Baird
Normandeau Associates, Inc., Gainesville, Florida

Average cross-sectional velocity data are archived with USGS manual measurements of flow at each measurement section along streams and rivers. This freely available historical record seems not to be widely recognized, and it provides opportunities to evaluate macro-level changes in instream velocity conditions over time. Ambient instream velocity affects the distribution of aquatic organisms, so time series analysis of velocity offers valuable insights to changes that affect aquatic habitat quality in rivers. In this presentation, online access to archived cross-sectional velocity associated with USGS field measurements of flow is detailed. Average cross-section velocity data compiled since the 1950's are explored for Rainbow River and Silver River, two first-magnitude spring runs in Marion County. The results show effects of measurement location changes along the run as well as differences in velocity conditions at similar locations at the two rivers and over time.

ALGAL COMMUNITY CHARACTERISTICS IN SELECTED SPRING RUN STREAMS IN THE ST. JOHNS RIVER BASIN

Robert A. Mattson, CEP, CSE, Tiffany Trent
Bureau of Environmental Sciences, St. Johns River Water Management District, Palatka, Florida

Benthic and attached algae (epiphyton, periphyton, etc.) are a principal source of autochthonous primary production in Florida spring run streams, in many cases algal production equals or exceeds that of submerged aquatic vegetation (SAV). Historically, the three major algal groups found in spring run streams (by abundance and species richness) include Cyanobacteria ("blue-green algae"), Chlorophyta (green algae) and Bacillariophyta (diatoms). Other groups include a few species of red algae (Rhodophyta) and yellow-green algae (Xanthophyta). Algae provide habitat for some macroinvertebrate species and are an important food source for many macroinvertebrates and a few fish species. Many springs and their spring run streams in Florida are exhibiting increased proliferation of algae (attached algae and benthic filamentous mats), which in some cases replaces SAV beds. There have been a limited number of studies of the algal communities of Florida spring run streams, and no long-term algal monitoring data appear to exist for these streams.

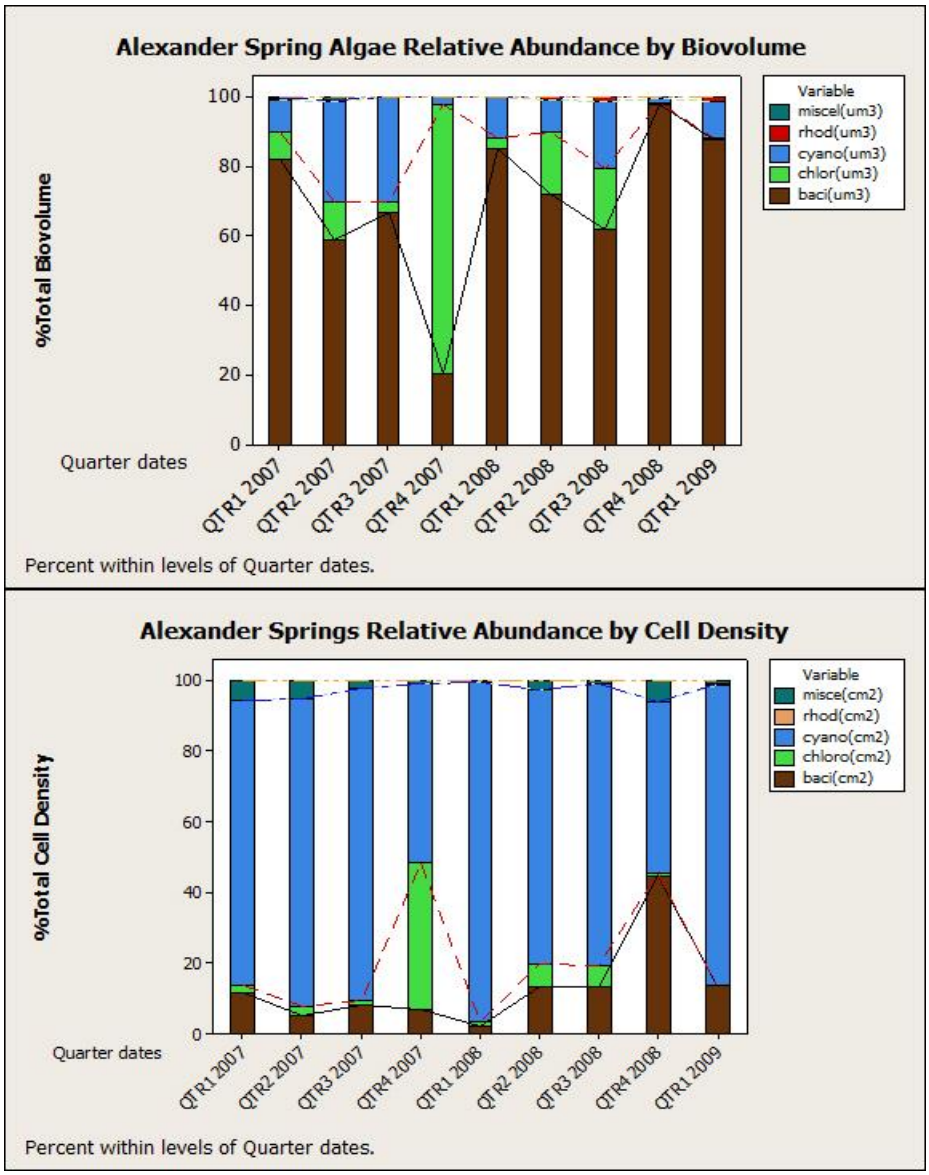
Following development of Pollutant Load Reduction Goals (PLRGs) for the Wekiva River system, the St. Johns River Water Management District contracted with GreenWater Laboratories to conduct two years of quarterly monitoring of attached and benthic algae, along with annual macroalgal surveys, of five spring run streams in the middle St. Johns River region: Wekiva River, Rock Springs Run, Juniper Creek, Alexander Springs Creek, and Silver Glen Run. Attached algae were collected by sampling dominant natural substrata at selected reach locations in these streams (varied by stream, but included SAV, emergent vegetation, and/or wood). Natural substratum sampling was supplemented by deployment and retrieval of glass slide periphytometers at selected reaches. Ash-free dry weight (AFDW), cell density, biovolume, and chlorophyll *a* per unit area were measured on these natural and artificial substrata samples. Annual macroalgal surveys were conducted down the length of each stream using 0.25 m^2 quadrats and measuring cover using the Braun-Blanquet scale; qualitative samples were collected for species identification/presence. Field measurements of water quality and water quality samples for laboratory analysis were also collected at the time of algal sampling.

Dominant macroalgal taxa (> 50% occurrence) in the five streams (as percent occurrence at the sampling transects) in 2007-08 were:

STREAM	MAJOR TAXON	SPECIES	Max. % Occur.
Alexander Springs Creek	Cyanobacteria	*Lyngbya wollei*	60
		Oscillatoria princeps	67
	Chlorophyta	*Oedogonium* sp.	87
		Spirogyra sp.	67
	Bacillariophyta	*Pleurosira laevis*	80
Juniper Creek	Cyanobacteria	*Lyngbya wollei*	53
		Phormidium sp.	60
	Chlorophyta	*Spirogyra* sp.	53
	Bacillariophyta	*Terpsinoe musica*	53
Rock Springs Run	Cyanobacteria	*Lyngbya wollei*	56
		Phormidium sp.	63
	Bacillariophyta	*Pleurosira laevis*	88
		Terpsinoe musica	100
Silver Glen Run	Cyanobacteria	*Anabaena* sp.	60
		Lyngbya wollei	100
		Lyngbya sp.	80

		Oscillatoria sp.	60
		Phormidium sp.	60
	Chlorophyta	*Cladophora glomerata*	70
		Oedogonium sp.	80
		Rhizoclonium hieroglyphicum	70
		Spirogyra sp.	70
		Stigeoclonium sp.	70
	Bacillariophyta	*Pleurosira laevis*	90
Wekiva River	Cyanobacteria	*Oscillatoria* cf *simplicissima*	72
		Oscillatoria princeps	80
	Chlorophyta	*Cladophora glomerata*	60
		Oedogonium sp.	76
		Spirogyra sp.	60
	Chlorophyta/ Xanthophyta	*Dichotomosiphon*/*Vaucheria* sp.	64
	Bacillariophyta	*Pleurosira laevis*	72
		Terpsinoe musica	88

The various measures of algal abundance exhibited significant variation among the five spring run streams and four substrata (three natural and one artificial). Generally, Juniper Creek had the lowest overall algal abundance and the Wekiva River the highest. Cell density and biovolume exhibited little temporal variation over the two years of quarterly monitoring, while AFDW and chlorophyll *a* exhibited more temporal variation. This suggests that the former may be more useful for long-term monitoring to detect changes in algal communities. Highest algal cover (from the annual surveys) was seen at Alexander Springs Creek and Silver Glen Run. Dominance by major algal group varied among streams and by measure of abundance; diatoms were generally dominant by biovolume and taxa richness in all streams, while cyanobacteria tended to be dominant by cell density in most streams, although in the Wekiva River and Rock Springs Run diatoms and cyanobacteria were codominant by density.



A major management issue affecting Florida springs and spring run streams is significant increases in nitrate concentrations over the past 30-50 years. Some data indicate that this increase could be responsible for increased algal proliferation in some of these streams. We conducted exploratory analyses comparing nitrate concentrations (measured as Nitrate-Nitrite N or NOx-N) at the time of sampling with the four measures of algal abundance. Statistically significant positive and negative relationships between NOx-N concentration and algal abundance were seen, but there was no consistent pattern among streams, abundance measure, or substrata. Statistically significant relationships between total phosphorus (TP) concentration and algal abundance were also seen, but these were consistently weaker than the relationships with NOx-N. Despite the lack of strong and consistent relationships between NOx-N concentration and algal abundance, we conclude from this analysis that nitrate appears to be a factor in increased algal abundance in some spring run streams. Also, even if nitrate levels are not a major driver of algal abundance, there are multiple reasons to focus management efforts on reducing nitrate levels in springs, including potential faunal toxicity, inhibition of SAV growth, and nitrogen loading to downstream ecosystems.

A SYSTEMS MODEL APPROACH TO UNDERSTANDING ALGAE GROWTH IN FLORIDA SPRINGS: MOVING TOWARDS WHOLE-ECOSYTEM RESTORATION

Angelique M.K. Bochnak, PhD, PWS[1], Sara Miller[2], Todd Osborne, PhD[3];
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In recent years, the complex spring-fed systems in Florida have received considerable attention due to a variety of challenges: decline in desired aquatic vegetation, excessive algae growth, decreased aquifer levels, decreased water flows, and increased nitrate concentrations within the springshed as well as in connecting watersheds. Over the years, decreased biological diversity of our springs and spring-runs have been observed (Munch et al. 2006, FDEP 2007). A number of these springs-fed systems are plagued by excess growth of planktonic algae, typically attributed to non-point source loading from the landscape or a reduction in flow. Excessive algae growth can result in high turbidity and accelerated accumulation of flocculent material, which can effectively lead to algae outcompeting native submerged aquatic vegetation (SAV) for light – causing die-off of desirable aquatic plant species or inhibiting reestablishment in restoration efforts. Studies have linked this degradation to the loss of historical groundwater discharge and/or water quality and quantity problems that have resulted in prolific algal growth (Heffernan et al. 2010a, King 2014). Furthermore, nutrient enrichment can shift primary producer communities from macrophyte dominated communities to communities dominated by attached algae or benthic algae mats (Scheffer et al. 2001).

Objective:
The primary objective of this work is to develop a systems model to determine threshold limits for the forcing functions that control primary producers in spring-fed systems. It is assumed nutrient loading (primarily nitrate) must be reduced or flow must be restored in order to control continued excessive algae growth. However, there are other controls on algal production that could have significant contributions to the changes observed in springs. Additional forcing functions investigated with this model include: light availability, grazers, dissolved oxygen, predation, and nutrient limitations. The systems model is constructed using Stella. When available, inputs for the forcing functions and rates in model are based primarily on literature values from research conducted in Florida springs.

Background:
Recent studies investigating eutrophication of springs, spring-runs, and receiving water bodies have documented significant increases in nitrate levels (Munch et al. 2006, Upchurch et al. 2007, Quinlan et al. 2008, Albertin 2009, Sickman et al. 2009, Heffernan and Cohen 2010, Heffernan et al. 2010b, Cohen et al. 2011, Albertin et al. 2012). This increase in nitrate levels present management challenges as they threaten the presence of healthy SAV and benthic communities which are considered desirable features of freshwater systems (Moss 1990).

The considerable increases in nutrients (nitrogen and phosphorus) are in part due to development within springsheds, excessive fertilizer use (both agriculture and residential), wastewater treatment plant discharges and failing septic tanks (Albertin et al. 2012). Excess nitrate levels in water can be harmful to aquatic invertebrates, amphibians and fish (Mattson et al. 2007). When nitrates are unlimited, excessive algal growth may occur (Cowell and Botts 1994, Cowell and Dawes 2004, Albertin 2009, Sickman et al. 2009). Large amounts of algae growth can result in stress to desired aquatic life by reducing water clarity and causing extreme fluctuations in dissolved oxygen. Loss of native habitat can also be the result of the introduction of undesirable algae species as well as invasive aquatic plants (*Lyngbya* and *Hydrilla*).
Recent work by Quinlan et al., 2008 examined the changes in primary producer communities over time compared to those observed in the 1950's (Odum 1957) as a result of significant increases in nitrate levels. It has been documented that nitrate levels in Silver Spring has doubled since Odum's pinnacle work in 1957 (Phelps 2004). As expected, this study indicated that epiphytic and benthic algae mats are considerably higher than those reported by Odum, 1957. Interestingly, the composition, abundance, and distribution of macrophytes remain largely unchanged since 50 years ago de-

spite the doubling in nitrate concentrations. A likely reason for this result is that nitrate and algal biomass threshold levels have not yet been reached. Given more time and continued increases in nitrate levels could result in significant macrophyte community shifts.

In addition to water quality degradation, reductions in groundwater discharge at the spring heads has also occurred over the past 50 years (Munch et al. 2006, Upchurch et al. 2007). Groundwater withdrawals due to consumptive use account for some of this decrease, but the steady decline observed in rainfall since the 1960s also affects discharge rates. Seasonal fluctuations in weather patterns adds significant challenges to managing these spring-fed systems. Characterizing the effects of seasonal variability in water quantity and flow on the biological and chemical components of springs is a difficult task.

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Session E2: The S's! Stormwater, Sequestration, Swamps and Soils

Moderator: Drew Liddick
Thursday, June 11, 10:45 am to 12:05 pm

FACTORS AFFECTING EFFECTIVENESS OF STORMWATER DETENTION PONDS AT SEQUESTERING NUTRIENTS AS IMPLEMENTED IN SOUTH FLORIDA: A CASE STUDY IN LEE COUNTY

Drew Liddick, Don Duke, Serge Thomas, Brian Bovard, Ernesto Lasso De La Vega
Florida Gulf Coast University, Ft. Myers Florida

Florida regulations require most residential and commercial developments built after 1997 to treat stormwater by capturing runoff in detention ponds, for the stated purpose of sequestering nutrients by settlement and natural processes before discharging to waters of the U.S. At present tens of thousands of residential detention ponds exist in south Florida, with some 4,000 in Lee County alone. Information is limited about the effectiveness of those ponds: monitoring is not routinely conducted by any agencies, and few studies have assessed water quality or performance, with no clear consensus resulting. The primary objective of this research is to determine whether it is possible to assess nutrient-sequestering performance or water quality of south Florida wet-detention ponds using data and tools readily available to a local agency. A secondary objective is to attempt to determine factors that may affect water quality or performance of these ponds, such as: number of years in service; sedimentation rate; size and surface type of the ponds' catchments; geometry of the ponds, including angle of perimeter slopes, variability of depth, and ratio of mean depth to surface area; and others. The research uses existing data for a case-study sample of 18 ponds in Lee County, Florida, for which reasonably long historical water quality data are available from volunteer Pond Watch organizations. The degree to which ponds' as-built geometry conforms to permit requirements will be assessed by collecting bathymetry and sediment-depth data, using a sonar device verified by a subset of sediment cores, and comparing the data to Environmental Resource Permits on file at South Florida Water Management District. Bathymetry and sediment depth will be used to assess the degree and rate of sedimentation and changes in morphology over time. These and other factors will be compared to statistically-evaluated water quality data, in an attempt to identify, for this small case study grouping, any association of water quality with one or more of the physical geometry factors.

SOIL CARBON SEQUESTRATION IN MANGROVE ECOSYSTEMS OF SOUTHWEST FLORIDA

Daniel A. Marchio Jr. and William J. Mitsch
Everglades Wetland Research Park, Naples, Florida

Coastal wetlands including mangrove swamps, seagrass beds, and tidal salt marshes are increasingly being recognized for their ability to produce and sequester large amounts of organic carbon. The objective of this study was to compare recent (50 years) carbon sequestration in mangrove swamps in a hydrologically disturbed and relatively pristine reference mangrove creeks near Naples Bay, Southwest Florida. It was hypothesized that mangroves along the disturbed tidal creek sequestered significantly less carbon than mangroves along the reference creek. Three soil cores were collected in a basin, dwarf, fringe, and riverine hydrogeomorphic settings along each of the creeks, sectioned into 2-cm segments, and analyzed for total organic carbon and inorganic carbon profiles. Detection of ^{137}Cs and ^{210}Pb in each segment was used to estimate recent sediment accretion and carbon sequestration. The majority of carbon found within our study was organic (89 - 99%). Mean carbon sequestration rates for the tidal creeks (98 ± 49 g C m^{-2} yr^{-1} (n = 18)) is low compared to published global means for mangrove wetlands. Highest carbon sequestration was in the riverine mangroves and lowest in the basin mangroves. The hydrologically disturbed creek sequestered less carbon in the past 50 years than

did the reference creek with mean values of 82 and 113 g C m^{-2} yr^{-1}, for the disturbed and reference creeks, respectively [f (1) = 6.39, p = 0.0265]. In addition, using the ^{210}Pb-calculated rates of sedimentation, only two of the seven sampling sites may be able to persist, given the current rates of sea-level rise rates for this region of Southwest Florida (2.4 mm yr^{-1}). Both hydrologic disturbance and hydrogeomorphic setting of mangrove wetlands significantly affect the amount of carbon sequestered.

METHANE EMISSIONS FROM FRESHWATER SWAMP SOILS WITH DIFFERENT HYDROPERIODS

Andrea Pereyra and William J. Mitsch
Everglades Wetland Research Park, College of Arts & Sciences,
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Wetlands are the most significant natural source of CH_4 emissions, the majority of which are released from tropical wetlands. Land-use modifications in a watershed have a great impact on wetland areas. These alterations can cause changes in a wetland's hydroperiod, one of the most important factors controlling biogeochemical processes such as methanogenesis. Efforts have intensified to relate methane flux in wetlands to water table position; however, there is little research in tropical cypress swamps. We measured CH_4 fluxes from six sites within two cypress swamps in southwest Florida exposed to different hydroperiods and land-use conditions; one is located on the campus of Florida Gulf Coast University (FGCU) in a hydrologically altered landscape and the other in a highly protected strand of cypress in Corkscrew Swamp Sanctuary (CSS). Measurements were taken at two different times of the day over a period of 12 months to determine the influence of water level, time of inundation, and soil temperature on methane emissions. Methane fluxes range from 1.88 to 26.44 and from 4.84 to 440 mg CH_4-C m^{-2} d^{-1} in the FGCU and CSS sites, respectively. Median and mean $\pm$ standard error fluxes of methane were lower in FGCU (4.54 and 7.96 $\pm$ 3.74) than in CSS (113.52 and 165.04 $\pm$ 57.75). These rates will be compared to previous methane emission studies from wetlands in the region. The findings from this research will improve the understanding of how methane emissions relate to hydroperiods in cypress swamps and could provide useful criteria to take into consideration for evaluating permit requests during the design of any land-cover change.

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2015 FLORIDA LAKE MANAGEMENT SOCIETY 26TH ANNUAL SYMPOSIUM

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