22nd ANNUAL CONFERENCE OF THE FLORIDA LAKE MANAGEMENT SOCIETY

PROGRAM & PROCEEDINGS

Discovering the St. Johns River –
A River of Lakes

June 13-16, 2011
St. Johns County Convention Center
St. Augustine, FL

www.flms.net

FLMS

MISSION STATEMENT

The mission of the Florida Lake Management Society is to promote protection, enhancement, conservation, restoration, and management of Florida's aquatic resources; provide a forum for education and information exchange; and advocate environmentally sound and economically feasible lake and aquatic resource management for the citizens of Florida.

TABLE OF CONTENTS

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Request for additional copies of this program and information about the Society may be sent to the following address:

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THE FLORIDA LAKE MANAGEMENT SOCIETY ANNUAL AWARDS:

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

> <u>Past recipients include:</u> Hal Scott (1990), Vince Williams (1991), Cassie and David Gluckman (1993), Johnny Jones (1994), Richard Coleman (1995), Nat Reed (2000), Mike Kasha (2001), Everett Kelly (2002), Joe E. Hill (2003), Jake Stowers (2004), Henry Dean (2005), not awarded (2006), Dean Barber (2007), Ross Hamilton (2008), Not Awarded (2009), and John Brenneman (2010).

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

> <u>Past recipients include:</u> William Beck (Florida A&M University, 1990),Jim Hulbert (FDEP, 1991), Howard T. Odum (1993), Tom Crisman (1994), Marty Wanielista (1995), Karl Havens (1999), Claire Schelske (2000), and Betty Rushton (2003) – not awarded in 2004, 2005, 2006, 2007, Mark Hoyer, University of Florida (2008), Mike Coveney, St. Johns River Water Management District (2009), and Not Awarded (2010).

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

> <u>Past recipients include:</u> Helen Spivey (1990), Jim Hawley (1991), Wayne Nelson (1993), Jim Thomas (1994), Tom Reese (1995), Judith Hancock (1999), Carroll Head (2000), Mary Carter (2001), Al Cheatum (2002), Thomas E. Fortson (2003), Beverly Sidenstick (2004), Joanne Spurlino (2005), Barbara Ketchum (2006), Robert King (2007), Lake Powell Community Alliance (2008), Not Awarded (2009), and Ron Miller (2010).

The Richard Coleman Aquatic Resources Award is given to a professional who has worked to restore, protect, and/or advance our understanding of Florida's aquatic resources. This award is named in honor of Richard Coleman who was a founder and first president of FLMA and, prior to his death, worked tirelessly to protect and restore aquatic resources throughout the State of Florida.

> Past recipients include: Eric Livingston (1990), William Wegener (1991), Paul Shaffland (1993), Jeff Spence (1994), Sandy Fisher (1995), Kim Schildt (2000), Jess Van Dyke (2001), Patrick J. Lehman (2002), Lothian Ager (2003), Dr. Marty Kelly (2004), Dr. Harvey H. Harper, III (2005), Dr. Edgar F. Lowe (2006), Rae Ann Wessel (2007), Michael Hill, FFWCC (2008), Kevin McCann, City of Orlando (2009), and Jim Hulbert, Rollins College (2010).

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

> Past recipients include: John Morgan (2000), Georgia Davis (2001), Victor Hull (2002), Dave McDaniel (2003), Bob Hite (2004), Ron Littlepage (2006), Not Awarded (2007), Bruce Ritchie, Tallahassee (2008), Not Awarded (2009), Not Awarded (2010).

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

> Past recipients include: Robert B. Rackleff and Debbie Lightsey (2001), Shannon Staub (2002), Cliff Barnes (2003), Senator Ken Pruitt (2005) and John Delaney and Senator Jim King (2006), Don Ross (2007), Cindy Meadows (2008), Not Awarded (2009), Not Awarded (2010).

The President's Award is given by the President of the Society to an individual for outstanding support of the work of the Society during the past year.

Past recipients include: Nancy Page (1999), Julie McCrystal (2000), ErichMarzolf (2001), Chuck Hanlon (2002), Chuck Hanlon (2003), Jim Griffin (2004), Erich Marzolf (2005), John Burns and Michelle Jeansonne (2006), Erich Marzolf (2007), Michael Perry (2008), Todd Olson (2009) and Shannon Carter Wetzel (2010).

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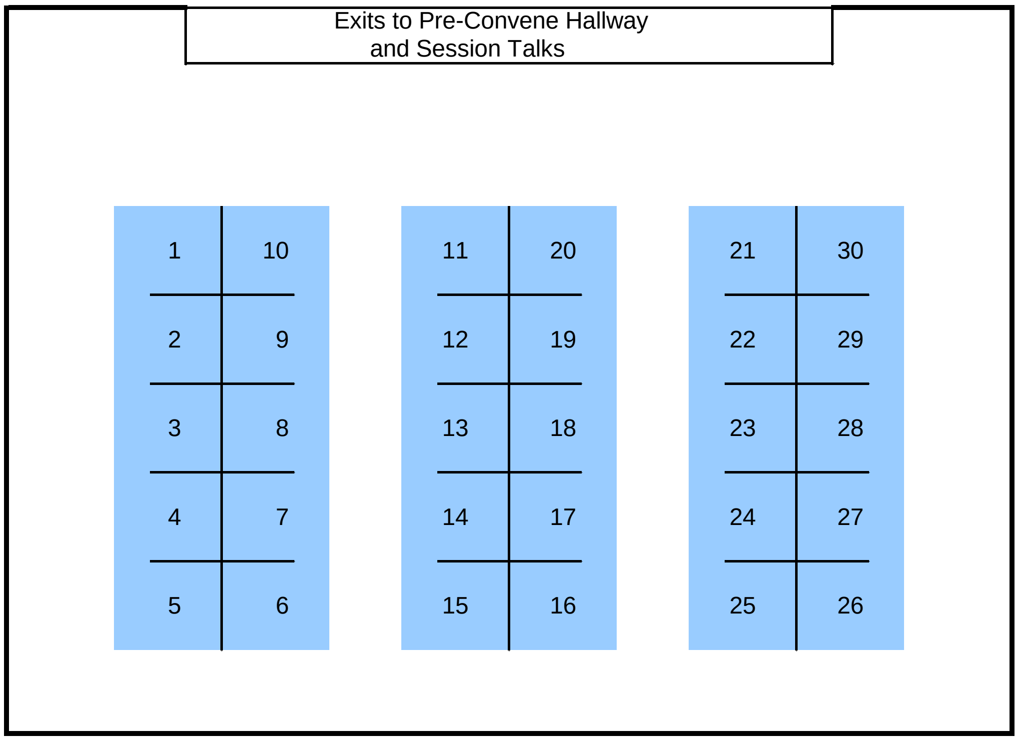

4	All Things Water	13	In-Situ
11	AMEC-BCI	10	MACTEC
12	Applied Polymer Systems	2	Red River Specialties
1	Aquatic Eco-Systems	5	SePRO Corporation
15	Aquatic Vegetation Control	16	Suntree Technologies
20	Arc Surveying & Mapping	17	Suntree Technologies
18	Dredge America	21	Syngenta
8	Dredging & Marine Consultants	3	UPI
22	Environmental Consulting & Technology	9	USF
19	Environ	30	Vertex Water Features
23	Geosyntec	25	Water & Air Research
6	GreenWater Laboratories	14	Wildlife Supply Company
24	Hach Environmental	7	YSI

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Arc Surveying & Mapping, Inc., a small business located in Jacksonville Florida, is comprised of a group of innovative professionals that specialize in topographic and bathymetric surveys. Arc serves clients in the southeast United States and the Caribbean, focusing primarily on projects which require the excavation of contaminated sediments. The company has performed bathymetric and sub-bottom surveys in harbors and rivers from Chicago to Puerto Rico and in numerous fresh water lakes throughout Florida. Typically, lake surveys by Arc are performed utilizing a combination of new technology and experience to accurately describe the lake bottom and sub-bottom surfaces. For more information visit our website www.arcsurveyors.com or contact Arc at (904) 384-8377.

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From offices in Florida, Michigan, Illinois, Iowa, and North Carolina, **Environmental Consulting & Technology, Inc. (ECT)**, provides full-service, multidisciplinary engineering, scientific, planning, and management services worldwide. More than 70 percent of these projects are conducted for repeat clients, demonstrating ECT's commitment to high levels of quality technical services and client satisfaction. ECT's experience base involves projects for industry; public utilities; federal, state, and local agencies; law firms; banking and insurance companies; A/E firms; and private developers. ECT has completed hundreds of water-related Florida projects, resulting in a wealth of experience in all phases of engineering, sampling/monitoring, permitting, and planning.

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MACTEC Engineering and Consulting, Inc.

MACTEC Engineering and Consulting, Inc. (MACTEC) is a nationwide engineering and environmental consulting firm with specialists in over 50 scientific and engineering disciplines. Our core business is engineering for environmental, water resources, transportation, and construction projects as well as a wide range of environmental services such as risk assessment and toxicology, environmental compliance, remediation, permitting and modeling; water quality modeling and nutrient management, watershed planning and management; wetland , stream and lake restorations; stormwater management; BMPS, design and retrofit; and TMDL determinations. MACTEC is currently ranked in the top 5% of Engineering News Record's Top 500 Design Firms, ranked one of the top Southeast design firms by Southeast Construction, and 3rd among 75 firms in the Annual Design Survey.

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CONFERENCE PROGRAM

22ND ANNUAL FLORIDA LAKE MANAGEMENT SOCIETY CONFERENCE

Discovering the St. Johns River – A River of Lakes

June 13-16, 2011

FINAL PROGRAM

MONDAY - JUNE 13, 2011 – Workshops (Location: Troon, Wentworth, and St. Augustine E and F)

8:00 am-5:00 pm	Check-In and Registration (Royal Melbourne Foyer)

8:00 am-8:30 am	**MORNING REFRESHMENTS** (St Augustine C and D)

8:15-11:45 am **Workshop 1: Part I: Application of the Lake Vegetation Index for Accurate Assessment (classroom).** Nia Wellendorf, FDEP (St. Augustine E and F)

12:00-1:00 pm	**LUNCH (provided with full-day Workshop registration)** (St. Augustine G)

1:15-4:45 pm **Workshop 2: Part II: Application of the Lake Vegetation Index for Accurate Assessment (field).** Russ Frydenborg and Nia Wellendorf, FDEP (St. Augustine E and F)

Open Discussion, No Cost:

1:15-4:45 pm **University of Central Florida Stormwater Education Task Force Meeting And NPDES/TMDL Update Session** Leesa Souto, University of Central Florida's Stormwater Education Task Force and Scott Deitche and John Walkinshaw, GPI Southeast, Inc. (Wentworth)

* Indicates Student Presenter

UNIVERSITY OF CENTRAL FLORIDA
STORMWATER EDUCATION TASK FORCE MEETING
AND NPDES/TMDL UPDATE SESSION

The University of Central Florida Stormwater Education Task Force (SET) lead by Leesa Souto will host their summer 2011 meeting as part of the Florida Lakes Management Society's annual conference. The SET meeting will review the new Water Resources Supersite on the web.

After the SET meeting, there will be a special presentation on the current status of regulatory efforts in Florida including legislative impacts to environmental programs, the National Pollutant Discharge Elimination System (NPDES) Program, and Total Maximum Daily Loads (TMDLs).

The 2011 Florida Legislature has made major changes to regulation and management of water resources in the state. As part of the session, we will learn about the changes and also here from the Florida Department of Environmental Protection (FDEP) on the changes and impacts.

Total Maximum Daily Loads (TMDLs) are part of the Clean Water Act of 1972. A TMDL is a tool to address water quality problems. TMDLs restore polluted waters by establishing the maximum amount of a pollutant that a water body can receive without adverse impact to fish, wildlife, recreation, or other uses.

States are responsible for developing TMDL action plans and submitting them to EPA for approval. In Florida the program is overseen by the (FDEP). The end result of the TMDL process is a management plan with quantitative goals to reduce pollutant loadings to impaired water bodies.

The ultimate responsibility for pollution reductions falls on local governments and other pollution contributors. Contents of the management plans will be included in National Pollutant Discharge Elimination System (NPDES) permits. The costs may be expensive. Local areas can challenge designated TMDLs and negotiate the management plans with the DEP.

After the 2010 national census and population increases, more locations will need to have NPDES permits. The NPDES program requires periodic reports on permit requirements.

The TMDL program is a work in progress and it can be a challenge to meet program requirements. The FDEP seeks local partnerships to develop management plans that can be effective yet flexible to meet TMDL goals. The plan development provides opportunities to identify credits, innovative approaches, and cost efficiencies to meet the TMDL requirements.

Presenters:

Scott M. Deitche - Scott is the Manager of the Water Resources Permitting and Outreach Department for the GPI Southeast - Tampa. He has 14 years of experience in environmental management, particularly in stormwater-related areas, NPDES permitting/compliance, Basin

Management Action Plan (BMAP) development, TMDLs, and the development and implementation of watershed management plans (WMPs).

John J. Walkinshaw - John is a Senior Environmental Specialist with GPI Southeast - Tampa and has over 24 years of experience in water resource management. He has managed projects involving water quality, water supply, and watershed management. He has worked with clients in developing and implementing programs in support of NPDES and TMDL requirements and program implementation. He is involved in four different TMDL efforts in Florida.

TUESDAY - JUNE 14, 2011

8:00 am-4:00 pm	Check-In and Registration (Royal Melbourne Foyer)
6:30 am-8 am	Breakfast (500 South)

Sessions	St. Augustine E and F	
8:30 – 8:45 am	Opening Remarks:	Shannon Carter Wetzel, FLMS President Sherry Brandt-Williams, Conference Co-Chair Dean Dobberfuhl, Conference Co-Chair Kelli Hammer Levy, Program Chair
8:45 - 9:00 am	NALMS Update:	Ann Shortelle, NALMS Director Region IV

Session 1: Understanding our Environment: Assessment Methods
Moderator: Kym Rouse Campbell

9:00- 9:20 am — **Macroinvertebrate Communities as a Tool for Minimum Flows and Levels Evaluation in the Pithlachascotee River.** David L. Evans, Douglas G. Strom, E. Lynn Mosura-Bliss, and Michael (Sid) S. Flannery

9:20- 9:40 am — **Hydrologic Influences on Water Quality in Blue Cypress Marsh Conservation Area.** Angelique M. K. Bochnak, Steven J. Miller, Lawrence W. Keenan, Dean Dobberfuhl

9:40-10:00 am — **Assessing Vulnerability of Florida Lakes to Climate Change.** Sam Arden and Ann Shortelle

10:00-10:20 am — **A Comparison of Macroinvertebrate Monitoring Methods in Central Florida Streams.** Paul Irvin, Kym Rouse Campbell, Doug Strom, Michelle Dale, Thomas D. Gauthier, and Robert P. De Mott

10:20-10:40 am	**MORNING BREAK** (St. Augustine C and D)

Session 2: Regulatory Framework: Numeric Criteria and Designated Uses
Moderator: Kelli Hammer Levy

10:40-11:00 am — **Phosphorous, Nitrogen, and the Designated Uses of Florida Lakes.** Roger W. Bachmann, Dana L. Bigham, Mark V. Hoyer, and Daniel E. Canfield, Jr.

11:00-11:20 am — **Methods to Detect Decadal-Scale Trends in Water Quality.** Dana L. Bigham*

11:20-11:40 pm — **Use Attainability Analysis and Class III-Limited Waters.** Russ Frydenborg, Nia Wellendorf, and Ken Weaver

11:40-12:00 pm — **Assessment of Dissolved Oxygen in Blackwater Systems.** Sherry Brandt-Williams, May Lehmensiek, and Robert Godfrey

12:00-1:00 pm	**LUNCH** (Legends 1)

* Indicates Student Presenter

TUESDAY – JUNE 14, 2011 (Continued)

Session 3: Environmental Analysis – Understanding the Data
Moderator: Sherry Brandt-Williams

1:00- 1:20 pm	**A Literature Review of Nitrate Toxicity and Implications for Florida Springs.** Robert A. Mattson and May Lehmenseik
1:20- 1:40 pm	**Update: Nitrate Sources in the Wekiva River Basin.** William A. Tucker, Robert Mattson, Marty Goodwin, and Erik Makus
1:40- 2:00 pm	**Lake Jesup Tributary Inputs: Preliminary Results from Seminole's Ambient Monitoring Network.** Shannon Carter Wetzel and Kim Ornberg
2:00- 2:20 pm	**Does this Make Sense? Assessing the Actual Condition of a Lake or River Resource?** Jim Griffin and David Eilers

2:20-2:50 pm	**AFTERNOON BREAK** (St. Augustine C and D)

Session 4: Best Management Practices – Focus on Nutrient Reduction
Moderator: Mike Perry

2:50- 3:10 pm	**Coupled Biological/Chemical Systems for Maximizing Phosphorous Removal from Natural Waters.** Hugo R. Sindelar*, Treavor H. Boyer, Mark T. Brown, and Taylor Bomarito
3:10- 3:30 pm	**Efficacy of a Large Scale Constructed Wetland to Remove Nitrogen from a Sub-Tropical Shallow Lake.** Ed J. Dunne, Mike Coveney, Erich Marzolf, Victoria Hoge, Roxanne Conrow, Robert Naleway, Edgar Lowe, and Lawrence Battoe
3:30- 3:50 pm	**The Use of a Mobile Alum Injection Dosing (MAID) System to Improve the Treatment Efficiency of Existing Stormwater Treatment Ponds.** Ron Novy and Matt Rayl
3:50- 4:10 pm	**Water Quality Changes Following Nutrient Loading Reduction and Biomanipulation in a Large Shallow Subtropical Lake, Lake Griffin, Florida.** Rolland S. Fulton, Walt Godwin, and Brian Sparks
4:10- 4:30 pm	**Nutrient Fluctuations Induced Through Manipulations of Aeration in a South Florida Retention Pond.** Amanda Quillen
4:30-4:50 pm	**Controlling Eutrophication through Phosphorous Reduction: Tools to Address Algae Blooms and Water Quality Standards.** Seva Iwiniski and Kyla Iwinski

5:00-5:30 pm	**FLMS Chapter Meetings** (St. Augustine E and F)
5:30-6:30 pm	**POSTER SESSION** (St. Augustine C and D)
6:30-8:30 pm	**EXHIBITORS' SOCIAL** (St. Augustine C and D)

* Indicates Student Presenter

Session 5: Poster Session (St. Augustine C and D)

5:30-6:30 pm	**Florida Lakes that will not Meet the Numeric Nutrient Criteria for Phosphorous, Nitrogen, and Chlorophyll a.** Dana L. Bigham*, Roger W. Bachmann, Mark V. Hoyer, and Daniel Canfield, Jr.
5:30-6:30 pm	**Phosphorous, Algae, and Water Quality: Interrelationships and Management Implications.** West M. Bishop, Dharmen Setaram, and Dan Bergeson
5:30-6:30 pm	**Changes in Residual Fish Pesticide Concentrations Following Dredge Spoil Deposition in a Restored Wetland.** Kelly Crew, Walt Godwin, Janet Nunley, John Stenberg, Randy Roth, Brian Sparks, Michael Coveney, Roxanne Conrow
5:30-6:30 pm	**Using Suitability Analyses for Surface Water Management Planning.** Robert Godfrey and Sherry Brandt-Williams
5:30-6:30 pm	**How Long Can You Go? Determining Alum: Buffer Dosages in Central Florida Restoration Areas.** Kelly Crew and Victoria R. Hoge
5:30- 6:30 pm	**Incorporating Nitrogen Fixation into a Water Quality Model of a Eutrophic Lake.** Scott Lowe and Kim Ornberg
5:30- 6:30 pm	**Little House on the Ferry: Harnessing the Potential of the Built Environment to Restore Florida's Inland Waterways.** Christina A. McDaniel*
5:30-6:30 pm	**The Viability of Rapid Eye and Worldview 2 Satellites for Mapping Cyanobacteria Blooms.** Louis Sanderson and Robert K. Vincent

6:30-8:30 pm	**EXHIBITORS' SOCIAL** (St. Augustine C and D)

* Indicates Student Presenter

WEDNESDAY - JUNE 15, 2011

8:30 am-3:00 pm	Check-In and Registration (Royal Melbourne Foyer)
6:30 am-8 am	Breakfast (500 South)
Sessions	St. Augustine E and F

Session 6: Discovering the St. John's River
Moderator: Lawrence Keenan

8:30-8:50 am	**The St. Johns River: An Overview of Morphology and Water Chemistry.** Sherry Brandt-Williams, John Hendrickson, and Lawrence Keenan
8:50-9:10 am	**Predicting the Magnitude and Duration of Algal Blooms in the St. Johns River.** Michael F. Coveney, John Hendrickson, and Erich Marzolf
9:10-9:30 am	**Assessing the Effects of Repeatedly Exposing *Vallisneria Americana* to Moderate Salinity in the St. John's River.** Mallarie Yeager, Charles Jacoby, Tanya Stevens, Cliff Ross, and Dean Dobberfuhl
9:30-9:50 am	**Field Transplants as a Tool for Assessing Effects of Salinity on *Vallisneria Americana* in the Lower St. Johns River.** Tanya Stevens, Charles Jacoby, MallarieYeager, Cliff Ross, and Dean Dobberfuhl
9:50-10:10 am	**Sources of Terrestrial Salts to the St. Johns River, Florida**. Joseph B. Stewart

10:10-10:30 am	**MORNING BREAK** (St. Augustine C and D)

Session 7: Understanding Nutrient Sources
Moderator: Harvey Harper

10:30-10:50 am	**Phosphorous Sources to Newnans Lake: Internal vs. External Loads.** Jian J. Di and Erich Marzolf
10:50-11:10 am	**Effects of Fertilizer Use on Groundwater Quality in a Residential Area.** William A. Tucker, Robert Mattson, Mark C. Diblin, Richard W. Hicks, and Yi. Wang
11:10-11:30 am	**Lake Tibet Sub-Basin 1 and 2 Nutrient Source Evaluation.** Sergio Duarte
11:30-11:50 pm	**Reflections on 30 Years of Sediment Inactivation Projects in Florida Lakes – Part I- Historical Perspective.** Harvey H. Harper
11:50-12:10 pm	**Reflections on 30 Years of Sediment Inactivation Projects in Florida Lakes – Part II – Sediment and Water Quality.** Harvey H. Harper

12:10-1:30 pm	**BANQUET LUNCH/FLMS ANNUAL MEETING** (Legends 1)

* Indicates Student Presenter

WEDNESDAY - JUNE 15, 2011 (continued)

Session 8: Macrophytes and Macroalgae
Moderator: David Evans

1:30-1:50 pm	**Influence of Lake Augmentation on Aquatic Macrophyte Productivity/Abundance and Phytoplankton Biomass in Central Florida Lakes.** Mark V. Hoyer
1:50-2:10 pm	**Distribution and Spatial Coverage of Filamentous Macroalgae in Five Florida Springs**. Andrew Chapman
2:10-2:30 pm	**Search for New Management Techniques for Hydrilla and Hygrophila.** Stacia Hetrick, Jim Cuda, William Haller, Dean Jones, Abhishek Mukherjee, Michael Netherland, William Overholt
2:30-2:50 pm	**Assessment of Periphyton and Macroalgal Biomass Within a Submerged Aquatic Vegetation Bed of the Lower St. Johns River.** Jennifer Sagan
2:50-3:10 pm	**Paralytic Shellfish Toxins Characterized from *Lyngbya Wollei* Dominated Mats Collected from Two Florida Springs.** Amanda Foss, Ed Phlips, and Mete Yilmaz

3:10-3:30 pm	**AFTERNOON BREAK** (St. Augustine C and D)

Session 9: Watershed Management: Tools in the Tool Box Part I
Moderator: Jim Griffin

3:30-3:50pm	**The Pinellas County Fertilizer and Landscape Management Program: Be Floridian - A Watershed Tool for Urban Communities.** Kelli Hammer Levy and Anamarie Rivera
3:50-4:10 pm	**Low Impact Development and Its Potential Role in Meeting Nutrient Load Reductions and Water Conservation.** Jennifer Sagan and Tom Blush
4:10-4:30 pm	**Sustainable Water Resource Education Using Inquiry Based Education and the Water Atlas.** Jan Allyn and Jim Griffin
4:30- 4:50 pm	**Winter Haven Chain of Lakes Water Quality Management Plan.** Pam Latham, Dave Tomasko, Emily Keenan, and Mike Britt

5:00-5:30 pm	**FLMS BOARD MEETING** (St. Augustine E and F)

* Indicates Student Presenter

THURSDAY - JUNE 16, 2011

6:30 am-8 am	Breakfast (500 South)
10:00 am-12:00 noon	Exhibitor Breakdown
Sessions	St. Augustine E and F

Session 10: Best Management Practices for Water Quality Improvement
Moderator: Shannon Carter Wetzel

8:15- 8:35 am	**Lake Florence: A Small Town Takes on a Big Problem**. Lance M. Lumbard
8:35- 8:55 am	**Lake Beauclair Aquatic Enhancement: An Examination of Bridging the Gap Between Permitting and Implementation of a Dredging Project.** Karen Warner and Michael Perry
8:55- 9:15 am	**Lake Istopoga Residential Canal Maintenance – Nearly Ten Years in the Making.** Clell Ford
9:15- 9:35 am	**Nutrient and Mass Removal Analysis of Street Sweeping Activities in Central Florida as a Surface Water Management Tool.** Brian Catanzaro

9:35-9:55 am	**MORNING BREAK** (St. Augustine C and D)

Session 11: Watershed Planning: Tools in the Tool Box Part II
Moderator: Ann Shortelle

9:55-10:15 am	**Seminole Environmental, Restoration, and Volunteer (SERV) Program: A Unique Idea.** Natalae Wilson Almeter
10:15-10:35 am	**Rapid Lake Assessment and Reporting: How to Produce Comprehensive Data Collection, Management, and Report Generation.** David Eilers and Jim Griffin
10:35-10:55 am	**Environmental Grants and How to Find Them.** John Walkinshaw
10:55-11:15 am	**Little House on the Ferry: Harnessing the Potential of the Built Environment to Restore Florida's Inland Waterways.** Christina A. McDaniel*
11:15-11:45 pm	**Student Awards and Closing Remarks.** Dean Dobberfuhl, 2011- 2012 FLMS President

12:00	**CONFERENCE ADJOURNED**

* Indicates Student Presenter

SESSION 1

UNDERSTANDING OUR ENVIRONMENT: ASSESSMENT METHODS

MACROINVERTEBRATE COMMUNITIES AS A TOOL FOR MINIMUM FLOWS AND LEVELS EVALUATION IN THE PITHLACHASCOTEE RIVER

David L. Evans[1], *Douglas G. Strom*[1], *E. Lynn Mosura-Bliss*[1], *and Michael (Sid) S. Flannery* [2]
[1]Water & Air Research, Inc., Gainesville, Florida
[2]Southwest Florida Water Management District, Brooksville, Florida

Florida Statute 372.042 defines MFLs as "the limit at which further withdrawals would be significantly harmful to the water resources or the ecology of the area." MFLs are not static and vary seasonally and spatially. The MFL process establishes relationships between key ecological components, such as salinity and flow, to the structure of biological communities, such as benthic macroinvertebrates.

Flow regimes are an important characteristic of rivers influencing a wide array of biological communities, including benthic macroinvertebrates. Additionally flows affect salinity, dissolved oxygen, sediments, and nutrients. Salinity is known to have a profound influence on composition of benthic invertebrate assemblages in tidal rivers as a result of varying osmotic tolerances of the individual invertebrate species. These interactive processes render the possible usefulness of benthic macroinvertebrates as biological indicators of flow-driven river conditions. In order to establish minimum flow for tidal rivers, it is necessary to establish quantitative relationships between flow or factors influenced by flow (salinity) and important biological communities, including benthic infauna. One objective of this work is to document quantitative relationships that explain the spatial distribution of the benthic invertebrate assemblages.

Mean water column salinity ranged from 0.48 ppt at RK (River Kilometer) 11.2 to 33.46 ppt at the river mouth. During low flow conditions, there is a zone of rapid change in salinity along the longitudinal river axis between RK 8 and RK 9.5 that roughly represents the mesohaline zone (salinity of 8 to 18 ppt).

Live oysters were observed from the river mouth upstream approximately to RK 6.6 where mean water column salinity was approximately 25 ppt at the time of sample collection.

The dominant species contributing most towards explaining longitudinal variability in benthic infauna distribution were the amphipods *Grandidierella bonnieroides* and *Apocorophium louisianum* and the polychaete, *Fabricinuda trilobata.* These three species represented 39 percent of the total number of organisms collected.

Number of taxa declined longitudinally from the river mouth traveling upstream. Forward stepwise regression revealed a significant relationship between number of taxa and river kilometer. Rank correlation indicated a significant decline in number of taxa with decreasing salinity. Number of taxa declined from 71 taxa at RK 2 to 24 taxa observed between RK 9.5 and RK 10.5. The decline in benthic community number of benthic invertebrate species with decreasing salinity is a commonly observed spatial pattern in estuaries that may, in part, be attributed to relatively wide fluctuations in environmental conditions along the river longitudinal axis.

Diversity index values (Shannon's and Margalef's) generally declined longitudinally with increasing river kilometer and decreasing salinity, but Spearman rank correlation did not indicate statistically significant relationships of these metrics to physicochemical variables.

Benthic community structure varied longitudinally along the river axis. ANOSIM benthic infauna assemblages at RK 0 through RK 8 significantly differed from assemblages at RK 9.5 through RK 11.2, and this difference was strongly driven by the salinity gradient. During low flow conditions, there is a zone of rapid change in salinity along the longitudinal river axis between RK 8 and RK 9.5 that roughly represents the mesohaline zone (8-18 ppt). Although the sampling design was insufficient to adequately characterize benthic assemblages within the relatively short (1.5 km) mesohaline zone, this portion of the river is now recognized as an important zone of transition during low flow conditions. Benthic community structure was very similar at RK 5 and RK 6.5, and physicochemical conditions were also very similar at those sites during the May 2009 sampling event.

Eleven dominant taxa were identified as having the greatest influence on dissimilarity in benthic community structure along the river's longitudinal axis including: **Amphipods:** *Grandidierella bonnieroides*, *Apocorophium louisianum, Americorophium* sp. A LeCroy, *Ampelisca* sp.; **Polychaetes:** *Fabricinuda trilobata, Hobsonia florida*, *Mediomastus ambiseta*, *Laeonereis culveri;* **Isopods:** *Uromunna reynoldsi, Edotia triloba;* **Insects:** *Polypedilum halterale* group Epler.

Potential biological indicators of the upper longitudinal limit of mesohaline zone, where salinity approaches 8 ppt, include: *Americorophium* sp. A, *Uromunna reynoldsi*, and *Polypedilum halterale* group. Potential biological indicators of the lower longitudinal limit of the mesohaline, with salinities approaching 18 ppt. include: *Apocorophium louisianum*, *Edotia triloba*, and *Laeonereis culveri*. Collectively, these are the most important taxa representing the dissimilarity in benthic community structure at RK 8 and RK 9.5, and the transition in species assemblages associated with the mesohaline zone.

Sustained decline in river flow and elevated salinity concentrations might lead to an increase in number of taxa, an increase in number of salt-tolerant taxa, and perhaps a decrease in chironomids (e.g., *Polypedilum halterale* group), *Gammarus cf. tigrinus*, and other taxa characteristic of the oligohaline and freshwater zones of the river.

HYDROLOGIC INFLUENCES ON WATER QUALITY IN BLUE CYPRESS MARSH CONSERVATION AREA

Angelique M. K. Bochnak, Ph.D. and *Steven J. Miller, Lawrence W. Keenan, Ph.D., Dean Dobberfuhl, Ph.D.*
St. John's River Water Management District, Palatka, Florida

Blue Cypress Marsh Conservation Area (BCMCA) is managed by the St. John's River Water Management District (SJRWMD) as part of the U.S. Army Corps of Engineers Upper St Johns River Basin Project (USJRBP) Water Control Plan (COEWCP) to temporarily retain floodwater, provide long-term water conservation storage, and to restore and preserve floodplain wetlands. BCMCA consists of approximately 29,500 acres of freshwater marsh underlain by deep organic peat soils and 6,500-acre Blue Cypress Lake (BCL). The BCMCA is bounded by levees, canals and water levels are managed by water control structures. Historically, BCL was a low nutrient, low productivity lake that received natural sheetflow off the surrounding floodplain marsh. The management efforts have been such as to try to maintain the historical hydro-patterns of this system.

Long-term water quality monitoring within BCL as been ongoing since the early 1980's. A recent assessment of this water quality database indicates that the once low nutrient concentrations of BCL are on the rise. There has been a steady incline in the Trophic State Index (TSI) since the mid 1990's which indicates that the lake has shifted from a lake with good water quality to one with fair to poor water quality (figure 1).

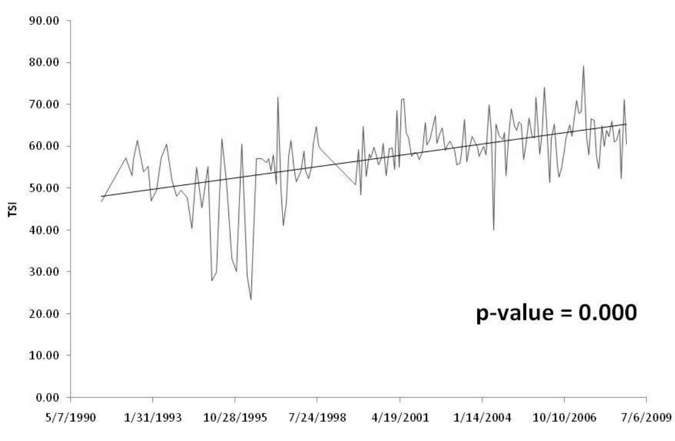

Figure 1: Long-term rise in Trophic State Index (TSI) for Blue Cypress Lake. TSI calculation is based on monthly grab samples from the water quality monitoring program. A trend analysis indicates a significant upward tend with a p-value = 0.000 (N=160).

The rise in TSI is primarily due to the considerable increase in TP and TKN, and not large increases in productivity (chl-a concentrations) (figure 2). The greatest change was observed in total phosphorus (TP) concentrations. There has been a 96% change in TP from the early 90's to 2009, increasing from 74.1 μg L^{-1} to 146 μg L^{-1}, respectively (figure 2c).

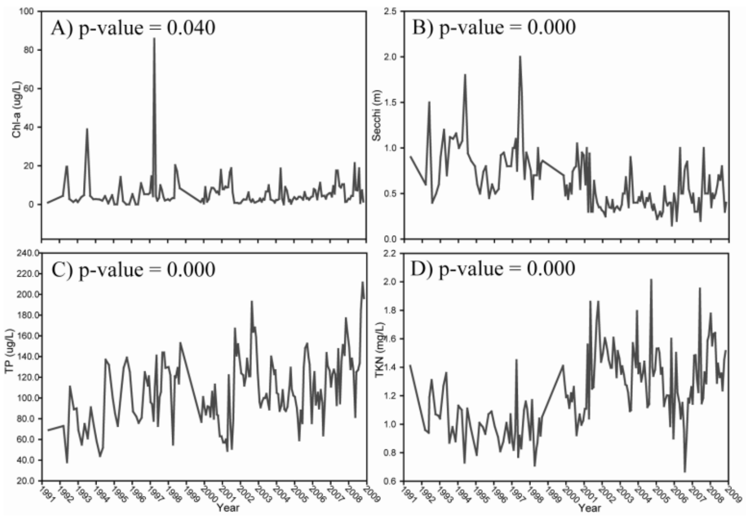

Figure 2: Individual water quality parameters that go into the TSI calculations, based on monthly grab samples. A) chl-a, slight increase with time, but low compared to the other parameters (p-value = 0.040, N=160); B) Secchi Disk, significant decline (p-value = 0.000, N=160); C) total phosphorus (TP), significant increase with time with a 96% change (p-value = 0.000, N=160); D) total kjeldahl nitrogen (TKN), significant increase with time with a 30% change (p-value = 0.000, N=160).

In addition to an increase in TSI and the associated water quality parameters, we have also observed significant increase in total organic carbon (TOC) concentrations in the lake (figure 3). The concentration of TOC increased from 18.9 mg L^{-1} to 30.1 mg L^{-1} from the mid 90's to 2009, respectively. This change equates to a 59% increase in TOC over this period.

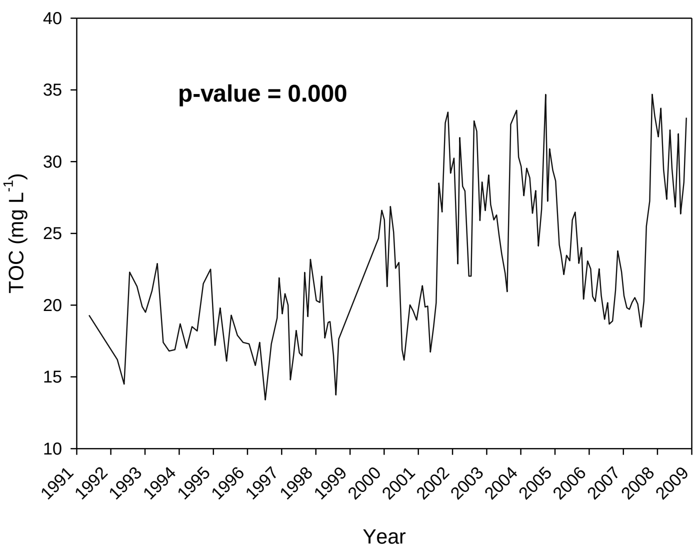

Figure 3: Long-term total organic carbon (TOC) trend for Blue Cypress Lake. Trend analysis indicates a significant increase in TOC over time with a p-value = 0.000 (N=160).

There are two possible causes for the decline in water quality of BCL; increased nutrient loading from run-off from the surrounding landscape and/or streams, and internal loading from the marsh itself. Long-term water quality monitoring from the three streams, Blue

Cypress Creek, Padgett Creek, and Fort Drum Creek, allowed us to eliminate run-off as the primary cause of this decline in water quality with the possible exception of TP. Total phosphorus loading from Blue Cypress Creek and Padgett Creek increased by 85% and 42%, respectively from the early 1990's to 2009. We observed as 34% improvement in TP for Fort Drum Creek. However, we do not see the same level of increase in TOC in any of the streams as compared to the increase observed in BCL.

If run-off is not responsible for increasing TOC in the lake, then it must be internal loading from the surrounding marsh ecosystem. Monthly water quality data collected in the center of the marsh shows a similar trend in TOC as observed in the lake (figure 4). From the early 1990's to 2009 we find a 96% increase in the TOC concentration measured in the surface waters of the marsh with a significant upward trend analysis (p-value = 0.000, N=120).

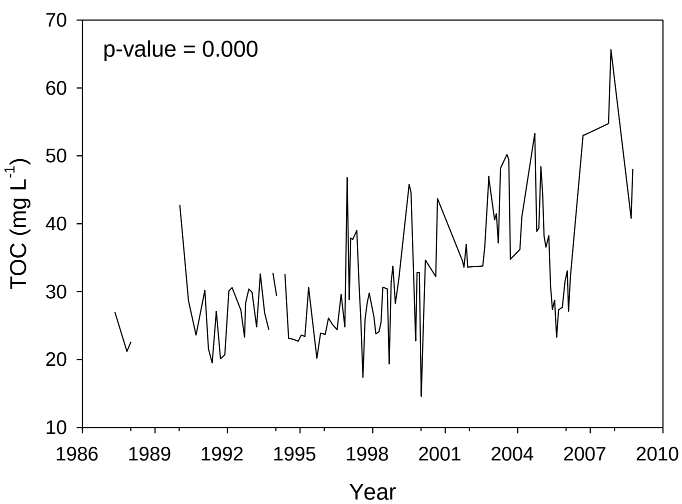

Figure 4: Long-term total organic carbon (TOC) trend for Blue Cypress Marsh. Trend analysis indicates a significant increase in TOC over time with a p-value = 0.000 (N=120).

One hypothesis was that a rise in TOC concentration in both the lake and the marsh suggests that the hydroperiod maintained in the marsh might not be adequate to protect the peat soils from oxidation. The oxidized peat soils are releasing excess TOC and other nutrients that are accumulating in the lake. In an effort to determine if there was a connection between the water levels in the marsh and the accumulation of TOC in the lake, we established an annual hydrologic index for the marsh by determining what the median water level was in the marsh within the 180 days prior to the maximum TOC concentration observed in the lake. We also established an annual TOC accumulation rate for the lake by taking the sum of the amount of TOC in excess of the minimum value observed to the maximum value observed within a given year. We then divided this sum by the number of days between the minimum TOC occurrence to the maximum TOC occurrence.

We regressed annual TOC accumulation observed in the lake against median water level in the marsh for the previous 180 days and found a strong negative correlation (figure 5, r^2=0.7362). During years when the median water level is low in the marsh, we observe the highest TOC accumulation rates in the lake. This strongly supports our hypothesis that long exposure periods of the peat soil is having a negative impact on the water quality of the lake.

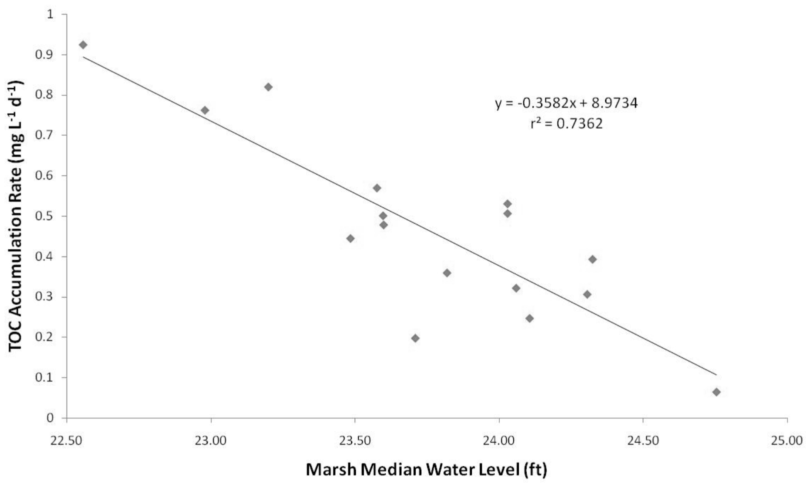

Figure 5: Regression of Blue Cypress Lake's TOC accumulation rate to the median water level in the marsh for a given year.

Shortly after the construction of the water control system was completed, the SJRWMD developed a suite of environmental hydrologic criteria to regulate water levels in BCMCA. The primary goal of the environmental hydrologic criteria was to re-create a hydrologic regime that mimics the natural historic conditions while maintaining the optimum soil and vegetation characteristics (Miller et al, 1996).

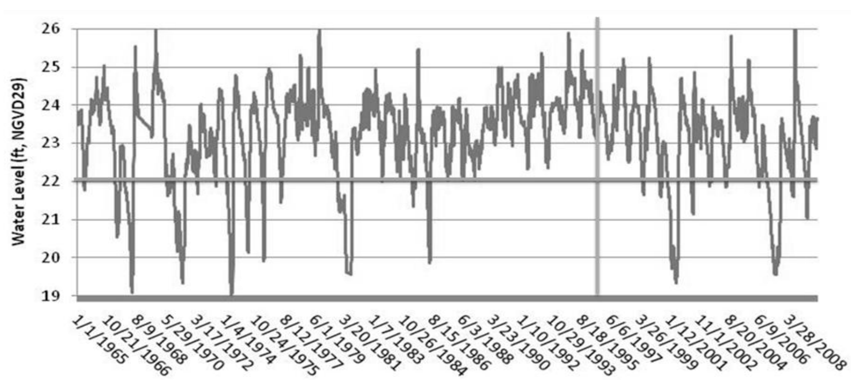

Figure 6: Long-term water levels recorded in Blue Cypress Lake.

Construction of BCMCA was completed in the early 1990's and the current water management schedule to meet the environmental goals was implemented in early 1997 (vertical line on figure 6). Looking at this figure and statistical comparisons of long-term water levels before and after project completion indicated that under the current environmental water management plan, the goal of re-creating the historic hydrologic regime has been achieved. However, water quality data suggests that even though the environmental hydrologic goals are apparently being met, the system is undergoing degradation associated with an over-draining effect. We attributed this degradation to a shift in seasonal flooding and drying associated with the flood control schedule (figure 7). By taking a different approach to looking at the water level trends pre and post project area operation, we have found that our management has changed the timing of the when the water rises within BCMCA (figure 7). The average, annual historical pre-project area water levels (1957-1997, dashed line; figure 7) indicates that prior to our management the water levels reached 23 ft by July 1st. However, the post-project area average, annual water levels do not reach 23 ft until mid August (1998-2009, solid line, figure 7). Additionally, we found that the number of days the water levels were below the 23 ft has been extended by 94 days.

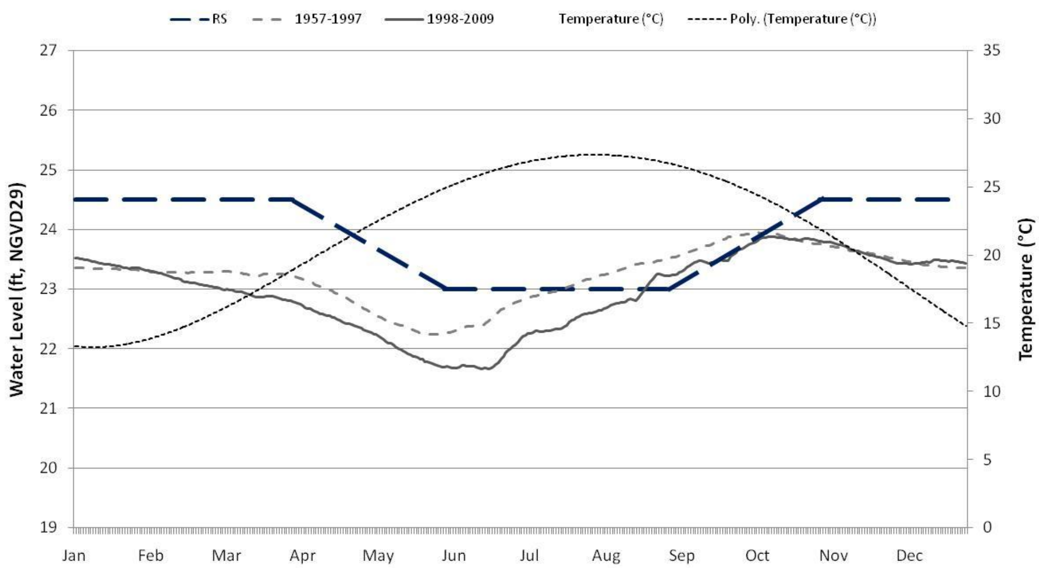

Figure 7: Pre and post project area average annual water levels in Blue Cypress Lake, and current COE flood control schedule (RS – regulation schedule). Temperature is plotted as a 3rd order best fit polynomial.

These additional days of exposure combined with the seasonal shift in re-flooding during the hottest time of the year can result in a two times greater rate of oxidation of the peat soil (temperature, figure 7). This shift alone results in an estimated additional release of 4.22 mtons TP yr^{-1}, 170 mtons TN yr^{-1}, and an additional 1340 mtons TOC yr^{-1}.

We can conclude that the hydrology of the lake strongly influences the water quality of the lake through its influences on the hydrology of the marsh. Therefore, we expect the water quality to continue to degrade under the current water management regime. We need to not only revisit the current environmental hydrologic criteria established for BCMCA but also re-evaluate the current COE flood control schedule and address the seasonality effects as well as extended exposure periods under the current water management regime.

ASSESSING VULNERABILITY OF FLORIDA LAKES TO CLIMATE CHANGE

Sam Arden, E.I., and Ann B. Shortelle, Ph.D.
MACTEC Engineering and Consulting, Inc., Newberry, FL

Many Florida lakes are currently impaired for a variety of constituents regulated under the Clean Water Act. The TMDL process provides a framework for improving water quality by reducing loading, primarily from the watersheds, to the impaired waterbodies. Environmental alterations associated with climate change such as changes in precipitation patterns and temperature may alter the transport and fate of many of the constituents causing impairment. Nutrients, dissolved oxygen, fecal coliforms, and mercury are prominent examples. A variety of factors associated with lakes may make them more resilient or susceptible to these loadings, and are estimated as the assimilative capacity of the waterbody. Some of these lake attributes are more closely linked with potential changes associated with climate change than others. These factors are evaluated to develop a framework for ranking vulnerability of Florida lakes to water quality impairment associated with potential climate change impacts. Examples associated with nutrients and other constituents will be provided.

A COMPARISON OF BENTHIC MACROINVERTEBRATE MONITORING METHODS IN CENTRAL FLORIDA STREAMS

Paul Irvin[1], *Kym Rouse Campbell*[1], *Doug Strom*[2], *Michelle Dale*[1], *Thomas D. Gauthier*[1], *and Robert P. DeMott*[1]

[1]ENVIRON International Corp., Tampa, FL

[2]Water & Air Research, Inc., Gainesville, FL

Since 2005, we have been conducting benthic macroinvertebrate monitoring in English Creek, as well as in an unnamed tributary of English Creek. This system is located in eastern Hillsborough and western Polk Counties, Florida and flows into the North Prong of the Alafia River. Over one-third of the English Creek watershed consists of agricultural land uses, such as cattle operations, citrus groves, and strawberry fields. Moderately high nutrient and fecal coliform levels are typical of English Creek's water quality, and it was verified as impaired for fecal coliform by Florida Department of Environmental Protection (FDEP) in 2008.

Our monitoring program is conducted in association with a point source discharge into English Creek. The benthic macroinvertebrate community has been monitored using Hester-Dendy (H-D) artificial substrate samplers from the beginning of the project in 2005, and Habitat Assessments and Biological Reconnaissance (Biorecon) evaluations per FDEP protocols were added to the monitoring program in 2007. While the monitoring requirements related to frequency and location have changed over time, monitoring events now typically occur only during the wet season months. However, monitoring during the dry season was required in the past.

To determine which method best characterized the health of the benthic macroinvertebrate community and which metrics were most sensitive to water quality parameters that often affect benthic invertebrate community health (e.g., dissolved oxygen, specific conductance, temperature, and stream flow), we compared the results of the H-D artificial substrate sampling and the habitat and Biorecon assessments conducted from 2007 through 2010. Thirty-seven monitoring events were conducted during the four-year period in English Creek and the unnamed English Creek tributary in which paired H-D substrate sampling and Biorecons occurred. Metrics that were compared for both methods included: number of total taxa, number of sensitive taxa, number of Ephemeroptera/Plecoptera/Trichoptera (EPT) taxa, number of long-lived taxa, number of clinger taxa, and the Shannon Wiener Diversity Index (SWDI). The Habitat Assessment (HA) scores and Biorecon Total Score obtained during each event were also compared in the analysis.

There were significant correlations ($p<0.05$) between four of the five similar H-D sampler and Biorecon metrics, indicating that the use of both methods may be redundant. There was no correlation between long-lived taxa for both methods; however, long-lived taxa, such as clams, shrimp, and crayfish, typically do not colonize H-D artificial substrates and are best measured by sampling suitable benthic macroinvertebrate habitats.

There was a negative correlation ($p<0.05$) between specific conductance and three of the H-D substrate metrics and seven of the Biorecon metrics. Temperature was correlated with H-D total taxa, H-D EPT taxa, Biorecon total taxa, Biorecon EPT taxa, and Biorecon SWDI. There were no significant correlations between either dissolved oxygen level or stream flow from a downstream US Geological Survey gauge and any of the H-D or Biorecon metrics, which is unusual since these parameters are often considered important for benthic macroinvertebrate community health; however, site stream flow correlated with HA score, H-D long-lived taxa, and Biorecon clinger taxa. Specific conductance and temperature were correlated with more Biorecon metrics as compared to H-D metrics, suggesting that the Biorecon method may be more sensitive to these parameters, as well as overall community health.

NOTES

SESSION 2
REGULATORY FRAMEWORK: NUMERIC CRITERIA AND DESIGNATED USES

PHOSPHORUS, NITROGEN AND THE DESIGNATED USES OF FLORIA LAKES

Roger W. Bachmann, Dana L. Bigham, Mark V. Hoyer, and Daniel E. Canfield, Jr.
Florida LAKEWATCH, University of Florida, Gainesville, FL

We reviewed the published information on the biology of Florida lakes to determine what concentrations of total phosphorus (TP), total nitrogen (TN) and/or chlorophyll (Chla) might impair their designated uses. We did not find any logical biological thresholds that can be used to establish numeric nutrient criteria in Florida lakes that have a designated use of recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Studies showed fish standing crops increased with the concentrations of TP, TN and Chla with no absolute upper limit within the range of nutrient concentrations found in Florida lakes. The quality of the fish populations also remained about the same at different concentrations of TP and TN. The best fishing lakes tended to be more eutrophic than Florida lakes as a whole, and most of them have concentrations of TP, TN or Chla that would place them in violation of some of the USEPA's nutrient criteria. The studied populations of aquatic birds and wildlife also increased with increases in trophic state with the species richness of birds increasing with trophic state. Benthic macroinvertebrate indices of lake condition were not related to anthropogenic nutrient pollution. None of the studied lakes had annual average concentrations of the algal toxin microcystin in the open waters that exceeded the World Health Organization suggested recreational guidance level of 20 μg/L, though high levels of microcystin can sometimes be found in some lakes in surface accumulations of cyanobacteria. Because there is a natural diversity of lake trophic states in Florida and all lakes have the same use classification, it is not possible to establish one set of nutrient criteria that will be optimal for all uses. We recommend that numeric nutrient criteria for Florida lakes be based on alterations from the expected concentrations of TP and TN for geographic regions containing similar types of lakes.

METHODS TO DETECT DECADAL-SCALE TRENDS IN WATER QUALITY

Dana L. Bigham
University of Florida, Gainesville, FL

The assumption of many scientific and regulatory frameworks is that anthropogenic eutrophication causes lake water quality degradation over time. Long-term changes in water quality, however, have not been well defined among a population of lakes. This paper explores alternative approaches to best detect patterns of change in water quality for a population of Florida lakes.

Water quality data (i.e. total phosphorus, total nitrogen, total chlorophyll, and water clarity measurements) for Florida lakes were obtained from the Florida LAKEWATCH program. Continuous monthly water quality data (N=27 Florida lakes) and mean annual water quality data (N= 193 Florida lakes) were examined for the last 15 years. Least-squared linear regression models and times series ARMA/ARIMA models were used to test if the water quality of Florida lakes changes temporally as measured by total phosphorus, total nitrogen, total chlorophyll concentrations and water clarity.

For the population of 27 Florida lakes, least-squared linear regression analysis detected about half of the population of lakes exhibit degradation in water quality over time. For total phosphorus 63% of the lakes increased, 22% decreased, while 15% showed no change. For total nitrogen 56% increased, 33% decreased, and 11% showed no change. For chlorophyll 41% increased, 41% decreased, and 18% showed no change. For water clarity, 48% decreased, 13% increased, and 39% showed no change. Time series analysis showed changes in water quality for this population of Florida lakes is much smaller than derived from linear trend analysis. For total phosphorus 11% of the lakes increased, 7% decreased, while 82% showed no change. For total nitrogen 18% increased, 7% decreased, and 75% showed no change. For chlorophyll 18% increased, 0% decreased, and 82% showed no change. For water clarity, 0% decreased, 5% increased, and 95% showed no change.

For the population of 193 Florida lakes, least-squared linear regression showed for total phosphorus 35% of the lakes increased, 11% decreased, while 54% showed no change. For total nitrogen 41% increased, 10% decreased, and 49% showed no change. For chlorophyll 18% increased, 15% decreased, and 67% showed no change. For water clarity, 34% decreased, 11% increased, and 55% showed no change. Time series analysis showed for total phosphorus 19% of the lakes increased, 10% decreased, while 71% showed no change. For total nitrogen 20% increased, 2% decreased, and 78% showed no change. For chlorophyll 22% increased, 10% decreased, and 68% showed no change. For water clarity, 12% decreased, 3% increased, and 85% showed no change. For total phosphorus, total nitrogen, total chlorophyll, and water clarity the proportion of lakes showing degradation is greater than expected by chance (i.e. > 5%).

These results show that least-squared linear regression analysis best detected increasing and decreasing monotonic patterns among years. Linear regression analysis, however, seems to overestimate the number of lakes that have experienced change over time. Time series modeling provides a more reliable estimate of the proportion of lakes showing change over time. Both linear regression analysis and time series analysis show the proportion of Florida lakes that have shown changes in water quality over time is greater than expected by chance.

USE ATTAINABILITY ANAYSES AND CLASS III-LIMITED WATERS

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Water quality standards consist of: 1) designated uses for each waterbody; 2) numeric or narrative criteria designed to protect this designated use; and 3) an antidegradation policy. Florida DEP recently established a new classification of waters known as Class III-Limited, which applies to wholly artificial waterbodies or those natural waters that were significantly altered prior to November 28, 1975. Waters may be moved into this new class provided certain requirements are met, as demonstrated via a Use Attainability Analysis (UAA). A UAA is a structured scientific assessment of the factors affecting the attainment of the waterbody's designated uses, including appropriate and scientifically defensible water quality, biological, hydrological, and habitat studies and analyses, as well as environmental, social, and economic information, to justify reclassification to a lower class. To move a waterbody into the Class III-Limited category, the UAA must demonstrate that:

- None of the uses being removed are existing uses;
- The uses to be removed would not be attained by implementing effluent limits required by Sections 301(b) and 306 of the Federal Clean Water Act in conjunction with implementation of cost-effective and reasonable best management requirements for nonpoint source pollution control;
- The proposed reclassification is clearly in the public interest;
- Water quality standards in downstream waters will be fully protected; and
- One or more of the criteria from 40 C.F.R 131.10(g) prevent a higher use. These include:
    1. Presence of naturally occurring substances;
    2. Natural desiccation;
    3. Human caused conditions that cannot be remedied or would cause more environmental damage to correct than to leave in place;
    4. Hydrologic modifications;
    5. Physical conditions related to the natural habitat features; or
    6. Controls more stringent than those required by sections 301(b) and 306 of the Federal Clean Water Act would result in substantial and widespread economic and social impact.

The criteria for Class III-Limited waters are the same as those for Class III waters, but entities requesting a UAA are expected to also apply for Site-Specific Alternative Criteria for at least one of the following parameters: nutrients (including nutrient response variables), bacteria, dissolved oxygen, alkalinity, specific conductance, transparency, turbidity, biological integrity, or pH. Site Specific Alternative Criteria (SSAC) for these parameters must be protective of the most beneficial use for the waterbody and must be set at levels no less stringent than water quality conditions at the time of reclassification.

This presentation will provide an overview of the technical aspects of a UAA and provide examples of the process of moving waters into the new category.

ASSESSMENT OF DISSOLVED OXYGEN IN BLACKWATER SYSTEMS

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The surface water quality standards of Florida establish a dissolved oxygen (DO) standard of 5.0 mg/L for Class III waters (FL Statutes Chapter 62-302, F.A.C.) Concentrations below this for extended periods of time can lead to fish kills and other negative ecological impacts if the aquatic system has structured itself around higher oxygen concentrations. Any deviations from this minimum level are typically assumed to be of anthropogenic origin related to excess organic material or nutrient loading from the watershed. While this is often true, and usually related to point and nonpoint source pollution loads, some water bodies receive high loads of organic materials from natural sources such as forests and wetlands. The effect of these natural organic loads is accentuated in warm, slow moving, low gradient rivers and lakes with long hydraulic residence times. There is interest in revising the standard to better reflect these types of systems to avoid dedicating resources to fix a perceived impairment that is actually reflects a healthy system.

These highly colored streams and lakes are called blackwater systems and can be designated as impaired because they do not meet the DO standard, but they do not have any anthropogenic load to reduce. Further, most of these blackwater systems are shallow and located in warm climates leading to strong temperature effects on DO saturation, especially during summer months. While this temperature effect is usually considered during modeling used for determination of impairment, a Site Specific Alternative Criteria (SSAC) for DO is useful to better represent natural background inputs of organic material leading to low DO.

This study evaluates four wetlands that have less than 10% developed land use within their watersheds and their effect on the DO levels in the receiving river or lake. We present the macrophyte, algal and invertebrate data recommended by the Florida Department of Environmental Protection to establish the wetlands as unimpacted, high quality ecosystems and discuss the DO and temperature data as the basis for development of a DO SSAC application. We began this study during the colder season in Central Florida and do not have warm weather results yet, however, even outside summer all four wetlands have exhibited occasional DO concentrations below 5.0 mg/L.

NOTES

SESSION 3

ENVIRONMENTAL ANALYSIS – UNDERSTANDING THE DATA

A LITERATURE REVIEW OF NITRATE TOXICITY AND IMPLICATIONS FOR FLORIDA SPRINGS

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Elevated levels of nitrate-nitrite nitrogen (NOx) in Florida springs and spring run streams is a water quality issue of statewide significance. While much of the focus of the impacts of NOx enrichment has been on its role in proliferation of macroalgal mats in spring run streams, downstream nitrogen loading, and how increased NOx may affect other ecological characteristics, some attention has been given to potential toxicity effects. Most dissolved inorganic nitrogen compounds have been shown to be toxic at some concentration, with the sequence of toxicity (most to least toxic) being unionized $NH_3 > NO_2 > NO_3$. A review of the existing literature on nitrate toxicity was conducted. Consideration was given to both acute (lethal) and chronic (non-lethal) effects. Nitrate toxicity thresholds down to 0.23 mg/L NO_3-N were reported for invertebrates, down to 1.1 mg/L for fishes, and down to 5 mg/L for amphibians. A number of springs in Florida display NOx concentrations above one or more of these thresholds, suggesting nitrate toxicity should be considered in water quality management of springs.

UPDATE: NITRATE SOURCES IN THE WEKIVA RIVER BASIN

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Results of the Wekiva River Basin Nitrate Sourcing Study, funded by the Florida Department of Environmental Protection (FDEP), are presented. Preliminary results were presented at the 2007 FLMS conference. The findings were updated using environmental monitoring data collected within the basin during 2008 and 2009.

The Wekiva is a predominantly spring-fed river that discharges to the St. Johns River. Its headwaters are Wekiwa Springs and Rock Springs in central Florida, north of Orlando, FL. The springs and river are impaired by elevated levels of nitrate. The objective of this study was to identify the sources of nitrate to the Wekiva River.

This project was initiated in 2006 and was completed in three phases. Phase I was a desktop study using the best available information. Phase I (2007) recommended field investigations within the Basin intended to reduce the most important uncertainties, and those recommendations were implemented in 2008 and 2009 (Phase II), concluding with recalculation of source terms using these data, and completed in 2010.

During the study technical publications and databases maintained by FDEP, the St. Johns River Water Management District (SJRWMD), and the Florida Department of Health (FDOH) were reviewed. Agricultural fertilizer use (row crop, field crop, citrus, nurseries, and pasture); residential fertilizer use; golf course fertilizer use; industrial and municipal wastewater (permitted facilities); septic systems; atmospheric deposition; and livestock are the major source categories that were quantified. Nitrate loadings were partitioned by stormwater and groundwater. Stormwater loadings were estimated using the Watershed Management Model (WMM). Loadings to groundwater were estimated by applying land use-specific groundwater concentrations (determined from the technical literature), then overlaying land use and recharge rate maps using GIS software.

Basin-specific studies were completed in 2008 and 2009 and focused on the residential fertilizer use source category; because the Phase I report identified that the contribution from this source was the most uncertain. Activities included a survey of residential fertilizer users, performed by the University of Central Florida; and a groundwater monitoring program in areas that would be affected primarily by residential fertilizer use. The groundwater monitoring program is presented in a companion paper at this conference. In parallel investigations, FDOH monitored groundwater affected by three septic systems in the basin. Nitrate source loadings were recalculated using these data.

The study found that fertilizer use contributed approximately 48 percent of nitrate loadings to the river, while sanitary waste (septic systems and sewage treatment plants) contributed approximately 38 percent.

LAKE JESUP TRIBUTARY INPUTS: PRELIMINARY RESULTS FROM SEMINOLE'S AMBIENT MONITORING NETWORK

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The Lake Jesup Watershed spans 59.6 square miles and contains 16 named lakes and 14 named rivers, streams and canals. Lake Jesup is the largest lake in Seminole County at approximately 8,037 acres, although its size can significantly change due to water level fluctuations throughout the year. The lake receives inputs from numerous tributaries and has one main outfall connection to the St. Johns River at the northeastern end of the lake. The tributary inputs include Howell Creek, Soldier's Creek, Gee Creek, Six Mile Creek, Solary Canal, Navy Canal and several other smaller canals and creeks. FDEP has established Total Maximum Daily Load goals of 0.096 mg/L for TP and 1.270 mg/L for TN. The current mean in-lake nutrient concentrations are 0.167 mg/L for TP and 2.400 mg/L for TN. The BMAP focus was to achieve reductions in external TP loads since nitrogen fixation plays such a significant role within the lake. The reductions were allocated to the contributing entities within the basin, which include 11 municipalities, 2 counties, 3 transportation agencies and agriculture. The overall reductions were allocated a 15 year timeframe to comply, which allows for the re-evaluation of the basin utilizing the additional monitoring results and other research information.

During the BMAP development, water quality was assessed at established monitoring points in the tributaries to Lake Jesup. The purpose of this initial assessment was to determine if "hot spots" could be identified. Based on the available data, stations closest to the lake had higher TP. While Soldiers Creek, Sweetwater Creek, and Salt Creek had higher TP concentrations than the lake itself, each tributary discharges such small annual volumes that their overall pollutant load contribution is relatively minor. Howell Creek, the largest tributary, has the most monitoring sites along its reach. TP concentrations tripled below Lake Maitland and doubled again below Bear Creek along Howell Creek's reach. Based on these initial tributary monitoring results, data gaps were identified and a comprehensive monitoring network was established as part of the BMAP to address inputs throughout the Jesup watershed. The BMAP Group agreed to track implementation efforts and monitor water quality throughout the watershed. Many of the new monitoring points were established at jurisdictional boundaries in order to better assess stakeholder allocations. There are 16 sites that the County began monthly sampling in June 2010 as part of the monitoring network, as well as several other entities monitoring other points throughout the Jesup drainage basin, including the City of Orlando, SJRWMD, Orange County, FDEP and several cities. The results will be used to evaluate the effectiveness of the BMAP in reducing external TP loading, whether the lake is responding to the anticipated reductions, and to more accurately assess specific allocations. This paper will address the preliminary results from the County's monitoring efforts.

DOES THIS MAKE SENSE FOR THIS LAKE?
ASSESSING THE ACTUAL CONDITION OF A LAKE

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Background

The Water Atlas Lake Assessment project collects biological, morphological and water chemistry data from Hillsborough County lakes to assist the county in assessing and understanding the condition of their freshwater water resources. One of the products of the project is a lake assessment report which is written by the assessment team and published via the Water Atlas. These reports attempt to describe the lake's general condition in terms of the aquatic vegetation, physical factors and water chemistry. As final reviewer of these reports, one of the primary questions I ask is "Does This Make Sense?", that is, Does the water column nutrient chemistry support the vegetation data and general lake conditions and vice versa? This single question has led to some interesting issues related to the way we evaluate a lake's general condition or "health" which are explored below. My investigation also uncovered some possible problems as Florida moves from narrative nutrient criteria to numeric nutrient criteria.

This extended abstract and the presentation will focus on data from four lakes assessed by the Water Atlas Assessment project; however, the insights discussed are based on experience gained from several hundred lake assessments. The Water Atlas Lake Assessment project published its first report in 1998 and has since published 208 lake assessment reports via the Water Atlas. All data from the assessments can be found in the Water Atlas Digital Library using keyword *Lake Assessment* and selecting Hillsborough Water Atlas as the Atlas or by going to the individual lake page on the *Hillsborough County and City of Tampa Water Atlas* (assessment reports are on the lake's Overview Page under *Related Links* and the Bathymetry Report is on the Water Levels & Flows Page under *Bathymetry*).

Lake Assessments Water Chemistry (Does this make sense)?

The lakes highlighted in this paper (Alice, Calm, Carroll, Brant) are different in terms of morphology, watershed land use, water chemistry, plant biology and human impact as measured by Lake Vegetation Index (LVI). Tables 1 and 4 provide the primary and adjusted summary statistics for these lakes. You will notice that the total phosphorus values in the table have "FDEP" next to the value. The Water Atlas Assessment project worked cooperatively with FDEP Southwest Region to conduct lake assessments that also included LVI assessments in 2010. Our team later was qualified by FDEP to conduct the LVI independently; however for the earlier lakes we worked with FDEP to secure access and conduct the assessment. For this reason we had two datasets for water chemistry based on samples that were taken on or near the same date. This turned out to be a fortunate circumstance when I realized that the TP from our analyzed samples was significantly different from what would be expected. I will discuss this issue later in the paper.

Table 1. Primary Lake Statistics

	Lake/Value	Lake/Value	Lake/Value	Lake/Value
Parameter/Units	**Calm**	**Alice**	**Carroll**	**Brant**
Lake Area (Acres)	118.2	87.07	210.11	60.63
Lake Area (m^2)	478,338.00	352,360.00	850,285.00	245,361.00
Lake Volume (m^3)	1,477,893.00	1,262,230.00	4,052,287.00	384,660.00
Number of Vegetation Sites	20	10	20	10
Mean Station SAV Weight (kg)	0.68	0.62	1.08	0
Wet Weight of Vegetation (g)	163,352,573	181,909,263	659,038,900	0
Dry Weight of Vegetation (g)	13,068,206	14,552,741	52,723,112	0
Total Phosphorus (µg/L)	8.0 (FDEP)	6 (FDEP)	9 (FDEP)	63
Total Nitrogen (µg/L)	529	328	510	930
Chlorophyll a (µg/L)	3.1	1.0	2.9	17.0
TN/TP	66	55	57	15
Limiting Nutrient	Phosphorus	Phosphorus	Phosphorus	Balanced
Chlorophyll TSI	34	17	32	57
Phosphorus TSI	25	19	26	58
Nitrogen TSI	43	34	42	54
TSI	30	18	29	57
Color (PCU)	5	8	10	37
Secchi disk depth (ft)	9.84	22.3	10.8	3.46
Impaired TSI for Lake	40	40	40	40
Lake Status (Water Column)	Not Impaired	Not Impaired	Not Impaired	Impaired

Lake Calm and Lake Alice are medium-sized lakes in northwest Hillsborough County and are within the Keystone Lakes Lake Region [1]. Lakes in this region are normally low nutrient, slightly acidic clear-water lakes. As seen in Table 1, both lakes are phosphorus limited with reasonably low nutrient levels and a resulting low chlorophyll concentration and low TSI. Calm has good clarity, but is significantly less clear, as measured by Secchi disk depth, than Alice which has historically exhibited the highest water clarity of lakes assessed in Hillsborough County. Both lakes would be considered “Not Impaired” based on the calculated TSI for this sample instance. Of course, more instances would be used in an actual determination [2].

Lake Carroll and Lake Brant are in the Land-O-Lakes Lake Region. Lakes in this region are normally clear-water lakes with low to moderate nutrient concentration and slightly alkaline, or have a neutral pH. As seen in Table 1, Lake Carroll is phosphorus limited and Lake Brant is balanced in terms of limiting nutrients with significantly higher phosphorus levels than Carroll, Alice or Calm and has an elevated TSI. Carroll is below the limit for classification as Impaired and Brant is significantly above it.

Table 1 does not tell the whole story. As implied earlier, there was an issue with the TP data from the laboratory used to analyze our water samples. Our project collected water samples for all lakes assessed and I normally used these results to determine the concentration of nutrient and chlorophyll at or near the time that the assessment was conducted. I also used water quality trend data (when available) to better understand the changes that may be occurring in the lake and to check the water quality sample data from the assessment. Finally, I checked the nutrient data by comparing chlorophyll concentration and Secchi depths with nutrient values from the assessment samples. When this was done for lakes Carroll, Calm and Alice and the question was asked, “Does this make sense?” it did not.

Our sample TP concentration for Alice (Figure 1) was 49 µg/L, for Calm (Figure 2) the value was 56 µg/L and for Carroll, (Figure 3) it was 41 µg/L. These values were not in line with the expectation from either Secchi depth (22.3, 9.84 and 10.8 feet, respectively) or chlorophyll concentrations (2.8 µg/L, 3.1 µg/L and 2.9 µg/L, respectively) or the lake’s TP trend data. A fairly exhaustive study resulted in our using the FDEP values as the more correct for TP. The difference for TN and chlorophyll were not significant so we used our data for these. A similar review for Lake Brant (Figure 4) showed that Brant TP may have been higher than expected but this could not be confirmed by trend or expectation based on Secchi depth and chlorophyll values.

Figure 1. Lake Alice

Figure 2. Lake Calm

Figure 3. Lake Carroll

Figure 4. Lake Brant

The basic problem seemed to be the analysis of TP concentrations in low phosphorus lake water. In an effort to better understand the issue that laboratories have with low phosphorus systems, I reviewed the methods and Method Detection Limit (MDL) [3] used for determining TP in natural waters. As can be seen in Table 2, laboratories vary greatly in methods and MDL for TP.

Table 2. The Regional Ambient Monitoring Program (RAMP), a cooperative laboratory program which attempts to standardized analysis methods, provides the below Method Detection Limits (MDL) for Total Phosphorus.

Total Phos as P mg/L		MDL
Benchmark	EPA 365.3	0.008
Cape Coral	SM 4500 PE	0.01
Collier Co. PC	SM18 4500 PE	0.004
EMD-MC	EPA 365.4	0.056
EPC-HC	SM18 4500 PF	0.018
FDEP Central	EPA 365.1 Rev. 2.0	
Lee County	EPA 365.1	0.006
Mote Marine	EPA 365.4	0.05
Pinellas	EPA 365.4	0.05
Tampa Bay Water	SM 4500 PE	0.01

Since it may be necessary to detect TP at or below 0.005 mg/L for low phosphorous systems, it is important to have a method that can detect phosphorus at these low levels. It should be understood that TP analysis requires preparation steps that include digestion which complicate (add noise) to the detection of the final product of analysis. As seen in Table 2, only one laboratory has a MDL that would allow detection at or below 0.005 mg/L. Additionally, even if the method allows detection, the practical quantitation limit (PQL), which is about 5 times the MDL, would require an MDL of 0.001 mg/L to confidently state detection at 0.005 mg/L. As is seen in Table 3, the method and MDL will be even more critical as Florida moves from narrative standards to numeric nutrient standards. For example, the present proposed standards shown in Table 3 would require a MDL of 0.002 mg/L for the PQL to be 0.01 mg/L.

Table 3. Florida Lake Numeric Nutrient Criteria. The values in parentheses are for site specific exceptions.

Lake Color/Alkalinity	**Chl-a (mg/L)**	**TN (mg/L)**	**TP (mg/L)**
Colored Lakes >40 PCU	0.02	1.27 (1.27-2.23)	0.05 (0.05-0.16)
Clear Lakes, ≤ 40 PCU and Alkalinity > mg/L $CaC0_3$	0.02	1.05 (105-1.91)	0.03 (0.03-0.09)

Clear Lakes, ≤ 40 PCU and Alkalinity ≤ mg/L CaC03	0.006	0.51 (0.51-0.93)	0.01 (0.01-0.03)

Lake Assessment Biology and Lake Condition (Does this make sense?)

When reviewing the water column nutrient data for lakes with significant submerged aquatic vegetation (SAV) volumes and asking the question "Does this make sense?" I again must respond "it does not." Our project, which is based on earlier work by Dr. Dan Canfield [4] at the University of Florida's LAKEWATCH program, attempts to determine the amount of SAV present within the lake's littoral zone and also to determine the potential nutrient captured by this volume of vegetation. The examples shown in Tables 2 and 4 indicate that, without assessing vegetation and just using water column chemistry, three lakes would not be impaired by narrative criteria or numeric nutrient criteria (Table 1), but when vegetation is considered all lakes would fail for narrative and numeric criteria (Table 2). There would be no change for Lake Brandt, but significant change for Alice, Calm and Carroll. So, water column nutrients and chlorophyll alone do not indicate the trophic state of a lake, since they cannot indicate a potential release from lake vegetation. This is not to say that these three lakes are impaired at this time, rather that the lakes with high SAV coverage are responding in a natural way and have not yet reached a point where they cannot manage lake nutrients. Otherwise, significant nutrients and algal chlorophyll would be found in the water column. However, without such data, the analyst has no idea that the lake is managing nutrients with increased vegetation growth. Efforts by FDEP to include the LVI into lake condition reporting [5] should be commended, but I believe some estimate of percent volume infestation (PVI) is also needed to allow a determination of the potential effect of SAV on water column chemistry.

Table 4. Water Column Nutrient/Chlorophyll Adjusted for SAV

Parameter	Value	Value	Value	
	Calm	**Alice**	**Carroll**	**Brant**
Percent Area Cover (PAC)	50%	83%	72%	4%
Percent Volume Infestation (PVI)	7%	11%	21%	1%
Lake Vegetation Index (LVI)	33	71	57	NA
Total Phosphorus Adjusted (ug/L)	12	16	18	0
Total Phosphorus - Combined (ug/L)	21	22	27	63
Total Nitrogen - Adjusted (ug/L)	168	219	247	0
Total Nitrogen - Combined (ug/L)	697	547	757	930
Chlorophyll - Adjusted from Total Nutrients (ug/L)	4	6	7	17.08
Chlorophyll - Combined (ug/L)	7	7	10	57
Adjusted Chlorophyll TSI	45	44	50	58
Adjusted Phosphorus TSI	47	49	63	54
Adjusted Nitrogen TSI	49	44	52	57
Adjusted TSI (for N, P, and Chl-a)	47	45	54	57
Impaired TSI for Lake	40	40	40	40
Lake Potential Status	Impaired	Impaired	Impaired	Impaired

Conclusion

In this short discussion of some of the issues related to lake assessments, and especially assessments of low phosphorus lakes, I have tried to point out the need for analysts to use all available information in drawing conclusions concerning lake condition or impairment. I have discussed the problems related to low phosphorus detection as it may apply to numeric nutrient criteria and the need to consider additional aspects of the biology of a system to gain a complete understanding of how that system is responding to nutrient inputs.

Reference

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NOTES

SESSION 4

BEST MANAGEMENT PRACTICES – FOCUS ON NUTRIENT REDUCTION

EVALUATING ADVANCED OXIDATION PROCESSES FOR THE TRANSFORMATION OF ORGANIC PHOSPHORUS INTO BIOLOGICALLY LABILE COMPOUNDS

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Research Objective

The main objective of this research is to develop an innovative combination of chemical and biological treatments for phosphorus (P) removal from surface waters. The research will focus on understanding the P processes and dynamics within algae scrubbers and developing treatment technologies that will enhance their P uptake. Three areas of potential enhancement are being explored: (1) using advanced oxidation processes (AOPs) to transform organic and particulate P to more biologically labile compounds; (2) understanding calcium-P co-precipitation and natural organic matter interactions within algae scrubbers; (3) testing different operating conditions and potential chemical amendments to maximize algae scrubber P uptake. This presentation will highlight results for Objective 1 in the context of the larger research project aimed at increasing P uptake from algae scrubbers.

Research Motivation

P remains a primary pollutant in natural waterways. P in agricultural and residential fertilizers, cattle feed, and reclaimed water, eventually finds its way into streams, rivers, and lakes. Excessive P loads can cause eutrophic or hyper-eutrophic conditions in these surface waters or significantly alter the ecosystem's nutrient balance. There are numerous examples of Florida lakes that have become eutrophic as a consequence of excessive P loading. For example, Lake Jesup, near Orlando, Florida and part of the St. Johns River watershed, was placed on the Verified Impaired list by the US Environmental Protection Agency and Florida Department of Environmental Protection for excessive water-column P concentrations. In developing a Total Maximum Daily Load for the lake, the St. Johns River Water Management District (SJRWMD)estimated the lake needs a 9-ton reduction in annual P loads to reach natural background conditions(SJRWMD 2008).The main objective of this research is to improve an effective, affordable technology that can be used near these impaired waterways at both point and non-point sources of P.

Brief Methodology

Water is collected from Everglades Stormwater Treatment Area 1 West. Oxidation experiments are conducted in a ~160 mL re-circulating UV reactor with an 8W low-pressure (254 nm) UV lamp. Table 1 shows the raw water chemistry and Table 2 shows the experimental set-up for all of the oxidation studies. The oxidation processes is hydrogen peroxide + UV (UV/H_2O_2).

Table 1. Raw water characteristics

Parameter	Range
Total P (ug P/L)	110 - 125
Soluble Reactive P (ug P/L)	58 - 100
Dissolved Organic P (ug P/L)	15 -18
Particulate P (ug P/L)	14 - 72
Dissolved Organic Carbon (mg C/L)	26.4 - 36.2
UV_{254} (cm^{-1})	0.879 - 1.320
SUVA (L/ mg C * m)	3.3 - 3.7

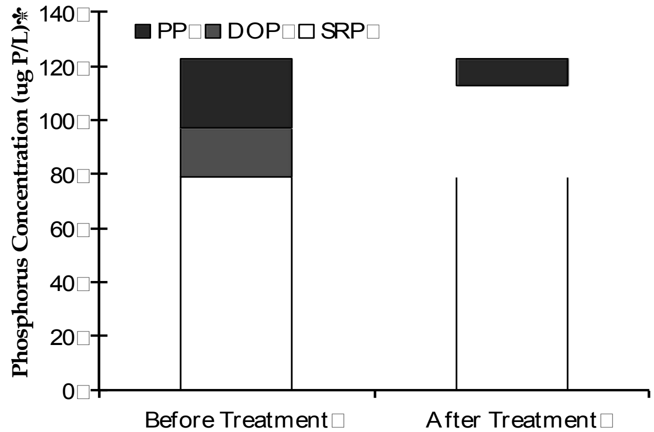
Table 2. Oxidation Experimental Setup

UV Exposure Time (min)	Hydrogen Peroxide Dose (mg H_2O_2/L)			
0	0	10	100	1000
10	0	10	100	1000
60	0	10	100	1000

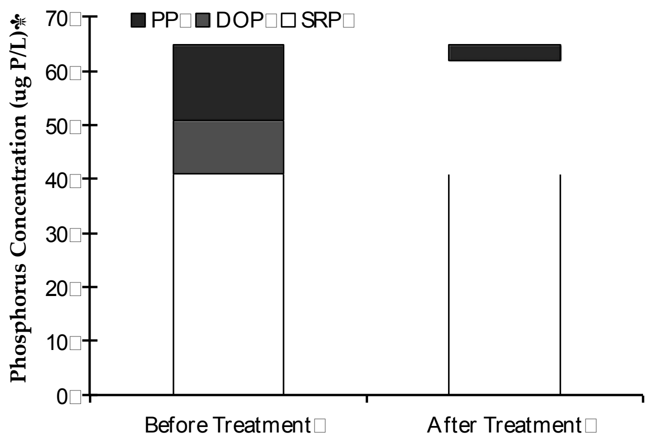
Water was analyzed for total phosphorus, total soluble phosphorus, soluble reactive phosphorus, dissolved organic carbon, and UV_{254} to determine the effectiveness of each oxidant dose and UV exposure time.

Results and Conclusions

Figure 1 shows an example of phosphorus speciation changes after a UV exposure time of 60 minutesand a H_2O_2 dose of 100 mg/L. One can see that after UV exposure both particulate P and dissolved organic P are reduced and there is an increase in soluble reactive P. Figure 1 clearly shows that the UV/H_2O_2 oxidation system can oxidize recalcitrant forms of P. More data on the necessary UV exposure and H_2O_2 dose for P oxidation will be provided in this presentation.



(a)



(b)

Figure 1. Phosphorus speciation before and after treatment of: (a) raw Everglades water from STA-1W and (b) 2x diluted Everglades water from STA-1W. Both graphs represent a UV exposure time of 60 min and a H_2O_2 dose of 100 mg/L

Preliminary conclusions from this study of advanced oxidation processes for P oxidation are:

- Complete oxidation of organic P compounds requires both higher UV exposure times and H_2O_2 doses than those normally seen in drinking and wastewater applications
- Partial oxidation of particulate P and dissolved organic P can be accomplished at lower UV exposure times and H_2O_2 doses
- Particulate P and dissolved organic P oxidize at UV exposure times and H_2O_2 doses that also significantly reduce measures of aromatic carbon, suggesting that the oxidation process shows no specific preference for P compounds
- Because the oxidation process shows no apparent P specificity, high competition from other hydroxyl radical scavengers (DOC, nitrogen compounds, bicarbonate) is limiting overall P oxidation
- H_2O_2 doses greater than 100 mg/L are not feasible because of the unstable nature of the reaction

Future Work

The following represent future avenues of research on AOPs for P oxidation:

- Evaluate hydrogen peroxide at different UV exposure times to determine if its effectiveness is consistent with changes in UV exposure
- Conduct more replicate experiments to determine the variability associated with the use of AOPs for organic P oxidation
- Evaluate other potential oxidation processes for P oxidation. Especially, ozone and ozone/H_2O_2 systems, which have shown promise for specifically targeting other compounds over aromatic carbon

References

St. Johns River Water Management District (SJRWMD). (2008). *Lake Jesup total phosphorus removal treatment technologies floating island pilot project.* Presentation. Gainesvlle, FL.

EFFICACY OF A LARGE-SCALE CONSTRUCTED WETLAND TO REMOVE NITROGEN FROM A SUB-TROPICAL SHALLOW LAKE

Ed J. Dunne, *Michael F. Coveney, Erich R. Marzolf, Victoria R. Hoge, Roxanne Conrow, Robert Naleway, Edgar F. Lowe and Lawrence E. Battoe*
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Emergent marsh wetlands treat many types of water ranging from agricultural runoff to point source wastewaters. However, few treat and re-circulate incoming lake water to help reduce nutrient loads in lake water. The main objective of our study was to determine the efficacy of the marsh flow-way constructed wetland at Lake Apopka to retain nitrogen from incoming lake water. The marsh flow-way has four treatment cells with a total area of 276 ha. We will present hydrologic and nitrogen performance data for the operating period November 2003 through December 2010. Nitrogen data considered for this presentation will include ammonium, nitrate, biologically available nitrogen (total kjeldahl nitrogen) and total nitrogen.

THE USE OF A MOBILE ALUM INJECTION DOSING SYSTEM (MAIDS) TO IMPROVE TREATMENT EFFICENCIES OF EXISTING STORMWATER PONDS

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[2]Aqutic Ecosystems, Inc., Apopka, FL

In order to comply with today's TMDL and BMAP pollutant reduction requirements many entities are faced with serious compliance challenges. Many of these challenges include land available, funding restrictions. One avenue to meeting reduction goals is to improve what is currently in place. Many basins have stormwater treatment ponds scatter throughout them, improving the pollutant removal efficiency of these ponds can be a cost effective method of meeting removal goals. One such methodology is the use of alum injection to improve the settling of particulate associated nutrients as well as the more difficult dissolved phosphorus fraction. However, constructing a permanent alum station can be expensive, intrusive to area residents and permanent commitment. For these reason a simple, self-contained system with solar powered capabilities that can be easily removed when no longer needed is highly desirable.

Orange County Lake Management Section together with Aquatic Ecosystems. Inc. began configuring the Mobile Alum Injection Dosing (MAID) system. The system is entirely portable by utilizing a metal cargo shipping container(s) to house all the essential mechanical, electronic control devices and alum product. The MAID system monitors the stormwater inflow rate and injects flow proportional alum doses. The dosed stormwater is effectively mixed using an aeration mixing system and the floc is allowed to form and settle within the existing treatment pond system. The system continuously monitors pH and turbidity levels near the ponds outfall as safeguards to dosing. The system is controlled by a Programmable Logic Controller (PLC) with web-based monitoring of such parameters as total volume treated, rainfall, pond stage, pH, turbidity and alum supply levels. The site manager user can log-in remotely and review and adjust setting on any/all of these MAID systems. Estimated removal efficiencies of up to 90% can be achieved for phosphorus removals.

WATER QUALITY CHANGES FOLLOWING NUTRIENT LOADING REDUCTION AND BIOMANIPULATION IN A LARGE SHALLOW SUBTROPICAL LAKE, LAKE GRIFFIN, FLORIDA

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Lake Griffin, a large, shallow subtropical Florida lake, has suffered for decades from nutrient discharges from muck farms developed on former floodplain wetlands adjacent to the lake. In the 1990s, Lake Griffin was hypereutrophic, with persistent severe cyanobacterial blooms. The St. Johns River Water Management District (SJRWMD) acquired the muck farms adjacent to Lake Griffin in the early 1990s and has managed the area to restore wetland habitat and reduce nutrient discharges to the lake. Additionally, SJRWMD harvested of gizzard shad in Lake Griffin from 2002-2008, as a means to reduce recycling of nutrients from the bottom sediments and directly remove nutrients in the shad biomass. External load reduction had the largest effect on nutrient budgets and water quality. Shad harvesting significantly reduced population size and appeared to impact water quality even though the removals after the first few years were lower than previously recommended. Despite a reported susceptibility to severe wind-driven sediment resuspension, there have been substantial improvements in water quality in Lake Griffin since the late 1990s, including decreases in nutrient concentrations, chlorophyll-*a*, and cyanobacterial biovolume, and increases in water transparency. Total phosphorus and total nitrogen concentrations in Lake Griffin were strongly related to external total phosphorus loading and to gizzard shad population size. Total phosphorus concentrations were also generally predicted well by water quality models based on external loading and water residence time. Other water quality variables (chlorophyll-*a*, Secchi depth, and total suspended solids) were strongly related to nutrient concentrations.

NUTRIENT REDUCTION AND OXYGENATION IN A SOUTH FLORIDA RETENTION POND USING ARTIFICIAL DESTRATIFICATION AERATION

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The purpose of this study was to track the processes that take place during the startup and shutdown of an aeration system in order to further our understanding of how aeration may help control algae growth and otherwise benefit the lake. An existing system was turned off in February 2009, and the lake stratified normally as summer progressed. The system was restarted in June, after the lake had fully stratified. Another shutdown took place in April 2010, restarting in July. For this project, the lake was examined from June 2009 through August 2010.

Several water quality parameters were observed during the study period. A sampling location was chosen in the middle of the lake, away from air stations. Samples were taken in approximately same place each time, as determined by line of sight and GPS. The lake was monitored daily during startup, then less frequently. The boat was anchored prior to sampling. A YSI 556 multi-probe system was used to record pH, oxidation-reduction potential (ORP), specific conductivity, dissolved oxygen (DO), and temperature at 1 foot intervals from just below the surface to the sediment-water interface. A water sample from various depths in the water column was brought back to the lab where ammonia and phosphate levels were determined using spectrophotometric methods.

In order to accurately estimate lake volume and surface area, a 3-dimensional map was created using GPS and sonar data. A Lowrance HDS5 fishfinder/GPS chartplotter recorded depth and location information on the water while a Magellan Triton 400 handheld GPS was used to collect shoreline data. Didger software was used to line up location information from USGS orthophotos and the two GPS units. Surfer software was used to create 3-dimensional surface and contour maps. Volumes and surface area were calculated in Surfer.

By combining data from the YSI and Surfer we calculated the amount of oxygen present in each 1 foot slice of depth on each day of interest. Choosing the time between minimum measured oxygen and recovery, we determined the amount of oxygen transferred to the lake per hour. Dividing this number by the amount of oxygen pumped into the lake gives an estimate of the efficiency of the system in this particular lake.

Water column ammonia and phosphates declined after starting up aeration, which can be attributed to the measured increase in oxidation-reduction potential at the sediment-water interface resulting from increasing dissolved oxygen and off-gassing of CO_2 and H_2S. ORP profiles showed the earliest response to aeration, while DO did not change until startup was complete. Despite a careful startup procedure, DO dropped sharply after startup, resulting in a small oxygen related fishkill. Due to an undersized aeration system, destratification was not complete until natural fall turnover set in, however positive effects from aeration were still achieved.

During the 3 month shutdown period, the concentration of ammonia and phosphates increased rapidly in water from all depths tested. Within one week, water quality profiles from the YSI (most notably DO and ORP) showed evidence of restratification. On one occasion, a ‘hump’ on the DO and pH profiles suggested an algae bloom several feet below the surface. The aeration system was restarted in July, and water quality improved more quickly than the previous year. This difference is attributed to the aeration system receiving significant maintenance prior to the restart.

Considerations before installing aeration, especially in reference to salinity gradients, and proposals for future investigations will also be discussed. The system in this lake was shut-down again in early 2011, and will be used to study the effects of under-aeration by decreasing the number of diffusers in operation. Suggestions for monitoring strategies are welcome.

CONTROLLING EUTROPHICATION THROUGH PHOSPOROUS REDUCTION: TOOLS TO ADDRESS ALGAE BLOOMS AND WATER QUALITY STANDARDS

Seva Iwinski and Kyla Iwinski
Applied Polymer Systems, Woodstock, GA

Eutrophication is caused by sources such as agricultural runoff, construction and other land disturbing activities, sewer overflows, and urban runoff. Runoff coming from these sources such as sedimentation and excess nutrient loads, including phosphorous, contribute to algal blooms and water quality impairment of Florida's water bodies.

As aesthetic effects caused by Eutrophication may be unpleasant this does not even compare to the detrimental effects that turbid ponds, lakes and various water bodies can have on the health to humans living near the water body, aquatic organisms living within the water body and the overall ecosystem of the water body. Such negative effects include fine particulates that are a point of attachment for contaminants of not only nutrients but also bacteria, heavy metals, pesticides, and endocrine disruptors. These particulates make up turbidity which we measure in units called Nephelometric Turbidity Units (NTU's). Through various studies it has been found that as low as 10-100 Nephelometric Turbidity Units (NTU's) aquatic organisms will begin to show signs of stress. This happens through decreased light, food and oxygen, mechanical effects, and temperature increases due to darker water.

Every pond and lake is its own separate ecosystem which organic turbidity such as algae and other aquatic plant life is a natural part of and can hold beneficial roles. If algae begin to grow exponentially due to cultural Eutrophication however and algae blooms occur or a pond holds a toxic algae it can threaten the health of the pond and the organisms that reside within it. High nutrient levels, such as phosphorous that produce algae blooms will eventually lead to vegetation that die and decay, which in turn use up available dissolved oxygen. Fish need oxygen to survive and if oxygen is depleted fish kills can result.
Once we understand the effects turbidity has when it escapes into our waterways the next step is to determine what we can do to prevent this and if it has already occurred what we can do to remove it and clean the system up. The idea is to be proactive, not reactive. This is where Polymer Enhanced Best Management Practices (PEBMP's) come into play. Using anionic water soluble polymer technologies to enhance current best management practices (BMPs) we are able to greatly reduce sediment and nutrients (both organic and inorganic turbidity) from moving into a water body as well as reducing the amount of sediment and nutrients within a given water body. Two possible solutions are as follows: (1) capture or retain the sediment and nutrients before it can wash into a water body or (2) use polymer enhancement in conjunction with aeration systems, fountains, water falls, etc., to remove nutrients and turbidity from contaminated waters. Through various tests and case studies using polymer enhancement in conjunction with knows BMPs a 75-90

percent reduction in phosphorous has been found as well as a 95 percent reduction in total suspended solids (TSS) and NTU's.

Therefore, what we will look at is common and effective Polymer Enhanced Best Management Practices (PEBMPs) that have been quantified and are currently being used across various geographical locations to control sedimentation at the source so that it is not transported into our waters and if it has been transported into our waters to perform water clarification to reduce turbidity. Such Polymer Enhanced systems will include: soil stabilization including polymer enhanced soft armoring applications, de-watering systems, pond and lake clarification including nutrient (primarily phosphorous) reductions, de-mucking, and SRBs (Sediment Retention Barriers).

Notes

SESSION 5

POSTER SESSION

FLORIDA LAKES THAT WILL NOT MEET THE NUMERIC NUTRIENT CRITERIA FOR PHOSPHORUS, NITROGEN AND CHLOROPHYLL *a*

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Florida LAKEWATCH, University of Florida, Gainesville, FL

We found 952 lakes in our statewide database that had sufficient data on phosphorus, nitrogen, chlorophyll *a*, color, and alkalinity to determine which lakes did not meet the new numeric nutrient criteria for Florida lakes. There were 614 lakes or 65% of the lakes sampled that would be declared as impaired on the basis of one or more of the criteria. We found that there was an unequal distribution of impaired lakes across the state that did not reflect the distribution of human populations, but reflected the distribution of naturally eutrophic lakes in Florida. The list of impaired lakes by county is presented in the poster.

PHOSPHORUS, ALGAE, AND WATER QUALITY: INTERRELATIONSHIPS AND MANAGEMENT IMPLICATIONS

West M. Bishop[1], *Dharmen Setaram*[2], *and Dan Bergeson*[3]
[1] SePRO Corporation, SePRO Research and Technology Campus, Whitakers, NC
[2] SePRO Corporation, Winter Garden, FL
[3] SePRO Corporation, Oldsmar, FL

With increased demand on our freshwaters, factors that threaten water quality elicit devastating ecological and economic consequences. Nutrient enrichment of water bodies can impact aquatic life, drinking water supplies and compliance of water quality standards. Phosphorus is highly correlative to algae productivity, algal assemblage composition, and the primary component governing eutrophication. As phosphorus accumulation becomes more intense and widespread throughout freshwaters, in situ management strategies that rapidly and permanently remove the amount of bio-available phosphorus are needed to restore water quality. The objectives of this presentation are 1) to relate phosphorus levels to algae densities and classification; 2) to illustrate water quality impacts (i.e. TSS, turbidity, Chlorophyll) of increased phosphorus levels; and 3) to highlight new solutions for management of algae, internal phosphorus and water quality. Laboratory and field research provided data on the efficiency of these new solutions at addressing nuisance algae and phosphorus pollution. SeClear* is an algaecide and water quality enhancer that can control toxin and taste/odor compound producing cyanobacteria and decrease phosphorus levels. Phoslock® is a novel phosphorus locking technology that provides an effective and ecologically friendly approach to combat the eutrophication process and restore water quality.

CHANGES IN RESIDUAL FISH PESTICIDE CONCENTRATIONS FOLLOWING DREDGE SPOIL DEPOSITION IN A RESTORED WETLAND

Kelly Crew[1], Walt Godwin[2], Janet Nunley[2], John Stenberg[2], Randy Roth[2], Brian Sparks[1], Mike Coveney[2], Roxanne Conrow[2]
[1]AMEC-BCI, Palatka, FL
[2]St. Johns River Water Management District, Palatka, FL

Former muck farming practices on Area 7 in Emeralda Marsh Conservation Area left elevated soil organochlorine pesticides (OCPs) that threatened fish and piscivorous birds. In 2004, BCI Engineers and Scientists, Inc. (Lakeland, FL) worked in conjunction with SJRWMD and Lake County Water Authority (LCWA) to design a spoil disposal project that would result in reduced fish exposure to OCPs in Area 7. The design involved overlaying the contaminated sediments with spoil material from Lake Griffin canals, which were being dredged by LCWA for maintenance.

Between August 2005 and June 2008, approximately 206,400m^3 of material from the canals was deposited in a containment area in Area 7. Distribution of the spoil material was uneven throughout the containment area, creating several islands. Approximately 54% of the containment area increased by a minimum elevation of 0.15 m and 33% increased by more than 0.3 m. Fish were sampled for OCP concentrations in their tissue before, during and after disposal activities.

Whole-body fish samples were collected from Area 7 in 2003, 2004, 2006, 2008, 2009 and 2010 using a Smith-Root GPP 9.0 electrofisher. Common species were *Micropterus salmoides* (largemouth bass), *Lepomis microlophus* (redear sunfish), *Lepomis macrochirus* (bluegill), *Pomoxis nigromaculatus* (black crappie), *Notemigonus chrysoleucas* (golden shiner) and *Dorsoma cepedianum* (gizzard shad). Concentrations of OCPs were compared from before and after disposal activities.

Fish tissue showed significant decreases ($p<0.001$) in median wet weight DDTx (-72%), dieldrin (-56%), total chlordane (-81%) and toxaphene (-82%) after disposal activities were completed. Lipid-normalized DDTx (-45%), total chlordane (-64%) and toxaphene (-65%) also decreased significantly. Toxicity reference values (TRV) for piscivorous birds (U.S. Fish and Wildlife Service 2002) were exceeded for 4'4-DDE (1,500 µg/kg wet weight) in 22% of pre-disposal samples and 2% of post-disposal samples. The TRV for dieldrin (140 µg/kg w wt) was exceed in one sample in 2004. TRVs for toxaphene (4300 µg/kg w wt) and chlordane constituents were not exceeded in any samples.

The sediment disposal project successfully reduced fish and piscivorous bird exposure to OCPs. The creation of emergent islands was initially a concern because of increased foraging habitat for wading birds, but the contaminants in fish tissue were much lower than toxicity reference values for wildlife.

USING SUITABILITY ANALYSES FOR SURFACE WATER MANAGEMENT PLANNING

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Suitability analyses are useful tools for determining the appropriateness of a given area for a particular land use. Each attribute of the landscape has intrinsic values that are either suitable or unsuitable for the planned activities. Suitability is determined through sequential multi-factor analysis of the different landscape attributes. Criteria used can be derived from a variety of physical, ecological, cultural, political and economic factors. Each criterion eliminates inappropriate geographic regions until a final set of locations meeting the selected objectives remains. This type of analysis is common in habitat evaluation, but is also critical in watershed management to reduce costs and improve project efficacy.

This poster illustrates three different case studies used in the management of surface water resources within the St. Johns River Water Management District. The first example identifies locations for effective algal control through nutrient reduction. The second locates non-impacted wetlands draining into lakes and rivers that are appropriate for a dissolved oxygen study. The last case study reviews a model for defining an efficient monitoring network for BMAP and TMDL modeling in a lake watershed with multiple jurisdictions and numerous interconnected lakes and streams. Geographic Information Systems (GIS) are an effective tool in the multi-factor analyses of these studies. GIS process project criteria quickly and efficiently and allow results to be viewed in an easily recognized spatial context.

HOW LOW CAN YOU GO?
DETERMINING ALUM: BUFFER DOSAGES IN CENTRAL FLORIDA RESTORATION AREAS

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The addition of aluminum sulfate (alum) to lakes and reservoirs to remove phosphorus from the water column and reduce phosphorus flux from sediments has become common practice. However, if low alkalinities are present, addition of a buffering agent is required. Current recommendations for determination of alum/buffer dosages in lakes and reservoirs involve jar tests utilizing raw water from the site. If buffering is necessary, a general ratio of 2:1 (alum:sodium aluminate) by volume to maintain a neutral pH is recommended. However, sodium aluminate is approximately six times more expensive by volume than alum.

The goal of this experiment was to determine if suspended sediments contribute alkalinity to the overlying water column. Biogeochemical processes in the sediments can create alkalinity (Baker et al. 1982). In several Florida lakes, cation exchange (Ca^{2+}, Mg^{2+}, and soil OM) was a dominant neutralizing mechanism in well-mixed sediments (Brezonik and Perry 1983, Perry et al. 1986).

In multiple alum applications in the Emeralda Marsh Conservation Area (EMCA) and Lake Harris Conservation Area (LHCA), the amount of chemical buffer needed to maintain lake water at pH > 5.5 was significantly less than the amount predicted by jar tests. The amount of applied buffer was on average 51% less than the predicted amount, which saved an average of $26,650 per site.

Because of shallow water depths (less than 3 feet) in EMCA and LHCA restoration sites, alum barge applications frequently resulted in significant sediment resuspension. Rapid neutralization (within hours) in these well-mixed sediments may explain the overestimation of required buffer. To measure the contribution of alkalinity to the water column by suspended sediments, we designed various jar test scenarios.

If the sediments contribute a significant amount of acid neutralizing capacity, then less buffer and more alum can be procured, therefore improving treatment effectiveness. A more accurate prediction of chemical use will also benefit application planning and budgeting arrangements.

INCORPORATING NITROGEN FIXATION INTO A WATER QUALITY MODEL OF A EUTROPHIC LAKE

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As part of a long term study of Lake Jesup, a hyper eutrophic lake in central Florida, extensive water quality modeling has been performed using the EPA QUAL2k model. The model has been calibrated against a mutli-decadal dataset of water quality measurements taken in the lake - total of several thousand data points. Separate studies of the lake have measured significant amounts of nitrogen fixing bacteria. As yet there are no available water quality models that include this as a variable. In an attempt to reconcile differences between the model and the measured data, the model code was modified to account for this type of algae. The initial results seem promising and have produced an immediate improvement in model results. The paper will discuss the story so far.

LITTLE HOUSE ON THE FERRY: HARNESSING THE POTENTIAL OF THE BUILT ENVIRONMENT TO RESTORE FLORIDA'S INLAND WATERWAYS

Christina A. McDaniel
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Lake Jesup was historically a key component in the transportation of goods and people to and from southern Florida. Communities blossomed along its shores, bustling with commerce and recreational activities. Today it is tucked out of sight, hidden behind private single-family lots that adorn its shores. Limited public access remains available. Decades of wastewater and storm water runoff, in addition to other human interfering factors, have led to a degradation of the lake quality, altering the biological makeup of the species that reside there. While Winter Springs, Oviedo, and other surrounding communities pride themselves of the environmental tourism they have to offer, Lake Jesup is an amenity waiting to be rediscovered and used to its full potential. It has the opportunity to harness a new urban community typology that encourages a symbiotic relationship between people and nature in a contemporary society.

A mixed-use floating development on Lake Jesup can become a prototype community that instills environmental initiatives at the core of its design. It would not only be sensitive to the environmental challenges the lake possesses, but also seek to improve upon the lake's wellbeing by the sheer nature of its existence. The built environment can be used as a tool to extract the harmful chemicals in the lake through algae harvesting, removing unwanted invasive species for use as construction material, and creating emergent vegetation as a byproduct of both edible and non-edible floating gardens. The floating community has potential for economic sustainability as well, able to sell goods produced from the algae and floating gardens on-site. The unique informative and exploratory qualities of this mixed-use community would welcome visitors from both near and far. By reconsidering our inland waterways, such as Lake Jesup, as a viable resource for new development, we can transform the built environment as we know it, so that we may once again live in harmony with nature and reunite with our biophilic tendencies.

THE VIABILITY OF RAPID EYE AND WORLDVIEW 2 SATELLITES FOR MAPPING CYANOBACTERIA BLOOMS

Louis Sanderson[1] *and Robert K. Vincent*[2]
[1] Blue Water Satellite, Bowling Green, Ohio
[2]Bowling Green State University, Bowling Green, Ohio

Cyanobacteria blooms are an increasing problem throughout the world, posing health risks to humans as well as animals. Current methods for monitoring cyanobacteria blooms involves waiting until high levels are visible to the eye, and then collecting a few grab samples as representatives for the entire water body. This can result in the full scope of the cyanobacteria problem being missed. Currently, Blue Water Satellite Inc. uses patented algorithms to detect cyanobacteria blooms using the USGS Landsat satellites. This is done by mapping a pigment found almost exclusively in cyanobacteria called phycocyanin. Due to the age and potential degradation of the Landsat satellites, it has become necessary to start exploring other options for cyanobacteria monitoring. Using Landsat images as grab samples, this study attempted to correlate Rapid Eye and Worldview 2 satellite images to phycoyanin processed Landsat images to determine the viability of using these new high resolution satellites. The results indicated extremely high correlation with the phycocyanin processed Landsat images, showing that with future studies involving ground truth, new algorithms can be created for each of these satellites, and that satellite monitoring for phycocyanin in cyanobacteria can be expanded to even higher resolution images.

Notes

SESSION 6

DISCOVERING THE ST. JOHN'S RIVER

THE ST JOHNS RIVER: AN OVERVIEW OF MORPHOLOGY AND WATER CHEMISTRY

Sherry Brandt-Williams, *John Hendrickson and Lawrence Keenan*
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The St Johns River is often called a river of lakes because many reaches of the river are wide and exhibit characteristics of lakes. It is a slow moving, low incline blackwater system with three distinct segments defined by different morphology, water chemistry and watershed land cover running from south Florida to north where it flows into the Atlantic Ocean. We present the unique characteristics that define these three segments: the Upper Basin beginning in the Vero Beach area; the Middle Basin flowing through Central Florida and the metropolitan Orlando area; and the Lower Basin that flows through Jacksonville to the sea.

An overview of the river's important ecological properties is provided as an introduction to the rest of the talks in this special session. We illustrate the elevation profile from headwaters to outfall using a map of the flow-through lakes along the mainstem of the river. We show changing water quality at different points in the river along with changes in land cover in the watershed. We discuss primary water resource issues and current projects addressing them, as well as data gaps and opportunities for future research.

PREDICTING THE MAGNITUDE AND DURATION OF ALGAL BLOOMS IN THE ST. JOHNS RIVER

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Most reaches of the St. Johns River (SJR) are subject to current nutrient TMDLs or are listed as impaired for nutrients by the Florida Department of Environmental Protection. Nutrient enrichment increases phytoplankton abundance and can lead to blooms of cyanobacteria and red-tide dinoflagellates. Algal blooms can have deleterious effects on herbivorous zooplankton and on higher trophic levels, shade submersed plants, contribute to low dissolved oxygen, increase nitrogen loading through N_2-fixation, produce toxins that affect animals and humans, and interfere with recreation.

Inter-annual variation in nutrients, water color, and hydrologic conditions affect the timing, magnitude, and duration of seasonal algal blooms in the SJR, and the interactions can be complex. We are investigating whether antecedent flow and nutrient conditions can be used to predict subsequent algal blooms. We are developing linear and logistic multiple regression equations to relate discharge, TP, TN, and water color for the previous six months to the magnitude and duration of summer algal blooms. Our focus is on cyanobacterial blooms in freshwater portions of the lower and middle SJR.

We will discuss the results from two perspectives. First, can we develop predictive equations, and how accurate and precise are the predictions? Second, do the relationships provide any insights into possible mechanistic relationships? The results should have scientific value and may be interesting to resource managers.

ASSESSING THE EFFECTS OF REPEATEDLY EXPOSING *VALLISNERIA AMERICANA* TO MODERATE SALINITY IN THE ST. JOHNS RIVER

Mallarie Yeager[1], *Charles Jacoby*[2], *Tanya Stevens*[2], *Cliff Ross*[2], *and Dean Dobberfuhl*[2]
[1]AMEC-BCI, Palatka, FL
[2]St. Johns River Water Management District, Palatka, FL
[3]University of North Florida, Jacksonville, FL

The predominant species of submerged aquatic vegetation in the St. Johns River, *Vallisneria americana*, plays important roles in sustaining the health of this system. The grass beds provide nursery and refuge habitats for resident fishes and invertebrates, absorb nutrients before they promote algal blooms, as well as prevent erosion of the river's shoreline. Although *V. americana* is characterized as a freshwater grass, it is known to withstand low to moderate salinities allowing it to inhabit a large portion of the tidally influenced lower river basin. Loss of *V. americana* caused by changes in the salinity dynamics of the lower St. Johns River basin represents a concern for managers as they address water withdrawals, dredging and other activities that alter freshwater flows and an impetus to understand how *V. americana* responds to salinity.

Previous studies primarily focused on the response of *V. americana* following single exposures to differing salinities for varying durations. An integration of available data suggests that *V. americana* exhibits stress when exposed to salinities of 10 for 7 days or longer, with moderate to extreme stress observed after 1 day exposures to salinities of 15-25. This field-based, transplant experiment augmented available data by examining the response of *V. americana* following repeated exposures to salinities < 12 for varying durations in an attempt to simulate short-term saltwater intrusions.

Three sites were selected to represent regimes of increasing salinity: Murphy's Island (MI), Alpine Groves (AG), and Bolles School (BS). *Vallisneria americana* ramets used in this study were harvested from two sites, Murphy's Island and a downstream bed near Alpine Groves, to garner plants accustomed to different salinities. In total, 320 cores containing ramets and associated sediment were placed in 15-cm diameter pots that were held in submerged crates anchored to the bottom in 0.5 m of water. Initially, plants were left to equilibrate at their sites of origin, MI and AG, for 7-10 d.

During the experiment, groups of 16 pots were moved from their site of origin to a site where they were exposed to higher salinity, a treatment site, and returned for an equal period of recovery. Exposure and recovery cycles lasted 1, 2 and 3 wk. In addition, pots that were handled according to the three cycles but never transported served as controls for handling stress, and pots that were transported once and handled infrequently served as controls for transportation and handling stress.

Whenever pots were moved or at selected times, ramets and blades were counted and epiphyte coverage and presence of reproductive structures were noted. In addition, stress at the physiological level was evaluated by assaying stress enzymes in *V. americana* blades. One blade was clipped from a ramet in each of two pots from each cycle-treatment combination. Samples were frozen, transferred to University of North Florida, and analyzed for total soluble protein concentrations, total antioxidant capacity, and catalase activity.

A variety of water quality data were collected at each site to characterize environmental conditions. Chlorophyll concentrations differed significantly among sites, but concentrations of suspended solids and color levels were statistically equal. Overall, light regimes were similar and unlikely to cause differential stress as shown by statistically equal ratios of Secchi depths to total depths. Macronutrient concentrations varied significantly among sites, but they were within long-term ranges and unlikely to cause direct stress. As planned, salinities were significantly different among the sites, with maximum values for BS, AG, and MI of 8.8, 5.0 and 0.5, respectively.

At the individual level, counts of ramets and blades led to two primary conclusions: repeated exposures to salinities up to 8 yielded little to no biologically significant influence and some pots exhibited slight signs of handling stress. For example, mean numbers of ramets differed significantly among groups of pots transported to stations at BS from MI, but the mean numbers did not change in a consistent pattern through time. Initial means were 10.5 and 8.6 for the two stations in the 1-wk cycle, and final means were 10.8 and 6.9. For the 3-wk cycle, the initial and final means were 8.9 and 14.5 versus 8.9 and 10.1. A slight effect from handling stress was demonstrated by pots that were handled weekly but remained at the southern station at AG. Mean numbers of ramets decreased from 15.9 to 11.2.

Similarly, enzyme analyses did not show a significant relationship between stress at the physiological level and fluctuations in either salinity or water temperature. For example, statistically significant variation through time indicated that catalase activity varied consistently at all sites across the 19 time periods in the 1-wk cycle, although salinities varied from 0.5 to 8. Mean catalase activity began at 0.7 units mg protein^{-1}, rose to 1.00 units mg protein^{-1} in week 5, declined to 0.5 units mg protein^{-1} by week 10, and remained below 0.7 units mg protein^{-1} for the remaining 9 weeks. A similar pattern was observed for the duration treatment where plants were transported once and handled only four times, which indicated no effect of handling stress. Potentially, the equilibration period was too short for plants to fully recover from stress associated with potting.

Results from this study show that *V. americana* plants exposed to salinities of 8.8 for up to 18 cycles of exposure and recovery during a period of 128 days exhibited little evidence of stress at the individual and physiological levels. Integrating these results with previous studies, confirms that *V. americana* should survive at salinities ≤ 10. Therefore, managers should seek to avoid activities that cause salinities to exceed these levels over large areas and for long periods of time if they seek to maintain healthy beds of *V. americana* and their contributions to the health of the St. Johns River.

FIELD TRANSPLANTS AS A TOOL FOR ASSESSING EFFECTS OF SALINITY ON *VALLISNERIA AMERICANA* IN THE LOWER ST. JOHNS RIVER

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Vallisneria americana is one of the most commonly occurring species of submerged aquatic vegetation (SAV) in the St. Johns River. It provides habitat and protection for numerous fish and invertebrates, anchors sediment, helps control phytoplankton blooms by competing for nutrients, and feeds aquatic wildlife such as manatees, turtles, and waterfowl. Its tolerance of moderate salinities allows this grass to occupy shallow water in the St. Johns River's lower basin, which is tidally influenced. Given the interaction between tides and flow, activities that lower freshwater flows, such as dredging and water withdrawals, could alter the dynamics of salinity in to the detriment of *V. americana*.

This study determined the responses of *V. americana* to repeated pulses of increased salinity. Previous studies that exposed *V. americana* to different salinities predominantly used single exposures of varying durations. This field-based, transplant experiment exposed *V. americana* to three different salinity regimes according to four cycles of exposure and recovery, with data collected to document survival of ramets and blades.

Three sites were chosen to represent different salinity regimes. Salinities commonly reached 18 at the Jacksonville University site, 4 at the Bolles School site, and < 1 off Murphy Island. At each site, crates were anchored to the bottom in approximately 0.5 m of water to hold pots containing *V. americana*. The 15-cm diameter pots were lined with fabric to reduce loss of sediment from cores containing *V. americana* ramets. In an effort to obtain plants accustomed to different salinity regimes, cores were taken from two sites, Murphy Island and a site slightly upstream and across the river from Bolles School. The site near Bolles School harbored the most downstream *V. americana* bed at the time of the experiment. Plants in the pots were allowed to equilibrate for 5-7 d at the Murphy Island and Bolles School sites, considered their sites of origin.

Pots containing *V. americana* were exposed to higher salinities by transporting them in bins of water from their site of origin to a site with higher salinity - a treatment site. The experiment involved four cycles of exposure: 3-5 d, 6-9 d, 10-12 d, and the duration of the experiment (28 d). The three shorter cycles included transporting pots back to their sites of origin for periods of recovery equal to the periods of exposure. Pots transported once and exposed for the duration of the experiment represented controls for transportation and handling stress. In addition, pots that were handled on the 3-5, 6-9 and 10-12 d schedules without being transported from their sites of origin served as controls for handling stress.

Each time pots were transported to or from their exposure sites and at the end of the experiment, blades and ramets were counted and epiphyte cover and reproduction were noted. At these times, water was collected for laboratory analyses determining concentrations of macronutrients, suspended solids and chlorophyll. In addition, total depths and Secchi depths were measured, and YSI multi-probe readings of salinity and temperature were taken to augment and validate 15-min records from YSI sondes deployed at each site.

Factors other than salinity could influence the results of this field-based experiment, with three key influences being temperature, light, and nutrients, which could affect *V. americana* directly or through increased standing stocks of epiphytes or phytoplankton that reduce light. Water temperatures were not significantly different among sites. Color was not significantly different among sites, but total suspended solids were higher at the Jacksonville University site and chlorophyll was higher off Murphy Island. Thus, different factors influenced light availability, but light regimes as estimated by the quotient of Secchi depth to total depth were statistically equal. Nutrient concentrations varied among sites, but they were within long-term ranges and unlikely to cause direct stress. Epiphyte cover on over 95% of ramets remained at 0-25% throughout the experiment.

As planned, salinities did vary significantly among sites. Plants at Jacksonville University experienced salinities as high as 18.8, salinities at Bolles School reached 8.8, and salinities at Murphy Island never exceeded 0.5. For each cycle, there were statistically significant differences in numbers of ramets and blades per pot through time, with temporal patterns varying according to combinations of sites of origin and treatment. In particular, the mean number of ramets and blades decreased for pots that traveled to Jacksonville University from both Murphy Island and Bolles School on all four cycles. For example, the mean number of blades decreased from 13-15 to 1-3 on ramets subjected to two 3-5 d cycles of exposure. In contrast, pots transported between the Murphy Island and Bolles School sites on the same cycle retained over 80% of their blades.

Although the losses were not as extreme, ramets and blades were lost to handling stress. Pots held at the Bolles School site illustrate these losses, with mean numbers of ramets decreasing from 4 to < 1 for plants handled each 3-5 d, 5 to 2 for the 6-9 d cycle, and 5 to 3 for the 10-12 d cycle. Pots handled only at the beginning and the end of the experiment did not lose ramets.

This experiment provided some valuable data regarding the effects of salinity on *V. americana*. Previous studies showed that single, short exposures to salinities higher than 15 caused significant stress, and the results of this experiment confirmed these findings. In addition, this study showed that interspersing exposure to salinity of 18 with recovery in salinity of < 1 to 8 did not ameliorate loss of blades and ramets. In contrast, repeated exposure to salinity of 8 produced little to no sign of stress at the level of individual ramets. Overall, the study demonstrated the utility of field-based, transplant experiments as a way to guide decisions and management actions that would affect freshwater flow in the St. Johns River.

SOURCES OF TERRESTRIAL SALTS TO THE ST JOHNS RIVER, FLORIDA AND THE RELATIONSHIP BETWEEN SPECIFIC CONDUCTIVITY AND SALT CONSTITUENTS

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As part of the ongoing study to assess the potential impacts of withdrawals of surface water from the Saint Johns River (SJR), Florida, an evaluation of the terrestrial sources of salt and their influence on hydrodynamics along the SJR was conducted. The intent of this effort was to assist with the development of a hydrodynamic model using the Environmental Fluid Dynamics Code (EFDC) (Hamrick, 1995) along the SJR. Terrestrial salts are defined in this analysis as salts of geologic origin that enter the system through flushing and dissolution and not directly from the Atlantic Ocean through its exchange with the river at the mouth.

The St Johns River (SJR) watershed owes its geologic structure to the variability of sea level over millions of years (Alt, 1965). During the Tertiary Period, reefs that grew when the entire region was intermittently part of a shallow sea were then covered with sand as the state of Florida emerged from the water (White, 1970). The substrates of the SJR valley and adjacent uplands contribute the majority of chlorides and other salts that are entrained in surface flows through surface runoff, direct spring discharge, diffuse groundwater contribution (Odum, 1953). In the valley of the SJR, namely within 25 feet of present sea level, the primary source for salts comes from the flushing of relict seawater (RSW), while above this elevation the primary source for salts is dissolution of relic substrates such as gypsum, limestone, and dolomite (Torres, 2001).

Terrestrial salt dynamics in the SJR are dominated by the diffusive flux of groundwater, carrying with it RSW, into the bottom of the river. The presence and subsequent flushing of RSW is due the transgression (sea level rise) and regression (sea level fall) of the Atlantic Ocean into the St Johns valley in response to glacial geology (Flint, 1947). With the previous inundation of the SJR valley, Eocene substrates that comprise the Floridan Aquifer were saturated with Pleistocene seawater. This water has been flushing out of the system to varying degrees since the last high stand (Stringfield, 1951). Anthropogenic effects may influence salt dynamics in some localities along the river or adjacent tributaries, but in general, natural processes dominate terrestrial salt dynamics of the SJR.

The classic relationship between specific conductivity and salinity is based on the relative abundance of ionic salt constituents in ocean water. Since the salinity that is input into hydrodynamic models is calculated using specific conductivity, a rigorous analysis was conducted to understand how the relative abundance of ionic salt constituents in the SJR influence specific conductivity. The results of the analysis show that due to the dominant presence of relict seawater (RSW) in the SJR, specific conductivity data can be used to reasonably calculate salinity throughout the system. The results also provide methods for making reasonable estimates of the concentration of major salt ions (Cl, Na, K, Ca, Mg, SO_4, CO_3, and HCO_3) using specific conductivity within the Saint Johns River watershed.

NOTES

SESSION 7

UNDERSTANDING NUTRIENT SOURCES

PHOSPHORUS SOURCES TO NEWNANS LAKE: INTERNAL VS. EXTERNAL LOADS

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Newnans Lake is a large (27 km^2), shallow (mean depth – 1.6 m) hypereutrophic lake located east of Gainesville, Florida. Although the watershed's dominant land uses are upland forest (52%) and wetlands (23%) the water quality has been deteriorating since 1994. Some past studies conducted such as the nutrient budget analysis for Newnan Lake (Nagid 1999) and watershed loading model development by FDEP suggested that internal phosphorus (P) loading was a major P source to the lake. However, several recent studies find that external P loads are high enough to support the observed in-lake P concentrations. Little input of groundwater and porewater sediment concentrations suggest frequent bioturbation and nutrient recycling of surficial sediments. While the internal P recycling is one mechanism responsible for sustaining the lake's hypereutrophic status, the external P load must be reduced to lower the lake's trophic state.

EFFECTS OF FERTILIZER USE ON GROUNDWATER QUALITY IN A RESIDENTIAL AREA

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Although the effect of agricultural fertilizer use on groundwater quality has been monitored and reported for many different agricultural practices, the effect of residential fertilizer use on groundwater quality has not been documented by field scale monitoring programs. In many areas of the country, agricultural land has been rapidly converted to residential use, and the effect on springs, streams, and lakes – by the groundwater pathway – is not well understood. The subject study defines the effect of residential fertilizer use on groundwater quality in a central Florida springshed. The results are expected to be relevant at other locations with similar climate and geology.

Concentrations of constituents associated with fertilizer use were monitored in shallow ground water in residential areas in Orange and Seminole Counties of central Florida, within the springshed of Wekiwa Springs. Sampling locations were selected to represent land in residential use for more than five years, and to avoid septic systems and areas recently used for citrus production. Twenty-six (26) wells were installed in the surficial aquifer, screened within approximately 10 feet (ft) of the water table, which was encountered between 1 and 38 ft below land surface. Of these wells, 24 were in residential areas, scattered over an area of about 10 square miles; while 2 were in nearby undeveloped areas. Samples were collected four times between October 2008 and July 2009. Concentrations of nitrate/nitrite nitrogen (NOX-N) averaged 2.0 ± 0.2 milligrams per liter (mg/l) in the residential areas and 0.3 ± 0.1 mg/l in undeveloped areas. NOX-N concentrations in residential areas were significantly elevated above those observed in the undeveloped areas. Groundwater was also analyzed for stable isotopes of nitrogen and oxygen, and bacteria (by others) which confirmed that these wells were not affected by human or animal waste. Levels of NOX-N in the residential areas are attributed to residential fertilizer use. The results support evaluation of the relative importance of agricultural and residential sources of nitrate in spring fed river systems.

NUTRIENT SOURCE EVALUATION WITHIN LAKE TIBET SUB-BASINS 1 & 2

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The Butler Chain-of-Lakes Study conducted by Environmental Research & Design (ERD) between 2006 and 2007 indicated that discharges from the Lake Tibet Sub-basins 1 & 2 contribute approx. 25% of the annual total phosphorus (TP) loadings from sub-basins into Lake Tibet; with elevated phosphorus concentrations compared with similar drainage basins discharging into other lakes within the Butler Chain-of-Lakes. These two sub-basins contain approximately 994 acres of residential and golf course area. The golf course areas receive an average of 0.75 inches/week of reclaimed wastewater (RW) from the South Water Reclamation Facility for irrigation purposes.

The extensive use of RW for irrigation by the Bay Hill Golf Course at Sub-basis 1 & 2, along with the presence of sandy soils, high groundwater tables and a constant water flow from the golf course ponds into Lake Tibet prompted Orange County to hire ERD to conduct a new study. This study (1) Establish the source of pollutants coming from the Bay Hill Golf Course basin and associated neighborhoods and (2) Develop conceptual management recommendations to reduce phosphorus concentrations and loadings discharging to Lake Tibet-Butler.

The monitoring program for the new ERD study included analysis of both surface water and groundwater samples for general parameters and phosphorus species. In addition, stable isotope analyses of ^{15}N and ^{18}O were also conducted to assist in identifying nutrient sources.

The results of the investigations indicate that both RW irrigation and fertilizers appear to have a significant impact on concentrations of both nitrogen and phosphorus in surface water <u>and</u> groundwater within the golf course area. RW irrigation used within the basin is characterized by elevated levels of TP, which are 3-5 times higher than commonly observed in untreated stormwater runoff and 100 times higher than phosphorus concentrations in Lake Tibet.

Nitrogen concentrations measured throughout the golf course area, particularly in groundwater, appear to be higher in value than nitrogen concentrations in reclaimed water, suggesting that additional nitrogen inputs are occurring from fertilizer applications within the basin. The isotope analyses indicate that both fertilizer and reclaimed water are linked to nitrogen concentrations within the golf course area.

Substantial increases in mass loadings occurred during migration through the golf course compared with upstream basin areas. Calculated mass loadings of TP increased by approximately 1,478% during migration through Sub-basin 1 compared with phosphorus loadings entering the golf course from upstream areas. A 191% increase in phosphorus loadings was monitored in Sub-basin 2 during migration through the golf course.

Concentrations of both soluble and TP were substantially higher beneath golf course areas than in more upland portions of the two sub-basin areas, suggesting leaching or accumulations of nutrients from long term use of RW. The vast majority of phosphorus present in groundwater appears to be in the form of soluble phosphorous which is readily available for biological uptake by algae and plants and detrimental to the water quality of the lakes.

The Lake Tibet Sub-basis 1 & 2 study recommended the installation of two alum-aeration systems at the Bay Hill Golf Course to mitigate the current nutrient loadings into Lake Tibet-Butler; along with changes to golf course fertilization practices, herbicides applications, wet ponds aquascaping and RW storage/irrigation management procedures.

REFLECTIONS ON 30 YEARS OF SEDIMENT INACTIVATION PROJECTS IN FLORIDA LAKES – HISTORICAL PERSPECTIVE

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Sediment inactivation using metal salts was introduced in Florida during 1981 in a pilot project on Lake Eola in Orlando. Since that time, more than 30 sediment inactivation projects have been conducted throughout the State of Florida. Surface areas for treated waterbodies 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. Prior to 1990, application rates for sediment inactivation projects were based primarily on available water column alkalinity, with the quantity of alum added based on water column rather than sediment characteristics. Many applications were designed to maximize water column removal of P with the assumption that the resulting floc would inactivate sediment P release.

During 1992, a phosphorus speciation procedure was developed by ERD to quantify available sediment phosphorus, defined as the sum of saloid (soluble + easily exchangeable) plus iron-bound phosphorus. This method bases the amount and spatial distribution of the alum application on the sediments rather than the water column. Dosage calculations for all projects conducted in Florida since then have been based on this procedure. Prior to an application, sediment core samples are collected throughout the lake, and the 0-10 cm layer is collected and analyzed for available phosphorus. Prior research has indicated that processes responsible for exchange of P between the sediments and water column occur primarily within the top 10 cm of the sediment layer. Isopleth maps of available sediment phosphorus are then developed and used as a guide for the application with areal application rates varying throughout the lake depending on sediment available phosphorus concentrations. This technique of estimating inactivation requirements has become the standard for virtually all current projects conducted in North America.

Although the theoretical molar Al:P ratio for the formation of $AlPO_4$ is 1:1, an excess of aluminum is required to drive the conversion of P from saloid and iron bound associations into aluminum bound associations. Molar Al:P (available sediment phosphorus) ratios have ranged from 2 in early projects to 10 in recent projects. Extensive sediment monitoring has been conducted to document pre- and post-treatment sediment characteristics which has confirmed the conversion of saloid and iron bound phosphorus into aluminum bound phosphorus in the sediments. Alum application rates have ranged from 9.2-215 g Al/m^2, with water column doses from 3-54 mg Al/l. Projects conducted over the past decade have used multiple smaller applications rather than a single large application which is believed to increase phosphorus capture efficiency and provide a longer period of inactivation. Lime is becoming the pH buffer of choice in sediment inactivation projects since lime replaces alkalinity lost during alum addition and also provides an alternate stable bonding mechanism for sediment P in the form of calcium phosphate complexes.

REFLECTIONS ON 30 YEARS OF SEDIMENT INACTIVATION PROJECTS IN FLORIDA LAKES – PART II - SEDIMENTS AND WATER QUALITY

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Sediment inactivation projects in Florida can be divided into the two general categories of verified and non-verified. Verified projects consist of applications conducted where sediment P release has been determined, generally through a detailed hydrologic/nutrient budget, to be a significant proportion of the phosphorus loadings to the lake. Non-verified projects include applications where sediment P recycling has not been quantified in comparison to other inputs, and sediment inactivation is conducted as a low cost water quality improvement alternative with hopes that the water quality improvements will be long-lived. Of the 26 applications conducted to date in Florida, 6 have been verified projects where the significance of internal recycling was quantified, while the remaining projects have been non-verified.

Immediate improvements in water quality have been observed in each of the treated waterbodies with more than half exhibiting improvements for 10 years or more. Significant long term water quality improvements have been observed in each of the verified projects. Substantial reductions in TP concentrations have been consistently observed in Lake Conine for more than 15 years following sediment inactivation. Lake Mizell has exhibited steadily increasing water clarity and decreasing algal concentrations for 13 years and has converted from eutrophic to oligotrophic status. A similar pattern was observed in Lake Gatlin which has exhibited significantly improved water quality for 7 years. Lake Holden has been converted from hyper-eutrophic to oligotrophic status with lower and less variable water column TP concentrations.

Extensive sediment monitoring has been conducted to document pre- and post-treatment sediment characteristics. This monitoring has confirmed the conversion of saloid and iron bound phosphorus into aluminum bound phosphorus in the sediments following inactivation projects. Sediment incubation experiments were conducted to evaluate the stability of alum treated sediments under varying conditions of pH and redox potential. Alum treated sediments are more stable than untreated sediments with little potential for release of either phosphorus or heavy metals under the range of pH and redox conditions which occur in lakes.

NOTES

SESSION 8

MACROPHYTES AND MACROALGAE

INFLUENCE OF LAKE AUGMENTATION ON AQUATIC MACROPHYTE PRODUCTIVITY/ABUNDANCE AND PHYTOPLANTON BIOMASS IN CENTRAL FLORIDA LAKES

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This study examines the impact of augmenting lakes with well water from the Floridian aquifer to adjust for decreased water levels, on aquatic plants. The actual growth of aquatic plants was examined in the laboratory by measuring net oxygen production of nine species of submersed aquatic plants in well water used to augment lake levels and lake water from a lake without augmentation. For each species, net oxygen production was significantly higher for plants incubated in well water suggesting that augmentation may increase abundance of aquatic plants in lakes. Water chemistry (pH, alkalinity, specific conductance, chloride, total phosphorus, total nitrogen, chlorophyll, Secchi depth, and color) was measured from 14 well water samples used to augment lakes, 14 lakes with augmentation and 14 lakes without augmentation. Each augmented lake was paired with a non-augmented lake located in the same Florida Lake Region for comparison to eliminate overriding effects of geology on water chemistry. In-lake aquatic plant abundance and species distribution were also measured in all lakes. Average total alkalinity was significantly greater in lakes receiving augmentation, but total phosphorus was significantly lower, which resulted in lower phytoplankton abundance as measured by chlorophyll and greater Secchi depth. This was not expected because phosphorus concentrations in well water were significantly greater than lakes with or without augmentation and is probably the result of calcium phosphate precipitation in augmented lakes. Even with the measured increase in actual growth rate of aquatic plants in well water, in-lake aquatic macrophyte metrics showed no significant differences in lakes with and without augmentation. Lake augmentation significantly changed water chemistry of receiving waters, but no impact to aquatic macrophtyes could be measured suggesting that other environmental factors are limiting the distribution and abundance of macrophytes in the study lakes.

DISTRIBUTION AND SPATIAL COVERAGE OF FILAMENTOUS MACROALGAE IN 5 FLORIDA SPRINGS

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Florida's freshwater springs and their associated spring runs are important biological and recreational resources. Excessive growth of filamentous macroalgae in springs can degrade water quality and impact recreational use. In late spring/early summer 2007 and 2008 macroalgal distribution and coverage in 5 Florida Springs (Alexander Springs, Juniper Springs, Rock Springs, Silver Glen Springs, Wekiwa Springs) and their downstream runs was monitored using transects. Along each transect macroalgal frequency, abundance and density were determined using the Braun-Blanquet scale. Benthic/floating mats of filamentous macroalgae were most common in and around the headsprings and in wide, shallow areas with low canopy cover. Algal mats were least common in Rock Springs/Rock Springs Run. The most common macroalgae observed were the blue-green alga (Cyanobacteria) *Lyngbya wollei* and the green algae (Chlorophyta) *Oedogonium* spp., *Spirogyra* spp. and *Cladophora glomerata*. Largest mats observed were of *L. wollei*, *Vaucheria* sp. (Xanthophyta), *Hydrodictyon reticulatum* (Chlorophyta) and *Compsopogon coeruleus* (Rhodophyta).

SEARCH FOR NEW MANAGEMENT TECHNIQUES FOR HYDRILLA AND HYGROPHILA

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Hydrilla and hygrophila are submersed aquatic weeds that can dominate water bodies, interfere with flood control, inhibit navigation, and alter plant communities if left unmanaged. They are both exotic, invasive plants that can cause serious environmental and economic impacts in Florida. In recent years, management of hydrilla has become more challenging due to the prevalence of a strain of hydrilla that is resistant to the herbicide fluridone (i.e., Sonar™). In 2006, a Demonstration Project on Hydrilla and Hygrophila was initiated in order to find new management techniques for hydrilla and hygrophila. Researchers have been evaluating new and existing herbicides for the effectiveness and searching for potential biological control agents as well as educating stakeholders. So far, this project has contributed to the registration of four new aquatic herbicides and several more are being evaluated for registration in the future. Monitoring of large-scale hydrilla treatments using registered herbicides has provided insight into the effectiveness of different combinations, application rates, and timing. In addition, several new potential natural enemies of hygrophila have been discovered and are being evaluated for host-specificity and effectiveness in controlling the plant. Researchers are also optimistic about the success of the hydrilla tip-mining midge, (*Cricotopus lebetis*), and it continues to be evaluated. Lastly, the results of the project are being communicated to the industry, public, and governmental partners through various demonstration and outreach strategies including a website, teacher workshops, field days, presentations for community groups and scientific meetings, exhibits at community events, and various publications.

ASSESSMENT OF PERIPHYTON AND MAROALGAL BIOMASS WITHIN A SUBMERGED AQUATIC VEGETATION BED OF THE LOWER ST. JOHNS RIVER

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Assessment of periphyton and macroalgal biomass on submerged aquatic vegetation (SAV) was conducted to determine the possible deleterious effects on SAV and associated biota. Dense mats of detached macroalgae have occurred periodically within the Lower St. Johns River (LSJR) and periphyton are routinely seen covering SAV surfaces. Dense and persistent macroalgal blooms and periphyton growth are associated with nutrient enrichment and may greatly reduce light reaching SAV photosynthetic surfaces. Such fouling can also reduce nutrient exchange between SAV foliage and the water column. Decomposition of algal mats may cause anoxic conditions and decouple nutrient cycling exchange between sediments and the water column. A measure of the biomass load of these important biotic competitors is not currently assessed within the LSJR. This study designed a method for quantifying the periphyton and macroalgal load within the littoral zone of the LSJR.

The study was conducted at a SAV permanent monitoring site located in the oligohaline portion of the lower basin of the St. Johns River. Monthly sampling began on June 18, 2003, and was conducted through September 19, 2003. During each sampling event, leaf samples were taken from a total of ten *Vallisneria americana* plants located within two different sections within the SAV bed. Leaf samples were scraped of periphytic material. Detached algae was collected at the same intervals at which the periphyton samples were collected. Algae was removed from a 0.25 m^2 quadrat.

Detached macroalgal maximum dry weight (DW) and ash-free dry weight (AFDW) densities for both near-shore (294.557 g m^{-2} and 166.49 g m^{-2}, respectively) and outer-half (90.976 g m^{-2} and 73.533 g m^{-2}, respectively) bed locations occurred in August. DW density in the near-shore section and bed-wide increased five-fold between July and August. Two-way ANOVA showed the distance from shore x date interaction to be significant for detached DW mass. No other analysis showed a significant interaction indicating both sections of the bed responded equally to changes which occurred from month to month.

Bed-wide periphyton DW and AFDW density per leaf mass in August increased over 2.5 times by September; density per leaf area increased over 2 times. Maximum DW and AFDW densities per leaf biomass for both near-shore (0.360 g g^{-1} and 0.242 g g^{-1}, respectively) and outer-half (0.400 g g^{-1} and 0.309 g g^{-1}, respectively) bed locations occurred in September. Maximum densities per leaf area showed the same trend with the exception that the maximum AFDW for the outer-half occurred in July.

While periphyton density was much lower than other systems or that has been found to be deleterious to SAV, detached algal biomass as encountered during August is on par with or exceeded published results of other systems world-wide in which water quality conditions were identified as eutrophic. Although deleterious effects on SAV from the algal mat and periphyton were not observed during this study, previous blooms in the LSJR have resulted in SAV loss. Thus, this potential effect on SAV should be monitored. In addition, it would be useful to examine the role of nutrient loading as well as climatic and hydrologic events in giving rise to these algal blooms.

PARALYTIC SHELLFISH TOXINS CHARACTERIZED FROM *LYNGBYA WOLLEI* DOMINATED MATS COLLECTED FROM TWO FLORIDA SPRINGS

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Lyngbya wollei is a commonly found cyanobacterium in Florida's springs and is considered a nuisance organism by forming large mats. Two Florida Springs, Silver Glen Springs, and Blue Hole Spring (Ichetucknee) with standing crops of *Lyngbya* were sampled and mats characterized via microscopy. Paralytic shellfish toxins (PSTs) were characterized utilizing High Performance Liquid Chromatography coupled with fluorescence and mass spectrometry. Molecular data was also acquired via amplification of stxA genes and sequencing a section of filament collected from Silver Glen Natural Vent. It was determined that extraction techniques may convert less toxic *L. wollei* toxins to more toxic dcGTX2&3 and dcSTX toxins and modify the original toxin profile. Anything stronger than 0.01 M HCl should not be utilized if preservation of toxin profile is desired. Pre-column oxidation and LC fluorescence was not a preferred method of determining PST variants extracted from *L. wollei* mats as oxidation products are either converted or co-elute with other known PSTs and do not allow for characterization. LC/MS is the only method explored in this study with the potential ability to do so, but without usable standards for LC/MS/MS, quantitation and full confirmation could not be made. Analysis with LC/MS/(MS) of extracted algal material did show that dcGTX23 and dcSTX were present in *L. wollei* mats collected in Florida springs, with evidence pointing to the presence of all *L. wollei* toxins.

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SESSION 9

WATERSHED MANAGEMENT: TOOLS IN THE TOOL BOX PART I

THE PINELLAS COUNTY FERTILIZER AND LANDSCAPE MANAGEMENT PROGRAM: BE FLORIDIAN – A WATERSHED TOOL FOR URBAN COMMUNITIES

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Pinellas County is a highly urbanized coastal peninsula on the west coast of Florida, with over seventy percent of surface waters deemed impaired by the state and federal TMDL program for excess nutrients. Various studies have been completed on watersheds throughout the County to determine the source of the excess nutrients. Each of the studies indicated fertilizer as a primary source source. On January 19, 2010 the *Pinellas County Landscape Maintenance and Fertilizer Use and Application Ordinance* was enacted to address water quality issues. Components of the ordinance include seasonal and annual application restrictions for fertilizers containing nitrogen or phosphorous, training and licensing requirements for commercial fertilizer applicators, certification requirements for commercial landscape maintenance staff, and retail sales restrictions of fertilizers containing nitrogen or phosphorous. Other fertilizer ordinances have been enacted throughout the state; however, Pinellas County's ordinance is the first to address the impact of poor landscape management practices on water quality by requiring Best Management Practices certification of all commercial landscaper maintenance staff in addition to commercial fertilizer applicators. Additionally, Pinellas County's ordinance is the first to restrict the retail sale of fertilizer by product type and time of the year, thus addressing the relation of the purchase of fertilizers and the improper application and timing of applications and the resulting impact on water quality. The fertilizer sales restriction components were implemented in two phases. The details of these phases and the other components of the ordinance will be discussed and conclude with a current status report.

LOW IMPACT DEVELOPMENT AND ITS POTENTIAL ROLE IN MEETING NUTRIENT LOAD REDUCTIONS AND WATER CONSERVATION

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Florida water managers are faced with resolving both degrading water quality and declining water supply issues. Hundreds of Florida water bodies are listed as impaired. The majority of these water bodies are impaired for nutrients, fecal coliforms and turbidity. In addition, as surface water is used in lieu of groundwater sources for drinking water and irrigation, water withdrawal may impact water quality of these and currently unimpacted water bodies.

The transport of nutrient laden sediments, and other substrates on which nutrients are transported, via stormwater, contributes to the nutrient loads of Florida surface waters. This process is exacerbated by traditional development practices which increase the impervious surfaces of an area. Standard construction practices compact native soils and reduce their filtration capacity. Both of these practices reduce the surface area through which infiltration of stormwater can occur and increases the flow volume and rate of run off.

Low Impact Development (LID) involves construction and design practices that at a large scale preserve the existing hydrology of a site. At the microscale, it includes design features that increase stormwater infiltration, retention, and storage on each parcel of a development thereby reducing transport of pollutant laden sediments to downstream water bodies. Many of the practices associated with LID such as stormwater harvesting and preservation of native vegetation, can also reduce the demand on water supplies.

This paper will discuss the current application of LID in Florida and elsewhere in the United States, its applicability to both new development and redevelopment projects, and will provide examples of the nutrient load reduction capabilities as well as water conservation potential.

SUSTAINABLE WATER RESOURCE EDUCATION USING INQUIRY-BASED EDUCATION AND THE WATER ATLAS

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The Water Atlas has been used as a resource for K-12 education for over eight years and during this time the Water Atlas Curriculum, first developed in 2004 through a partnership with Seminole County, has been modified and improved to better meet the needs of primary and secondary school educators.

A version of the Curriculum is available on the Hillsborough, Pinellas, and Seminole County Water Atlas websites. On these sites, the lesson plans have used direct instruction methods, imparting scientific knowledge related to environmental resource stewardship using data localized to a County's geographical boundary. Lessons were developed to teach skills measured by the Sunshine State Standards and tested by the FCAT, with exercises giving practice in language arts (reading and writing), science, math and social studies (primarily geography/cartography). In some instances students are asked to respond to reading material or formatted data that is provided to them, but in most lessons they are instructed to visit one of the Water Atlas websites to locate, retrieve, organize, analyze and interpret information themselves.

Improvements were made to the Seminole Water Atlas Curriculum when it was re-developed for Pinellas County. These included the addition of resources on other Water Atlas sites and the use of a new tool, the Water Atlas "Real Time Data Mapper," thus expanding both the spatial and temporal range of the lessons. New lessons added at this time incorporated near-real-time sensor data from the Coastal Ocean Monitoring and Prediction System (COMPS), including air/water temperature, water level, conductivity, tides and precipitation.

Also added to the set of Pinellas County lessons was a mapping and exploration web component called the Watershed Excursion, which allows students to visit a watershed and learn more about its characteristics and conditions and then to create and share "stories" about the experience. The purpose of the Watershed Excursion is to make the seemingly abstract concept of a "watershed" more tangible to students by relating it to recognizable places within their community that they can visit (or have already visited). Virtual, exploratory excursions to a watershed can then be followed by a class trip to observe a particular point of interest within it—for example, a park, a water body, or a historical or cultural site—where students can participate in a group activity and then create and submit illustrated stories that document their observations and experiences. These stories are then published online on the Water Atlas, giving the students the ability to create a web presence and share their work. The "stories" component is supported by an image and word editor to allow a student or a group to enhance the story and learn about web editing and publishing.

A recent project with Orange County has added inquiry-based (IB) learning modules to the Water Atlas Curriculum and further enhanced the Watershed Excursion. The goals of the new curriculum initiative are to nurture scientific curiosity and develop information-processing and problem-solving skills, creating student knowledge of the content through active involvement. In addition to imparting facts and principles, the use of an IB instruction approach increases students' understanding of scientific practices and ways of thinking. Technology has made ever-increasing amounts of information of all kinds available to the public, but critical-thinking skills are vital in order to recognize significant trends and identify relationships among different data sets. In IB instruction, posing researchable questions and pursuing them through open-ended investigations are used to teach these skills. In the Water Atlas implementation of the IB learning modules, each revised lesson incorporates "five E's":

- Engage/Elicit: Intended to capture students' attention, get them thinking about the subject matter, raise questions in their minds, stimulate thinking, and access prior knowledge.
- Explore: Provides an opportunity for students to formulate questions, offer hypotheses, design and plan experiments, observe, record and organize data.
- Explain: Students analyze the results of their investigations, generate interpretive reports, and compare their outcomes to expected results.
- Extend: Follow-on activity which expands and solidifies student thinking and/or applies it to a real-world situation.
- Exchange/Evaluate: Activity which allows the teacher to assess student performance and/or understandings of concepts, skills, processes, and applications, including sharing results with other students, outside "experts", or on the Watershed Excursion.

The new Orange County curriculum uses, as its basis, 30 carefully-selected existing lessons from the Seminole and Pinellas County Water Atlas curricula, and then adds additional lessons: eight with content on climate change, one that deals with sustainability, and one that explores the topic of watersheds using the Watershed Excursion component as a vehicle. The subject matter and resources from the existing lessons have been retained, but were reformulated to incorporate the process of scientific inquiry and to include additional resources, both on the Water Atlas sites and elsewhere. The topics of climate change and energy conservation are of particular interest to the Department of Energy, which provided grant funding. New climate change modules address topics like extreme weather, ecosystem effects, saltwater intrusion, and sea level rise.

Performance objectives (i.e., the Sunshine State Standards) have been updated to reflect any additional skills taught in the revised lessons, and to conform to the more recently adopted Next Generation Sunshine State Standards. When existing lessons included FCAT-focused practice exercises, these were retained as supplemental lessons to the inquiry-based modules, and if necessary were changed to refer to Orange County water resources and datasets.

The structure of the Watershed Excursion component is such that each watershed may have defined for it one or more points of interest. Its implementation has been enhanced so that those points may now be characterized by type. In addition to general points of interest, map icons may now be defined to call attention to environmental resource points of interest in each of these categories: energy efficiency, low impact development, hydrology, water quality, climate change/sustainability, and conservation/natural area. Content—watershed descriptions and point-of-interest details—is provided by Orange County Environmental Protection Division, the project's sponsor.

Training of teachers in the use of the Water Atlas, the new IB lessons and the Watershed Excursion component will take place this summer. In time, many of the enhancements that have been made in the curriculum for Orange County will be incorporated into the curricula for other counties as well.

WINTER HAVEN CHAIN OF LAKES WATER QUALITY MANAGEMENT PLAN

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The Winter Haven Chain of Lakes (WHCL) is at the headwaters of the larger Peace River – Charlotte Harbor watershed. The lakes are located in central Florida, an area of rapid urbanization and commensurate high stormwater runoff and associated nutrient loadings to the lakes. A Water Quality Management Plan (WQMP) was developed for the WHCL to ensure long-term water quality protection and compliance with state and federal water quality regulations.

The WQMP presents a compilation of information relevant to water quality in the 25 lakes, an analysis of water quality and water quality trends, and proposed restoration projects and priorities for the lakes. One of the primary features of the plan is the recommendation of scientifically proven methods for managing lakes as an integrated ecological systems rather than managing based on nutrient inputs alone. Recommendations were also made in consideration of management projects implemented in the past that have had successful results. More specifically, the WQMP:

- Characterizes water quality associated with lakes in the WHCL
- Identifies restoration projects to address water quality issues
- Links restoration projects to lakes based on individual water quality needs
- Provides recommendations for lake restoration priorities

While traditional stormwater treatment projects can successfully reduce external phosphorus loadings to the lakes, historic point and nonpoint source runoff and subsequent sediment accumulation in some lakes resulted in internal phosphorus loads that existing stormwater projects cannot treat. Consequently, both traditional and non-traditional water quality management projects are proposed to address both external and internal phosphorus loading to the WHCL in this WQMP.

In addition to nutrients and chlorophyll *a* (algal growth), factors affecting quality in the WHCL include long-term land use and hydrologic alterations, stormwater runoff, historic point source discharges (particularly phosphorus), extent of submerged aquatic vegetation (SAV) and emergent aquatic vegetation (EAV), lake water levels, and hydrologic connections to forested wetlands and other lakes. A decision key was developed for the WHCL as a means of selecting these projects. These components are therefore included as part of a holistic lake management approach for the WHCL. The link between water quality issues and lake-specific water quality restoration projects for the WHCL are presented in the context of state and federal regulations, as well as lake management science.

A priority matrix was developed to rank lakes by management needs. Lake priorities were based on water quality (e.g. impairment status and chlorophyll trends), required phosphorus reductions, and lake connections and location. Lakes most likely to benefit from a project were also considered.

Several projects were proposed as part of the WHCL WQMP, including Stormwater Infiltration Areas (SIAs) that reduce direct runoff and associated external nutrient loads into lakes and redirect surface water flows into ground water. Sediment inactivation/removal projects are proposed to reduce internal phosphorus loading. Other projects, such as planting SAV and EAV provide sustainable means of phosphorus removal and immobilization. Non-native species control, especially for *Hydrilla*, should continue, and maintaining native SAV cover of at least 30 percent is also important. Forested wetland hydration is proposed for valley lakes (historically colored due to forest flooding) in instances in which more color may inhibit the growth of algae. Whole lake aeration in smaller lakes could decrease algae productivity in lakes. Sediment, SIA, and SAV and EAV projects were proposed for all lakes, but not always with the same priority, while forest rehydration, lake aeration, and Floating Treatment Wetlands (FTWs) were proposed for only a few lakes. Projects were ranked lake by lake based on the relative likelihood of improving water quality in a lake. Cost was not a part of the rankings, but relative magnitudes of restoration costs were provided as a means of comparison.

The WQMP is consistent with the Winter Haven Chain of Lakes Surface Water Improvement and Management Plan, state and federal regulations, and a local preference for managing lakes as part of an overall interconnected water resource. This report also relies heavily on previously completed lake studies and reports for the WHCL. The WQMP was developed with cooperative funding from the Southwest Florida Water Management District and City of Winter Haven. Restoration projects and planning level cost estimates for the recommended projects are included in this WQMP.

Notes

SESSION 10

BEST MANAGEMENT PRACTICES FOR WATER QUALITY IMPROVEMENT

LAKE FLORENCE: A SMALL TOWN TAKES ON A BIG PROBLEM

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Lake Florence is a 53-hectare lake with variable trophic states located in Central Florida just west of Lake Apopka in the Town of Montverde, population 1,100. The landlocked nature of the lake and steep shorelines provide for unusual depth in excess of seven meters. The watershed for Lake Florence is approximately 85 hectares and is comprised primarily of residential, agricultural, and commercial land uses. Lakewatch initiated a sampling program in 1995 although continuous data is not available until late 2003. Secchi depth decreased significantly ($p < 0.01$) and chlorophyll a (chl-a) increased significantly ($p < 0.01$) between the periods of 2003 to 2006 and 2007 to 2010. No significant difference in total phosphorus (TP) concentration was observed between these two time periods ($p = 0.43$). Available Lakewatch data indicate a mean TP concentration of 24 ppb (± 5.48 SD), a mean chl-a concentration of 30 ppb (± 13.7 SD), and a mean Secchi depth of 1.18 m (± 0.31 SD).

Although water quality problems are evident from the data beginning in the late 1990's, the period of declining water quality between 2007 and 2010 corresponds well with reports of persistent blue-green algae blooms and presence of shoreline scums. The Town is taking a three-pronged approach to address the problem by reducing the nutrient sources, providing additional treatment for stormwater runoff, and utilizing in-lake restoration methods. The Town of Montverde was one of the first in the state to craft and adopt a no-phosphorus fertilizer ordinance. The Town utilized grant funding made available by the Lake County Water Authority in 2008 to install a whole-lake aeration system and has secured additional funds to construct new stormwater BMPs. Data collected immediately following installation of the aeration system in July of 2009 indicate a temporary increase in TP and chl-a, and a decrease in Secchi. Eighteen months following installation of the aeration system, the lake is showing signs of stabilization and potential improvement.

LAKE BEAUCLAIR AQUATIC ENHANCEMENT: AN EXAMINATION OF BRIDGING THE GAP BETWEEN PERMITTING AND IMPLEMENTATION OF A DREDGING PROJECT

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The high-value benefits of aquatic dredging are widely known, as evidenced by the equally high expenditures by local governments, resource protection agencies, and others to undertake these projects. In Florida, the principle objectives of dredging projects often involve aquatic enhancement or navigational improvements. These initiatives are very costly and in many scenarios involve years of evaluation, planning, feasibility analysis, disposal alternatives evaluation and negotiations, followed by detailed design development and finally, regulatory permitting. With permits obtained, the project is ready to be advertised for bidding, and this is when the next phase of challenges begins for the project team and bidding contractors. To allow for alternate approaches during the permitting phase of a project, permits may be sought based on a potential design scenario, as is the case on the Lake Beauclair Aquatic Enhancement project, currently being undertaken by the Lake County Water Authority (LCWA) in cooperation with the St. John's River Water Management District (SJRWMD) and the Florida Fish and Wildlife Conservation Commission (FWC). So, as in the scenario of this project, how does the project team bridge the gap between project objectives designed for, the expected and unexpected permit conditions issued, and various alternative methods bidding contractors may propose? How do you allow for consideration of alternative project approaches during the bid process and facilitate the selection of the most cost effective method to achieve project goals?

This presentation discusses the complications encountered between the phases of obtaining regulatory permit approvals and bid review on the Lake Beauclair Aquatic Enhancement project in Lake County, Florida. Balancing liability and project costs when considering project-specific requirements will be discussed, including scenarios for pollution liability insurance and alternative project approaches. Budgetary concerns will also be discussed with emphasis on design refinement during the permitting phase and economic variations during the bid process. Stakeholder project requirements and budgetary limitations will also be discussed. This presentation will focus on addressing complications and lessons learned through the permit-to-bid process for Lake Beauclair, to facilitate discussion applicable to this and other dredging projects in the region.

LAKE ISTOKPOGA RESIDENTIAL CANAL MAINTENANCE – NEARLY TEN YEARS IN THE MAKING

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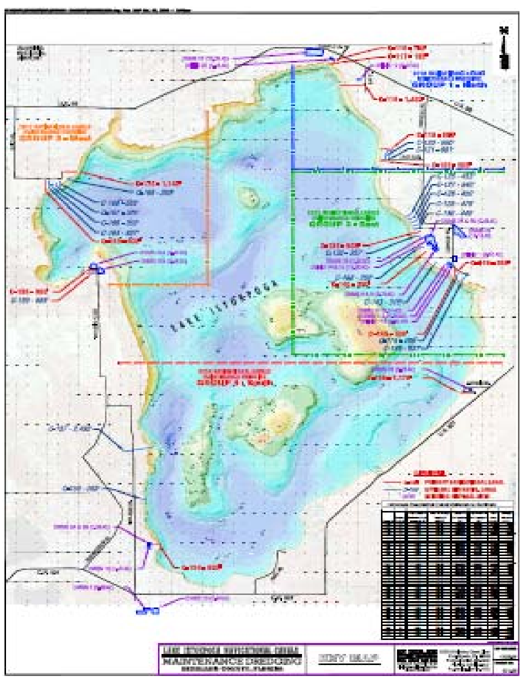
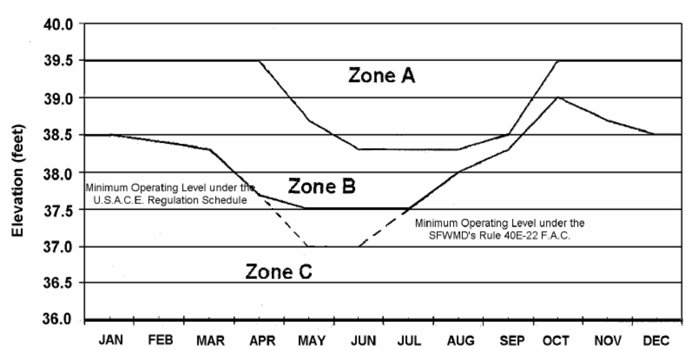
Lake Istokpoga, the fifth largest lake in Florida at 11,100 ha, has had a highly managed water regulation schedule since 1963 as part of the Central and South Florida Flood Control Project. Residential development resulted in an ad-hoc network of 61 residential canals, all constructed prior to 1970, ringing the lake shoreline (Fig. 1). None of these canals has a routine program of maintenance and most have never been dredged. Organic muck buildup in all the canals has been estimated to range from 40,000 to 60,000 yd^3, effectively eliminating lake access for most residents during the spring – summer regulatory drawdown for flood control and water supply (Fig. 2). Some canals are in such poor condition as to prohibit lake access year-round. These conditions have been a constant concern for the Highlands County Lakes Management Program since its inception, but active work to identify funds for maintenance dredging only began after a 2001 whole-lake drawdown and tussock removal (Champeau and Furse 2002).

Fig. 1. Istokpoga residential canals.



An evaluation of these canals was funded in 2005 Based on a 2006 evaluation of seventeen representative canals (Chastain-Skillman 2006), cooperatively funded by SFWMD, a Community Budget Issue Request was funded through the state legislature for $800,000 beginning in 2009 for maintenance activities. The original, overly optimistic schedule had the project being completed by September 2009. An extension was arranged through June 2010, then a second and final extension was granted for project completion by December 31, 2011.

Fig 2. Istokpoga Regulation Schedule.



Zone	Releases
A	Through all outlets
B	For agricultural demands only
C	No releases to be made

Meetings regarding exempting the project from permitting through FDEP began in May 2009, along with identification of dredge material management sites (DMMS). Ultimately, thirty-two sites were evaluated, though only seventeen were approved as DMMS. The request for exemption from permitting was submitted to FDEP for thirty-four residential canals on the lake in August 2010; the permit exemption was granted in December 2010, one year prior to the expiration of funding. Federal permitting for work in these thirty-four canals, which requires monitoring for threatened and endangered species including Crested caracara, Indigo snake and Everglades Snail Kite, was completed in May 2011.

Hole-Montes Inc. of Fort Myers was selected in June 2010 to assist with permitting, contractor selection, field inspections and contract management. The contract was advertised for bid in December 2010 and the contract awarded in March 2010 to Adventure Environmental of Miami; the contract price was sufficient to allow work in nineteen residential canals on the lake, with priority being given to lake-dependent businesses such as fish camps, marinas and mobile home parks. The project will remove approximately 20,700 yd^3 of organic muck from nineteen residential canals at a cost of approximately $\$32/yd^3$. All of this material is being stored in the permitted upland DMMS.

Fig. 3. Canal work from barge.

Maintenance activities began in May 2011 (Fig 3) with the target of completing work in these residential canals by late summer 2011. This presentation will detail the ins and outs of this residential canal maintenance project and provide insight into future management measures to minimize the need for such extensive work.

References:

Chapeau, Thomas R. and J. Beacham Furse. 2002. Littoral Zone Restoration of Lake Istokpoga: Enhancing Aquatic Habitat, Flood Control, and Water Quality. In: Proceedings of the 13th Annual Symposium of the Florida Lake Management Society, June 10 – 13, 2002, Naples Florida.

Chastain-Skillman, Inc. and Water and Air Research, Inc. 2006. Lake Istokpoga Canal Maintenance Dredging Evaluation Report, submitted to Highlands County Board of County Commissioners. Sebring, Florida.

NUTRIENT AND MASS REMOVAL ANALYSIS OF STREET SWEEPING ACTIVITIES IN CENTRAL FLORIDA AS A SURFACE WATER MANAGEMENT TOOL

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The goal of this study is to evaluate the quantity of material and nutrient content of street sweeping debris collected per curb mile from typical lakefront residential areas in Orange County, Florida. The data can be used to more accurately evaluate the benefits of a regimented street sweeping program. Data collected will also assist in determining potential mass loading removal from surface water systems for the benefit of TMDL compliance.

As part of Orange County's Lake Management Program, site specific street sweeping occurs on a regular basis throughout the year. The majority of the streets included in this study are curbed and located in a mostly residential area surrounding four separate lake watersheds. Total weight of debris is reported on a monthly basis. A moving average of the weight of debris collected per curb mile swept is then calculated. Monthly average weight per curb mile was evaluated for annual variability to see if there is a significant seasonal impact in the weight per curb mile collected.

On a quarterly basis the material was screened through a 1/2" trammel screen to produce two separate fractions. Laboratory analysis was then conducted to determine nutrient concentration averages and variability of the two separate fractions. The samples were analyzed for the following parameters: Percent moisture, Percent solids, Bulk density, Total-P, Total-N, and Nutrient Leachability (TCLP Analysis). The annual average debris weight per curb mile collected can then combined with the laboratory nutrient analysis to determine an accurate mass removal potential for street sweeping.

Notes

SESSION 11

WATERSHED PLANNING: TOOLS IN THE TOOL BOX PART II

SEMINOLE ENVIRONMENTAL, RESTORATION AND VOLUNTEER (SERV) PROGRAM: A UNIQUE OUTREACH IDEA

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The Seminole County Public Works Department, through its Seminole Education, Restoration and Volunteer (SERV) Program, recruits, educates, and trains citizens in a variety of volunteer and educational opportunities throughout the County This Program is open to individuals and groups interested in helping to preserve and protect their watershed and local environment. SERV utilizes volunteers to assist with restoration, cleanup, and educational activities such as: Adopt-A-Road, Adopt-A-River, Storm Drain Marking, Lake Restorations, Waterway Cleanups, Invasive Plant Removals, and Festivals/Events. Volunteers are crucial to improving the health of water bodies and natural areas in Seminole County. Due to active participation in such restoration and public education activities, volunteers are a highly valued component of the operations of Seminole County's SERV Program.

The SERV program has been able to reach a wide ranging volunteer base that includes high school and college students, church and community organizations, and families. The overwhelming popularity of this program since its inception in (date) has allowed Seminole County's Lake Management Program to conduct several whole lake restoration projects. Lake restoration events typically include removal of exotic and nuisance shoreline vegetation and planting of native, beneficial species and can occur several times on one lake with approximately 50-150 volunteers participating. The SERV Program was established not only to provide citizens the opportunity to actively participate in environmental restoration activities but also to satisfy several regulatory requirements such as annual NPDES education requirements, capital project lists and TMDL project lists. In addition, educational credits are provided for various Basin Management Action Plans (BMAPs) in progress, such as the Wekiva River and Lake Jesup basins, to meet TMDL goals.

RAPID LAKE ASSESSMENT AND REPORTING: HOW TO PRODUCE COMPRENENSIVE DATA COLLECTION, MANAGEMENT AND REPORT GENERATION

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Three primary objectives of the Water Atlas Lake and River Assessment program are to continue to improve assessment methods, reduce time in the field and reduce time of data and report processing. We have accomplished these objectives by developing methods and procedures that streamline field tasks while increasing data collection and reducing the time required inputting, managing and evaluating information collected in the field. In past years we have reported on improvements made to data collection through the use of integrated bathymetry and imaging systems and fully instrumented small boats and kayaks to reduce field time and improve access. In this paper we discuss a new approach that incorporates the FDEP Lake Vegetation Index (LVI); a new data management application to manage field data; and a new report generation and content management application for lake reports.

Last year, after attending the FLMS sponsored FDEP LVI training and later being qualified by FDEP to conduct LVI assessments, the Water Atlas assessment team began to incorporate the LVI into its lake assessment procedures and evaluated the LVI as a way to more rapidly assess river vegetation. This is made possible by combining the LVI with other lake assessment tasks. For example, our assessment procedures call for the mapping of the lake perimeter which requires maneuvering the boat close to the shore while collecting lake depth and boat position using an integrated GPS/Bathymetric system. This task is combined with the LVI “drive by” vegetation analysis task by conducting the analysis when the pre-selected LVI region is entered. We then combine our site-by-site vegetation analysis with the LVI’s intensive vegetation survey by selecting a portion of our vegetation assessment sites within the pre-established LVI regions. In this way we have incorporated the LVI into our lake assessment procedures without a significant increase in field time.

This concept has been carried over to the development of a hybrid river vegetation analysis by splitting the river study area into short reaches and conducting the LVI drive by (moving upstream) as we map the shoreline in a similar manner as we do for lakes. We then conduct the more detailed vegetation sampling while returning downstream. The LVI metrics are not currently applied to river systems; however the approach is being evaluated as a more efficient method of assessing river vegetation.

The largest improvement in terms of time and effort saved was the development of a *Lake Assessment Data Management System*. This database application was created by Jason Scolaro and Keith Bornhorst at the USF, Florida Center for Community Design and Research (FCCDR), the home of the Water Atlas. The application combines Microsoft Access and SQL databases and is served via the World Wide Web. From a user's perspective, the process starts with entering the general data about the waterbody assessment and locations of the sample sites in an Access data form. Next the vegetation sampling data are entered site by site followed by the field physical water sampling values. Laboratory sample identification numbers are then entered to allow a data query and match of field and laboratory data. A shadow system designed by FCCDR is entering these data into a SQL database as the user enters them into Access. The SQL database subsequently combines the field data with the lab data which is maintained by the Water Atlas SQL database in a seamless operation.

Photographs documenting the waterbody assessment, as well as images of the vegetation site overview map and bathymetry map, are all uploaded into the Water Atlas Content Management System for display on the Water Atlas, as well as later incorporation into the assessment report for the waterbody. Using a web-based administration tool, the images and maps for an assessment report are selected and cued for insertion into the lake assessment report. This tool also allows the preview of tables created from the water quality sampling and other data tables included in the final report.

The report is generated using a Word document template that incorporates Office Automation features and is designed especially for the data contained in the assessments. When cued, the SQL database places the data from the database into the coded placeholders in the Word document and inserts the pictures and maps from the CMS that were selected in the web-based administration tool. Additionally, the laboratory sample analysis is inserted into tables and 10-year nutrient trend graphs are inserted from data available on the Water Atlas. When all of the report components have been inserted, an email is sent by the system that alerts the report writer that the report is ready for review. At this point the lake assessment report is complete except for the addition of reviewer comments and conclusions, which are manually added to the report. Once approved, the report is posted to the Water Atlas on the lake's overview page.

The assessment reports for the 2010 Lake Assessments were generated using this method. For the 2011 assessment season, a template is being developed that will incorporate river and stream assessment data to create similarly designed reports. The methods developed for our lake and river assessments are available as research notes and Water Atlas partners can request incorporation of the data management system as a component of their Water Atlas content management system.

ENVIRONMENTAL GRANTS AND HOW TO FIND THEM

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In these times of dwindling tax dollars and funding availability, organizations must look to alternative sources for money. While cutting budgets and reducing services is part of the process of balancing budgets, some costs cannot be eliminated. In addition, existing and new regulatory programs place demands on local governments to initiate projects, increase monitoring, and to track efforts to reduce pollution.

Despite these challenging times, there is still funding available. However, you need to know how to strategize an approach to seeking grants, how to search for grants, and how to match projects and programs with specific funding sources.

The hard part of applying for grants is upfront...the research. Finding grant opportunities and information about possible funders is an ongoing project for any grant seeker. There are hundreds of grant resources for environmental projects.

The key is matching proposed projects with the appropriate grant. Using grants can involve two processes.

The grant presentation includes the following topics:

- A general grant overview
- Types of grants
- Grant Sources
- Funding categories
- Key criteria (Required)
- Thinking creatively
- Required and non-required considerations
- Partnerships
- Grant preparation tips
- Grant development examples

LITTLE HOUSE ON THE FERRY: HARNESSING THE POTENTIAL OF THE BUILT ENVIRONMENT TO RESTORE FLORIDA'S INLAND WATERWAYS

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Lake Jesup was historically a key component in the transportation of goods and people to and from southern Florida. Communities blossomed along its shores, bustling with commerce and recreational activities. Today it is tucked out of sight, hidden behind private single-family lots that adorn its shores. Limited public access remains available. Decades of wastewater and storm water runoff, in addition to other human interfering factors, have led to a degradation of the lake quality, altering the biological makeup of the species that reside there. While Winter Springs, Oviedo, and other surrounding communities pride themselves of the environmental tourism they have to offer, Lake Jesup is an amenity waiting to be rediscovered and used to its full potential. It has the opportunity to harness a new urban community typology that encourages a symbiotic relationship between people and nature in a contemporary society.

A mixed-use floating development on Lake Jesup can become a prototype community that instills environmental initiatives at the core of its design. It would not only be sensitive to the environmental challenges the lake possesses, but also seek to improve upon the lake's wellbeing by the sheer nature of its existence. The built environment can be used as a tool to extract the harmful chemicals in the lake through algae harvesting, removing unwanted invasive species for use as construction material, and creating emergent vegetation as a byproduct of both edible and non-edible floating gardens. The floating community has potential for economic sustainability as well, able to sell goods produced from the algae and floating gardens on-site. The unique informative and exploratory qualities of this mixed-use community would welcome visitors from both near and far. By reconsidering our inland waterways, such as Lake Jesup, as a viable resource for new development, we can transform the built environment as we know it, so that we may once again live in harmony with nature and reunite with our biophilic tendencies.

NOTES

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2011 FLORIDA LAKE MANAGEMENT SOCIETY 22ND ANNUAL CONFERENCE

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