

21st ANNUAL CONFERENCE OF THE FLORIDA LAKE MANAGEMENT SOCIETY

PROGRAM & PROCEEDINGS



“Exploring the Springs Coast”

**June 14-17, 2010
Plantation Inn
Crystal River, FL**



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.

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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.

Past recipients include: 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), and Ross Hamilton (2008), Not Awarded (2009).

The Edward Deevey, Jr. Award is given to an individual for contributing to our scientific 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.

Past recipients include: 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).

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.

Past recipients include: 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).

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).

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).

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.

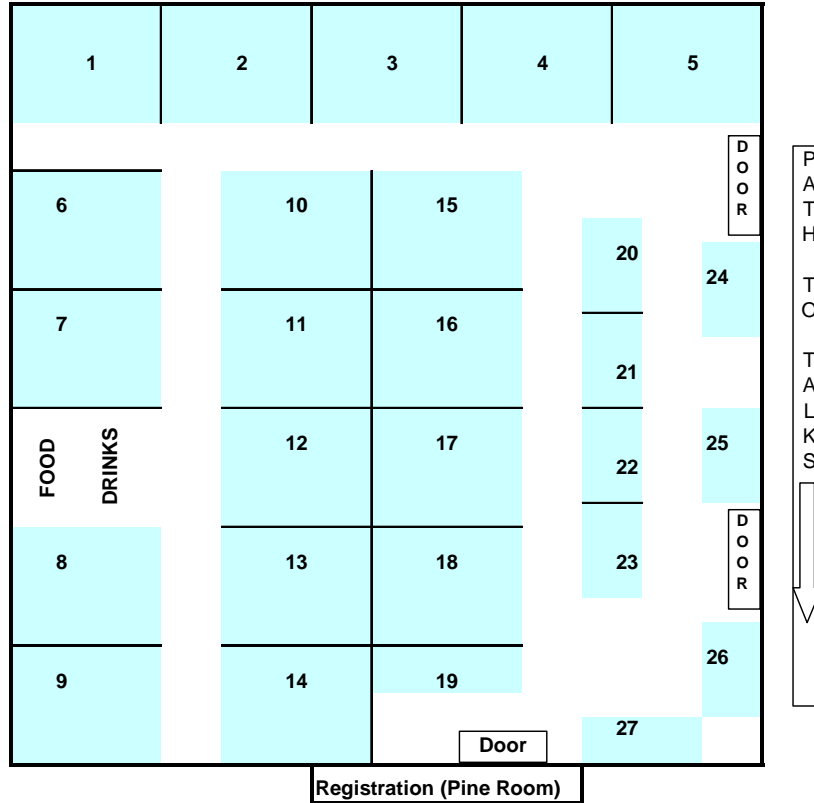
Past recipients include: Robert B. Rackleff and Debbie Lightsey (2001), Shannon Staub (2002), Cliff Barnes (2003), Senator Ken Pruitt (2005) and John Delaney and Senator Jim King (2006), Don Ross (2007), Cindy Meadows (2008), Not Awarded (2009).

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), Erich Marzolf (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).

Exhibitors

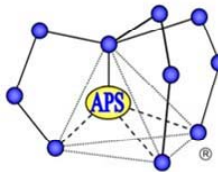
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Aquatic Vegetation Control, Inc. (AVC) is a Florida corporation founded in 1986 offering vegetation management and general environmental consulting services throughout the southeast. Since its establishment as an exotic/nuisance vegetation management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

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Arc Surveying & Mapping, Inc.

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. Recently Arc completed Bathymetric and Sediment Distribution Surveys of fifteen Lakes in the Tsala Apopka chain of lakes in Citrus County Florida. The survey, for Florida Wildlife & Fisheries Commission, required the identification of lake bottoms and the bottom of lake sediments. Specialized surveying technology was used to accurately survey lakes congested with aquatic growth. For more information visit our website www.arcsurveyors.com.

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BCI Engineers & Scientists, Inc.

BCI has been involved with the restoration, conservation, and management of Florida's aquatic resources for 30 years. Our experienced staff provide expertise in the following areas: ecological & environmental services; lake diagnostics & restoration; watershed management planning; flood prediction & mapping; hydrodynamic modeling; integrated ground & surface water modeling; water quality modeling; stream, lake, and wetland hydroecology; TMDLs; MFLs; stream assessment & restoration; ecosystem & statistical modeling; wetland delineation & mitigation planning; wetland assessment & restoration; biological assessments; database management; water quality & hydrologic monitoring; and stormwater services. Please visit www.bcieng.com for a complete description of our services and demonstrated experience.

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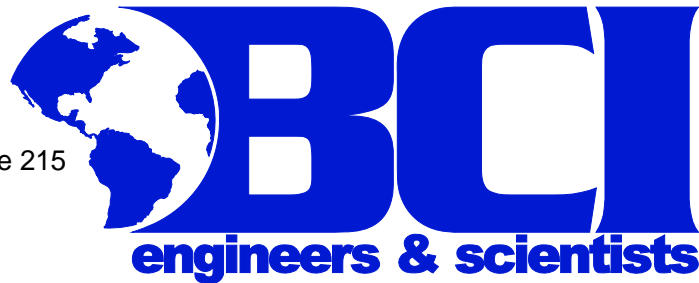
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For more information:

www.bluewatersatellite.com

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Environmental Consulting & Technology, Inc.

Environmental Consulting & Technology, Inc. (ECT), is a professional engineering and scientific services firm headquartered in Gainesville, Florida, with more than 210 personnel in 14 offices. These offices are located in Gainesville, New Smyrna Beach, Orlando, Jacksonville, Melbourne, Tampa, Fort Lauderdale, Tallahassee, and Fort Myers, Florida; Ann Arbor, Brighton, Detroit, and Clinton Township, Michigan; and New Castle, Delaware. ECT personnel have completed hundreds of water-related projects in Florida, which have resulted in a wealth of experience in all phases of engineering, sampling/monitoring, permitting, and planning. This experience has been gained from numerous projects involving studies of lakes, streams, spring and estuarine areas; evaluation of existing surface and stormwater systems and components; collection, analysis, and evaluation of water quality data; modeling and evaluation of urban and rural water resources using various in-house computer models; use of a GIS for mapping and cataloging of data; determination of basin and sub-basin watershed characteristics; development of pollutant loadings; wetland delineation and permitting, and design and development of mitigation systems; fishery studies; determination of water level impacts on ecological systems; identification of BMPs; evaluation of point and nonpoint sources; engineering evaluation and design of stormwater collection and distribution systems; implementation of comprehensive water quality monitoring systems; soil sampling; biological sampling; hydrologic/hydraulic modeling; hydric soil determinations; data management; development of TMDLs; preparation of grant applications and other documents to obtain funding for capital improvements; development of master stormwater plans for governmental agencies; and updating master stormwater plans on a continuing basis. ECT's key personnel have served as expert witnesses on many water resource engineering and permitting projects.



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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

21st ANNUAL FLORIDA LAKE MANAGEMENT SOCIETY CONFERENCE

Conference Theme: Exploring the Springs Coast

Plantation Inn, Crystal River, FL
June 14-17, 2010

FINAL PROGRAM

MONDAY - JUNE 14, 2010 – Workshops (Sabal A, B,C, D)

8:00 am-5:00 pm	Check-In and Registration (Magnolia – Pine Room)
8:00 am-8:30 am	MORNING REFRESHMENTS (Sabal)
8:15-11:45 am	Workshop 1: Water Quality Monitoring, Data Analysis and Interpretation. Harvey H. Harper, Ph.D., P.E. – President Environmental Research & Design, Inc.
8:15-11:45 am	Workshop 2: Application of the Lake Vegetation Index for Accurate Assessment, Part I (classroom). Russel Frydenborg and Nia Wellendorf, Florida Department of Environmental Protection.
8:15-11:45 am	Workshop 3: Where's the Money and How Do I Get It? Secrets of Successful Grant Writing. Sherry Brandt-Williams, Mary Brabham and Paul Haydt, St. Johns River Water Management District; Kelli Hammer Levy, Pinellas County; and Shannon Carter Wetzel, Seminole County
8:15-11:45 am	Workshop 4: Designing a Sediment Removal Project. Shailesh Patel, Dredging & Marine Consultants
12:00-1:00 pm	LUNCH (provided with full-day Workshop registration) (Sabal)
1:15-4:45 pm	Workshop 5: Application of the Lake Vegetation Index for Accurate Assessment, Part II (field)*. Russel Frydenborg and Nia Wellendorf, Florida Department of Environmental Protection (*requires Workshop #2 as a prerequisite)
1:15-4:45 pm	Workshop 6: Environmental Mapping with YSI's EcoMapper AUV. We all Love a Yellow Submarine. Brian Bendis, AMJ Environmental, Inc. and Matthew Previte, YSI/Services, Florida

* Indicates Student Presenter

TUESDAY - JUNE 15, 2010

8:00 am-4:00 pm	Check-In and Registration (Magnolia Conference Facility – Pine Room)
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7:00 am-8:30am	Breakfast (Plantation Room Restaurant)
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Sessions Sabal Conference Facility

8:00 - 8:20 am Opening Remarks: Kelli Hammer Levy – FLMS President and Program Chair
 Jim Griffin – FLMS Conference Co-Chair
 John Walkinshaw -- FLMS Conference Co-Chair

Session 1: Restoring Lake Jesup, A Hypereutrophic Central Florida Lake

Moderator: Sherry Brandt-Williams

8:20-8:40 am **The Lake Jesup Interagency Restoration Strategy Document and Basin Management Action Plan (BMAP) --** Sherry Brandt-Williams, Ed Lowe, Lawson Snyder, Jennifer Gihring, Erich Marzolf, Tiffany Busby, Marcy Policastro, John Abendroth, Samantha Budd, Regina Morse, and the Lake Jesup Technical Stakeholder's Group

8:40-9:00 am **Proactive Water Quality Implementation Process, Lake Jesup Basin, Seminole County, Florida –** Robert Walter and Mark Flomerfelt

9:00-9:20 am **Floating Island Treatment Systems (FITS): Phosphorus Removal From Organic-Rich Surface Water –** Treavor H. Boyer, Mark T. Brown, Sherry Brandt, Amar Persaud, Sam Arden, Poulomi Banerjee, R.J. Sindelar, and Pedro Palomino

9:20-9:40 am **Feasibility of Using Alum to Reduce Nutrient Loads to Lake Jesup –** Harvey Harper, Regina Morse, and Sherry Brandt-Williams

9:40-10:00 am **Nutrient Removal at Lake Jesup through Invasive Species Management: An Assessment of *Phragmites australis* –** Mary C. Boyd*, Mark T. Brown, and Sherry Brandt-Williams

10:00-10:20 am **Lake Jesup Cooperative Efforts: Vegetation Restoration--** Gloria Eby and Ed Hayes

10:20-10:40 am	MORNING BREAK (Magnolia – Exhibitor Hall)
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Session 2: Vegetation Management: Tools for Assessment and Monitoring

Moderator: John Walkinshaw

10:40-11:00 am **Quality Assurance for Use of the Florida Lake Vegetation Index –** Nia Wellendorf and Russel Frydenborg

11:00-11:20 am **Interspecific and Interseasonal Differences in Water Depth Distribution and Cover of Dominant SAV in the Lower St. Johns River –** Jennifer J. Sagan

11:20-11:40 pm **Update on Hydrilla Management in the Lakes of Winter Park and Maitland–**
Evaluation of Control Methods – Timothy Egan

11:40-12:00 pm **Use of Side Scanning Sonar Equipment to Image Physical Impacts of Recreational Boating on Seagrass Beds in Cockroach Bay, Florida –** David Eilers and Jim Griffin

* Indicates Student Presenter

TUESDAY – JUNE 15, 2010 (Continued)

12:00-1:00 pm	DELI BUFFET LUNCH (Palm Dining Room)
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Session 3: Hydrology and Nutrient Interactions

Moderator: Lawrence Keenan

1:00-1:20 pm	Control of Phytoplankton by Nitrogen and Phosphorus – Science and Semantics and Lake Management – <u>Michael Coveney</u>
1:20-1:40 pm	Seepage Pathways and Head Potentials at Lake Wimauma, Florida <u>Charles Fellows</u> , James Hirsch, Louis Motz, and Jill Hood
1:40-2:00 pm	Hydrologic Fluxes and Nutrient Regimes in Two Bayous of Western Choctawhatchee Bay – <u>Alison McDowell*</u> , Alexander Maestre, and Matthew Schwartz
2:00-2:20 pm	Water Quality Responses to Flow Variations in the Middle St. Johns River Basin: Lakes Harney, Monroe, and George – <u>Scott Wuitschick</u> and Gerold Morrison

2:20-2:40 pm	AFTERNOON BREAK (Magnolia – Exhibitor Hall)
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Session 4: The Results: Best Management Practices in Action Part I

Moderator: Mike Perry

2:40-3:00 pm	Efficacy of a Large-Scale Constructed Wetland to Remove Phosphorus and Suspended Solids From a Sub-Tropical Shallow Lake – <u>Ed Dunne</u> , Mike Coveney, Erich Marzolf, Victoria Hoge, Roxanne Conrow, Robert Naleway, Edgar Lowe, and Larry Battoe
3:00-3:20 pm	NuRF – The First Year – <u>Lance Lumbard</u>
3:20-3:40 pm	Geofilter Tube Technology Helps in Successful Restoration of Fish—Pocket Canal – <u>Sergio Duarte</u>
3:40- 4:00 pm	Nutrient Removal Evaluation of Suntree Technologies Curb and Grate Inlet Filter Baskets within Urban Residential Watersheds of Orange County, Florida – <u>Ron Novy</u> and Tim Lindsey

Session 5: Monitoring and Assessment -- Indicators of Change

Moderator: Jim Griffin

4:00- 4:20 pm	A Detailed Analysis of the Hillsborough River: The Application of Lake Assessment Techniques to the Assessment of River Reaches — <u>Jim Griffin</u> and David Eilers
4:20-4:40 pm	Factors Related to Warmouth (<i>Lepomis gulosus</i>) Biomass and Density in Florida Lakes — <u>David Watson</u> , Dan Willis, Mark Hoyer, and Dan Canfield
4:40-5:00 pm	A Review of Recent Wetland Findings Concerning Clam Shrimp and Fairy Shrimp Within a West-Central Florida Natural Area – <u>Jonathan Ipock</u> , Kym Rouse Campbell, Todd Campbell, Wayne Price, and D. Christopher Rogers

5:00-5:30 pm	FLMS Chapter Meetings (Sabal Conference Facility)
5:30-6:30 pm	POSTER SESSION (Magnolia – Pine Room)
6:30-8:30 pm	EXHIBITORS' SOCIAL (Magnolia – Exhibitor Hall)

* Indicates Student Presenter

TUESDAY – JUNE 15, 2010 (Continued)

Session 6: Poster Session (Magnolia – Pine Room)

- 5:30-6:30 pm **Dead on Arrival? A Fresh Look at Assumptions Regarding Impingement and Entrainment Mortality at Power Plants** – Judy Dudley, Ann Shortelle, Shannon McMorrow, and Joe Neese
- 5:30-6:30 pm **Water Quality Changes Following Nutrient Loading Reduction and Biomanipulation in Lake Griffin** – Walt Godwin, Rolland Fulton, and Brian Sparks
- 5:30-6:30 pm **A 20 Year External Phosphorus Budget For Lake Apopka, 1989-2008** – Vicki Hoge, Ed Dunne, and Mike Coveney
- 5:30-6:30 pm **Reclaimed Water in the Middle St Johns River Basin Watershed --** Sherry Brandt-Williams, Robert Godfrey, and Erich R. Marzolf
- 5:30-6:30 pm **Mapping Total Phosphorus Concentrations in Water Bodies Using LANDSAT TM and ETM+ Data --** Louis Sanderson, Robert K. Vincent, and Chip Tokar
- 5:30-6:30 pm **Coral diversity of nine natural reefs along Florida's Spring Coast --** Madison Hayes, Cole Kolasa, Brooke Liston, Morgan Liston, and Connor Waugh
- 5:30-6:30 pm **The Right Tool for the Right Place: Assessing The Use of Polyacrylamide in a Stormwater Pond --** Shannon Carter-Wetzel, Cayden Lawne, Matt Rayl, and Zynka Perez

6:30-8:30 pm	EXHIBITORS' SOCIAL (Magnolia – Exhibitor Hall)
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WEDNESDAY - JUNE 16, 2010

8:00 am-3:00 pm Check-In and Registration (Magnolia Conference Facility Pine Room)

7:00 am-8:00 am Breakfast (Plantation Room Restaurant)

Sessions Sabal Conference Facility

Session 7: Watershed Management: Results and Recommendations

Moderator: Shannon Carter-Wetzel

8:00-8:20 am **Sustainable Stormwater: Maximizing Your Low-Cost Resources** – Shannon Carter-Wetzel, Kim Ornberg, and Ann Shortelle

8:20-8:40 am **Integrated Water Management for Multiple Benefits – The Peace Creek Watershed** – Mike Britt

8:40-9:00 am **Use of Reclaimed Water to Offset Fertilizer Applications: A Cost Effective Pollution Prevention Management Practice?** – Erich Marzolf

9:00-9:20 am **Copper Impairment in Florida Waters: An Ounce of Prevention and Pounds of Cures** – Ann Shortelle and William Tucker

9:20-9:40 am **Ploidy of Grass Carp (*Ctenopharyngodon idella*) in the Suwannee River, Florida** – Bruce Jagers, Joe Hinkle, and Allen Martin

9:40-10:00 am **Restoration of Lake Holden: A True Success Story Using a Multi-Faceted Approach to Nutrient Load Reductions** -- Harvey Harper and Brian Cananzaro

10:00-10:20 am	MORNING BREAK (Magnolia – Exhibitor Hall)
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Session 8: Potential Methods to Develop Site Specific Alternative Nutrient Criteria for Lakes

Moderator: Kelli Hammer Levy

10:20-10:30 am **Introductory Remarks:** Russell Frydenborg

10:30-10:50 am **What Determines Nutrient Concentrations in Florida Lakes: Natural Factors or Human Activities?** – Dana Bigham*, Roger Bachmann, Mark Hoyer, and Dan Canfield

10:50-11:10 am **What is the Best Way to Set Nutrient Standards for Florida Lakes?** – Roger Bachmann, Dana Bigham, Mark Hoyer, and Dan Canfield

11:10-11:30 am **Challenges Associated with the Development of Site Specific Alternative Criteria for the Winter Haven Chain of Lakes** – David Tomasko

11:30-11:50 am **Using the Morphoedaphic Index, Water Color, and Compensation Depth to Develop Numeric Nutrient Criteria for Lakes** – Ed Lowe, John Hendrickson, Larry Battoe, and Mike Coveney

12:00-1:30 pm	BANQUET LUNCH/FLMS ANNUAL MEETING (Palm Dining Room)
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* Indicates Student Presenter

WEDNESDAY - JUNE 16, 2010 (Continued)

Session 9: Monitoring and Assessment of Florida's Aquatic Resources Part I

Moderator: David Evans

- 1:30-1:50 pm **Mapping Changes in Woody Vegetation Cover Over the Choctawhatchee Bay Area and Its Subsequent Effects on Water Chemistry of the Estuary System** – Jenney Kellogg Lazzarino* and Julia Terrell
- 1:50-2:10pm **Lake Morphology: Application of Spatial Analysis to Better Manage and Understand Lake Morphologic Data** – Jim Griffin and David Eilers
- 2:10-2:30 pm **Quantification of Seagrass Abundance in Choctawhatchee Bay, Florida Using Lansat TM Imagery** – Jenney Kellogg Lazzarino and Julia Terrell
- 2:30-2:50 pm **Seagrass Communities of Florida's Springs Coast - A comparison of the 1985, 1999, and 2007 Maps and Coverages** – Keith Kolasa
- 2:50-3:10 pm **Calibration of Three Florida Biological Indices Using the Biological Condition Gradient Approach** – Russell Frydenborg
- 3:10- 3:30 pm **Effects of a Catastrophic Forest Fire on the Trophic Parameters of an Outstanding Florida Water** – Ivelisse Ruiz-Bernard* and Dan Canfield

3:30- 3:50 pm	AFTERNOON BREAK (Magnolia – Exhibitor Hall)
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Session 10: Techniques and Tools for Water Quality Assessment

Moderator: John Walkinshaw

- 3:50-4:00pm **Water Quality Modeling of Lake Jesup Using QUAL2k: Part IV—Return of the Secchi** – Scott Lowe, Kim Ornberg, and Mark Flommerfelt
- 4:00-4:20 pm **Designing a Dynamic Data Driven Application System for Estimating Real-Time Load of DOC in a River** – Ying Ouyang
- 4:20-4:40 pm **The Southwest Florida Water Management District's Ambient Lakes Monitoring Network: Using Florida Lake Regions to Define Expected Water Quality in Lakes** – Chris Barnes*
- 4:40– 5:00 pm **The Relationship Between Land Use and Stormwater Quality in a Phosphate Rich Watershed in North Central Florida—**Jian Di and Erich Marzolf

5:00-5:30 pm	FLMS BOARD MEETING (Sabal)
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* Indicates Student Presenter

THURSDAY - JUNE 17, 2010

7:00 am-8:15 am Breakfast (Plantation Room Restaurant)
10:00 am-12:00 noon Exhibitor Breakdown

Sessions Sabal Conference Facility

Session 11: Monitoring and Assessment of Florida's Aquatic Resources Part II

Moderator: Kym Rouse Campbell

8:15-8:35 am **Use of Pressure-Sensing Data Loggers to Estimate Stormwater Runoff and Other Water Budget Components** – Charles Fellows, James Hirsch, Louis Motz, and Jill Hood

8:35-8:55 am **Rating Improvement and Uncertainty Analysis for Flow at G381B_C and G381E_C of Stormwater Treatment Area 3/4** – Kwaku Oben-Nyarko and Jing-Yea Yang

8:55-9:15 am **The Effects of Salinity Pulses on Submerged Aquatic Vegetation in the Lower St. Johns River** -- Jennifer Tallerico, Dean Dobberful, and Mallarie Yeager

9:15-9:25 am **Florida Lakewatch's Role in the Florida Long-Term Monitoring Project** – Jason Bennett and Mark Hoyer

9:25-9:45 am	MORNING BREAK (Magnolia – Exhibitor Hall)
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Session 12: The Results: Best Management Practices in Action Part II

Moderator: Lawrence Keenan

9:45-10:05 am **How to Combat the Detrimental Effects of Eutrophication, Control Algae Blooms, and Meet Water Quality Standards** – Seva Iwinski

10:05- 10:25 am **Evaluation of Stormwater Pond Functionality Through Alternative Designs for Ecosystem Facilitation** – Zachary Marimon*

10:25- 10:45 am **Lake Jackson Shoreline Restoration** – Erin McCarta

10:45-11:05 am **Nutrient Reduction and Oxygenation in a South Florida Retention Pond Using Artificial Destratification Aeration** – Amanda Quillen

11:05- 11:25 am **A Simple Approach for the Removal of Oil, Gas, and other Hydrocarbons from Stormwater Runoff** – Jiexuan Luo*

11:25-11:45 am **Student Awards and Concluding Remarks:** Shannon Carter-Wetzel, FLMS President 2010-2011

12:00	CONFERENCE ADJOURNED
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* Indicates Student Presenter

SESSION 1

RESTORING LAKE JESUP, A HYPEREUTROPHIC CENTRAL FLORIDA LAKE

THE LAKE JESUP INTERAGENCY RESTORATION STRATEGY DOCUMENT AND BASIN MANAGEMENT ACTION PLAN (BMAP)

Sherry Brandt-Williams¹, Ed Lowe¹, Jennifer Gihring³, Lawson Snyder², Erich Marzolf¹, Ed Hayes², Tiffany Busby⁴, Marcy Policastro⁴, John Abendroth³, Samantha Budd³, Mary Brabham¹, Regina Morse¹, and the Lake Jesup Technical Stakeholders Group⁵

¹St Johns River Water Management District, Palatka, Florida

²Florida Fish and Wildlife Conservation Commission

³Florida Department of Environmental Protection, Tallahassee, Florida

⁴Wildwood Consulting, St. Augustine, Florida

⁵Seminole County; Orange County; Cities of Orlando, Sanford, Winter Park, Maitland, Cassleberry, Lake Mary, Winter Springs, Oviedo, Longwood, and Altamonte Springs; Seminole County Soil and Water Conservation Service, Sierra Club Central Florida Chapter and the Friends of Jesup

The Florida Department of Environmental Protection (FDEP) adopted a Total Maximum Daily Load (TMDL) for nutrients (Total Phosphorus TP and Total Nitrogen TN) for Lake Jesup in August 2006. A Basin Management Action Plan (BMAP) process was started immediately, but a list of uncertainties that the stakeholders were not comfortable with and the high cost of most restoration projects was leading to long discussions about the right way to restore Lake Jesup.

In an effort to keep Lake Jesup restoration moving forward, the Executive Director of the St. Johns River Water Management District (SJRWMD) called upon FDEP and the Florida Fish and Wildlife Conservation Commission (FWC) to compile a collaborative report recommending a restoration strategy for Lake Jesup. The report needed to combine input from stakeholders and all three agencies and be approved as a document that would provide guidance on timing and criteria for all restoration efforts. Michael Sole, Secretary (FDEP), Ken Haddad, Executive Director (FWEC) and Kirby Green, Executive Director (SJRWMD) signed this paper in January, 2008. This document provides an overall strategy for restoration and some recommendations on regional projects that provide low cost nutrient treatment.

The BMAP document, directed by the FDEP, provides detailed summaries of TP allocations and reductions required from all municipalities, counties and other entities. Each stakeholder with a reduction has provided a list of projects that will meet the first of three increments of reduction allowed by FDEP. The BMAP for Lake Jesup was accepted by the Lake Jesup Working Group in its final draft in early 2010.

This presentation provides an overview of each document, a review of the water quality in Lake Jesup and the future restoration plans for the lake. This provides a foundation for the five restoration presentations making up the rest of this special session.

NOTES

PROACTIVE WATER QUALITY IMPLEMENTATION PROCESS LAKE JESUP BASIN, SEMINOLE COUNTY, FLORIDA

Robert Walter, P.E.¹ and Mark Flomerfelt, P.E.¹

¹Seminole County Engineering, Sanford, Florida

Lake Jesup is listed as a high priority impaired water body for nutrients and unionized ammonia by the Florida Department of Environmental Protection (FDEP). In 2005, FDEP published the total maximum daily load (TMDL) for Lake Jesup, which requires a 52 percent reduction in total nitrogen and a 37 percent reduction in total phosphorus. Achieving this target will require many water quality retrofit projects. Seminole County has collaboratively worked with other basin stakeholders to develop a basin management action plan (BMAP) to address these pollutant load reductions.

As a proactive measure, Seminole County has worked with the water management district, and state and federal governments to design and construct several major retrofit projects on shore and tributaries of Lake Jesup. Navy Canal Regional Stormwater Facility (RSF) and the Cameron Ditch RSF are located along the north shore of the lake. Cassel Creek RSF, Red Bug/Deer Run Outfall RSF, Howell Creek Tributary, and Howell Creek Erosion Control Project are along the lake's main tributary, Howell Creek. These facilities were designed to reduce pollutant loads to Lake Jesup. In conjunction with the construction of these facilities, the County will be implementing a water quality monitoring program to evaluate the pollutant removal efficiency of several of these facilities. This paper will present an overview of these projects from concept to implementation as well as other water quality improvement initiatives being implemented by the County and their role in improving water quality in the community.

NOTES

FLOATING ISLAND TREATMENT SYSTEM (FITS): PHOSPHORUS REMOVAL FROM ORGANIC-RICH SURFACE WATER

*Treavor H. Boyer¹, Mark T. Brown¹, Sherry Brandt², Amar Persaud¹, Sam Arden¹,
Poulomi Banerjee¹, R.J. Sindelar¹, Pedro Palomino¹*

¹University of Florida, Gainesville, Florida

²St Johns River Water Management District, Palatka, Florida

The goal of this work is to improve surface water quality by removing phosphorus (P) from tributaries that drain into lakes. This will be accomplished by a floating island treatment system (FITS) that combines biological and physical-chemical treatment. The FITS is organized with the biological component first and the physical-chemical component second to maximize synergies between the biology and chemistry. The biological component is designed as 4 parallel wetland linear treatment cells and 4 vertical biofilters. The wetland linear treatment cells contain emergent macrophytes and vetiver grass grown in plastic substrate. The vertical biofilters contain edible plants. The physical-chemical component is composed of 2 up-flow vertical fluidized treatment columns. Both waste byproduct materials, such as alum and ferric sludge from water treatment plants, and commercial ion exchange resins are being tested. The FITS is constructed on a floating framework, powered by solar panels and marine batteries, and operates for approximately 12 hr/day. The influent to FITS is a blend of lake water and treated water so as to achieve the desired influent P concentration. Samples are collected after each stage of treatment and analyzed for total P, orthophosphate, pH, turbidity, total nitrogen, nitrate, chloride, sulfate, ultraviolet absorbance, and dissolved organic carbon. The project is divided into two phases: (i) Proof of Concept and (ii) Optimization. The Proof of Concept phase is complete and the Optimization phase will be conducted during Spring/Summer 2010. This presentation will highlight results from the Proof of Concept phase and discuss ongoing work related to the Optimization phase.

NOTES

FEASABILITY OF USING ALUM TO REDUCE NUTRIENT LOADS TO LAKE JESUP

Harvey Harper¹, Regina Morse² and Sherry Brandt-Williams²

¹Environmental Research and Design, Orlando, Florida

²St Johns River Water Management District

In 2008, three Florida agencies (SJRWMD, FDEP and Florida Fish and Wildlife Conservation Commission [FWC]) adopted a restoration strategy that lists potential regional treatment projects for TP reduction (Lake Jesup Interagency Restoration Strategy 2008). This pilot project is one of several that are being evaluated as part of a feasibility study comparing all potential projects. There were three main objectives:

- 1) To complete all necessary jar tests required to provide the basis for determining alum application rates specific to Lake Jesup and its tributaries;
- 2) To determine the feasibility of a conceptual plan that uses alum treatment administered from as few control sites as possible (eg. minimizes land acquisition and capital costs), but provides between 4 and 6 metric tons TP reduction overall from tributary inputs to Lake Jesup with no flocculant or alum residual reaching Lake Jesup; and
- 3) To determine the economic feasibility of the plan by estimating the cost of capital, operation and maintenance of the proposed plan using 20 years as project life.

This presentation provides initial results from a feasibility study evaluating the use of alum as a nutrient reduction process.

NOTES

NUTRIENT REMOVAL AT LAKE JESUP THROUGH INVASIVE SPECIES MANAGEMENT: AN ASSESSMENT OF *PHRAGMITES AUSTRALIS*

Mary C. Boyd¹, Mark T. Brown¹, and Sherry Brandt-Williams²

¹University of Florida, Gainesville, FL

²St Johns River Water Management District

Phragmites australis (Cav.)Trin. ex Steud. (common reed) is a native, perennial wetland plant which exists as a dominant species in the littoral zone of Lake Jesup. Occupying at least 250 acres of wetland area as a near monoculture, *Phragmites australis* forms the boundary between the waterbody and the adjacent wetland and upland communities. Due to the species' high rate of above- and below-ground productivity and nutrient uptake, the potential for phosphorus (P) removal through *Phragmites australis* stand harvest was investigated as an adaptive management strategy to aid in restoring Lake Jesup to Class III water quality standards through the reduction of external P loading and in-lake P storage. Biomass production, P storage in aboveground biomass, and stand translocation, or the intra-plant movement of nutrients, were assessed monthly at a *Phragmites australis* stand to determine the expected mass removal of P through harvest and the appropriate timing of harvest within the growing season to maximize P removal and sustain stand regrowth. Preliminary results show a substantial increase in both aboveground biomass (g) and P concentration (mg P/kg biomass) between August and October, after which P concentration and P mass (g/m²) remain constant through January at 1515.2 mg/kg and 1.8 g/m², respectively. Harvest would capitalize on P present in aboveground living biomass as well as standing dead stems, retained over multiple growing seasons. Expected mass P removal, including living and dead stand components, at peak P concentration is 18.9 lbs/acre. P concentrations for belowground biomass steadily increased over fall and winter months indicating uptake to support the 2010 growing season. Harvest experiments were also performed in September (09/29/2009) and December (12/02/2009) to assess regrowth and nutrient uptake post-harvest. While P storage in regrowth was high for both harvest dates, regrowth itself was suppressed by winter temperatures following the December harvest.

NOTES

LAKE JESUP COOPERATIVE EFFORTS: VEGETATION RESTORATION

Gloria Eby¹ and Ed Hayes²

¹Seminole County Lake Management Program, Sanford, FL

²Florida Fish and Wildlife Conservation Commission, Eustis, FL

Lake Jesup is the largest and most eutrophic lake (historic average TSI; 80) in Seminole County, Florida. It is located on a tributary of the St. Johns River and is prone to frequent algal blooms and fish kills resulting from decades of poor management practices. The Florida Department of Environmental Protection (FDEP) identified Lake Jesup to be impaired by nutrients and un-ionized ammonia, and in 2006, adopted Total Maximum Daily Loads (TMDLs) for total phosphorus ([TP] 0.096 mg/L) and total nitrogen ([TN] 1.27 mg/L) for the lake. The Basin Management Action Plan (BMAP) represents the joint efforts of multiple stakeholders to prepare a restoration plan for Lake Jesup to implement the adopted TMDL. This BMAP (currently in its final draft) includes prioritized projects to limit external phosphorus loading into the lake and concurrent research projects to guide effective long-term restoration efforts.

In conjunction with these identified BMAP efforts/projects, Seminole County Lake Management Program is additionally focusing on in-lake activities for Lake Jesup, such as vegetation and habitat quality and restoration. As cooperators with the Florida Fish and Wildlife Conservation Commission (FWC) Aquatic Habitat Restoration Enhancement (AHRE) Program, a series of in-lake restoration projects has been initiated which targets invasive species and shoreline enhancement within a *Phragmites* dominant community of Lake Jesup.

Additionally, in July 2007, a baseline vegetation survey was conducted with interagency cooperation (FDEP, FWC, SJRWMD) in efforts to track BMAP projects and in-lake changes and again in May, 2010 for comparative analysis.

This paper will discuss these various vegetation restoration projects as cooperative efforts in and around Lake Jesup.

NOTES

SESSION 2

VEGETATION MANAGEMENT: TOOLS FOR ASSESSMENT AND MONITORING

QUALITY ASSURANCE FOR USE OF THE FLORIDA LAKE VEGETATION INDEX

Nia Wellendorf and Russel Frydenborg

Florida Department of Environmental Protection, Tallahassee, FL

The Florida Department of Environmental Protection (DEP) developed the Lake Vegetation Index (LVI) to assess the biological condition of aquatic plant communities in Florida lakes. This presentation will describe key quality assurance measures in the DEP standard operating procedures (SOPs) and the LVI Primer. The LVI sampling method is outlined in DEP SOP FS 7220 (DEP-SOP-001/01, effective 12/3/08). The LVI Primer is a guidance document that will soon be proposed for incorporation into the SOPs. The purpose for sampling should be established and understood by samplers and data users, and the data should be used in accordance with the sampling purpose.

Adequate knowledge of aquatic and wetland plant species is a critical component of LVI quality assurance. All sampling entities should employ a plant ID quality control (QC) program, such as the recommended QC exercise in SOP LQ 7310, in which a sampler must show that s/he can correctly identify 90% of plant taxa in the LVI sample. Any team submitting data to DEP must participate in and pass a field team proficiency test annually, per SOP FA 4330. For this test, the team will conduct a LVI assessment at one “benchmark” lake at which a consensus LVI score has been designated by the DEP, and the team score must be within +/- 12 points of the consensus score. These benchmark lakes are established each year in three locations statewide and announced on the Quality of Science Newsletter (to receive these announcements, sign up at <http://www.dep.state.fl.us/labs/bars/sas/training/listserv.htm>). Find plant identification resources, training presentations, and information about mounting plant specimens and maintaining your herbarium at <http://www.dep.state.fl.us/water/bioassess/plantid.htm>.

LVI sampling should only be conducted when conditions are favorable for an accurate assessment of the lake under usual conditions, unless the purpose of the study is to determine the effects of an unusual condition on the plant community. Abort sampling during extreme high or low water events, or when there is insufficient access to all parts of the lake. Dominant taxa should be selected wherever possible, and should reflect dominance based on surface area covered.

Upland taxa should not be included in the assessment. Samplers should assess plants that occur in the lake and up to the seasonal high water level as defined in 62-340.200(15), Florida Administrative Code (F.A.C). A species should not be included in the LVI assessment if it is not defined as aquatic, obligate (OBL), facultative wet (FACW), or facultative (FAC) in 62-340, F.A.C. (some exceptions are listed in the LVI Primer). Information about Florida wetland status of species is easily accessible at the Institute for Systematic Botany Atlas of Vascular Plant website (<http://www.plantatlas.usf.edu>).

Samplers should closely adhere to SOPs and the LVI Primer.

DEP SOPs: <http://www.dep.state.fl.us/labs/bars/sas/sop/index.htm>

LVI Primer: <http://www.dep.state.fl.us/labs/bars/sas/training/index.htm>

NOTES

INTERSPECIFIC AND INTERSEASONAL DIFFERENCES IN WATER DEPTH DISTRIBUTION AND COVER OF DOMINANT SAV IN THE LOWER ST. JOHNS RIVER

Jennifer J. Sagan

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Submerged aquatic vegetation (SAV) colonizes approximately 2140 acres corresponding to the mesohaline/oligohaline and freshwater sections within the Lower St. Johns River (LSJR). Ten species of freshwater and brackish angiosperms as well as charophyte genera were routinely seen along the littoral shelves of the LSJR during field surveys. *Ruppia maritima* was the only halophyte present within the river. *Vallisneria americana*, *Najas guadalupensis* and *R. maritima* were the dominant species in the system, accounting for 67%, 16% and 8%, respectively, of total SAV cover. The objective of the study was to investigate 1) year-round interspecific maximum water depth distribution and 2) inter-seasonal differences in maximum water depth distribution for each species. In addition, within-bed distribution of these species was obtained. Four years of fall, winter, spring, and summer data were included from fall 2000 through summer 2004 corresponding to periods ranging from drought conditions to above-normal precipitation.

Significant differences in year-round maximum water depth distribution were found as follows: *V. americana* > *N. guadalupensis* > *R. maritima*. Inter-seasonal water depth analysis indicated that seasonal in-bed water depth was significantly different. The greatest water depth occurred in the fall followed by summer; water depths were the shallowest in the winter and spring. *V. americana* and *N. guadalupensis* showed a similar seasonal trend. Both colonized a greater water depth in the fall than in either the winter or spring. *R. maritima* showed no differences in seasonal water depth distribution. Distribution of the SAV species throughout the bed showed some general trends. *V. americana* was distributed throughout the bed, occurring in mixed near-shore zones along with *N. guadalupensis* and *R. maritima*, often at 100% cover, while it dominated the outer and deep-water sections of the bed. *N. guadalupensis* had the next greatest distribution, often co-occurring with *V. americana* but often at a much reduced percent cover. *R. maritima* had the most restricted distribution, inhabiting the shallowest near-shore third to half of the bed and with cover usually below 50%.

Investigating seasonal differences in SAV distribution is useful for a variety of reasons. Like most systems, water quality parameters follow seasonal patterns which shape SAV growth and distribution into distinct temporal patterns. This is an important feature of seasonality that should be considered before grouping yearlong survey data together and comparing sites or yearly data. In addition, interseasonal differences in water depth and bed cover for these species have implications for potential water withdrawal effects and might guide management decisions regarding the timing of withdrawals.

NOTES

UPDATE ON HYDRILLA MANAGEMENT IN THE LAKES OF WINTER PARK AND MAITLAND – EVALUATION OF NEW CONTROL METHODS

Timothy J. Egan
City of Winter Park, Florida

The City of Winter Park is in the process of developing new hydrilla control methods integrating biological controls, contact and systemic herbicides and mechanical removal. Prior to 2004, the management of hydrilla (*Hydrilla verticillata*) on the Lakes in Winter Park and Maitland consisted of periodic (3 to 8 year intervals) whole lake treatments using fluridone, followed by as needed spot treatments using endothall. Under this treatment regime, hydrilla coverage was maintained below 10% on most lakes. During fluridone treatments in 2005, resistance of hydrilla to the herbicide was observed in several lakes. By 2007, the cost of controlling hydrilla on the Chain of Lakes using herbicides alone had more than tripled. In an effort to reduce costs and improve control, Winter Park began evaluating other methods including biological controls. Between 2006 and 2008 Winter Park worked with the Florida Fish and Wildlife Conservation Commission (FWC) to permit and stock triploid grass carp (TGC) in the eight area lakes at rates ranging from 0.5 to 2.5 fish per acre. The impact of the TGC stockings on the need for further herbicide treatments varied from lake to lake and appeared to depend on the level of initial control achieved by the chemical treatments. Herbicide treatments for hydrilla control in Lakes Killarney, Virginia, and Mizell have been reduced to levels below what they were prior to the fluridone resistance problem. In Lakes Osceola and Berry, hydrilla regrowth and subsequent treatments have been comparable to pre-fluridone resistance levels. As of August, 2009, regrowth in Lakes Baldwin, Maitland and Minnehaha was still above desired levels and frequent herbicide treatments were still required to keep hydrilla off the surface in large areas of the lakes.

In effort to bring Lakes Baldwin, Maitland and Minnehaha under the desired level of control, whole lake, low dose endothall treatments combined with additional grass carp stockings were planned and coordinated through FWC. In December of 2009, all three low dose endothall treatments were performed. In January of 2010, an additional 0.5 TGC were stocked per acre in Lakes Baldwin and Minnehaha. An additional 0.75 fish per acre was added to Lake Maitland. The range of overall stocking rates on these lakes did not exceed 1.5 fish per acre. Results on the three lakes recently treated and restocked are still being evaluated. Winter Park, Maitland and FWC are currently monitoring the three lakes to determine if any follow up treatments are needed and frequent hydrilla surveys will be ongoing to determine the efficacy of the current control strategies.

NOTES

USE OF SIDE SCANNING SONAR EQUIPMENT TO IMAGE PHYSICAL IMPACTS OF RECREATIONAL BOATING ON SEAGRASS BEDS IN COCKROACH BAY, FLORIDA

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The recreational and commercial boating industry has a major economic impact in Tampa Bay, Florida whether it is recreational and commercial fishing or pleasure boating and eco-tours. Essential to many of these activities are the nearshore seagrass meadows and associated organisms which use the areas for foraging, shelter, and reproduction including Sea Turtles, Manatee, dolphin, several species of wading birds and many of the commercially important species of fish, crustaceans and shellfish. However, this economic impact comes at a price to this essential habitat. Often inexperienced boaters and those who are not familiar with the local bathymetric conditions will severely damage seagrass beds by operating their vessels in shallow water, resulting in linear troughs through the seagrasses and sediments from the propellers. These barren scars are clearly visible from aerial imagery near the mouths of bays and estuaries of Tampa Bay.

With the importance of this habitat and its ongoing degradation comes the need to monitor and restore them to the best of our abilities. Implementing current low-cost technological advances in user friendly side scanning sonar and bathymetry units allows for researchers to document and monitor these features when conditions such as low visibility or time\personnel constraints exist.

In a preliminary study during October 2009, in conjunction with Hillsborough County Environmental Protection Commission, we used a Hummingbird model 797c2 equipped with an 83kHz, 200kHz and 455kHz transducer (the 455kHz is the side scanning part of the unit). The unit has been “custom mounted” on a Manta Ray 10’ sit on top kayak using the drain holes and a pvc structure to hold the display units, fathometers, and GPS receivers. This mount also incorporates the Lowrance LCX 28CHD bathymetry unit (50kHz and 200kHz transducer) that Florida Center staff has used for mapping and submerged vegetation analysis (percent area covered and percent volume infested) in Hillsborough County lakes since 2005. In addition the kayak has been modified to include a trolling motor mount and remotely mounted battery supplies. We then ran preset transects along the mouth of Cockroach Bay to compare the findings of the equipment to the results from the divers along the same transects. The results of the test showed that the equipment was successful at imaging the scar features in varying environmental conditions such as low visibility, which is common in the area.

As part of this cooperative study the same transects were monitored again in April of 2010 for several aspects of seagrass bed health including scar features present, species present along scar, species recruitment in scar feature, short shoot counts, canopy height and epiphytes present (performed by EPC staff by direct observation). In addition the side

scanning sonar was utilized for present and absence of seagrass scars. Once again the side scanning sonar proved to be a valuable rapid assessment tool for the identification of seagrass scar features. The units showed moderate success with the identification of these features in the presence of drift algae which the divers had missed due to the abundance of algae.

After field collection the images are displayed in ArcGIS and hyper linking of the images to the data points is performed for comparison of scar abundance along the transects over time. The results showed that some of the scar features that were documented in 2009 were no longer present in 2010 due to recruitment from neighboring seagrass beds and the accompanied sedimentation of the scar trough. This rate of recruitment was highest in *Halodule* dominated beds and lowest in *Thalassia* dominated areas. In addition new scar features were documented along the transects.

The primary benefits of utilizing this technology is to reduce field staff time, provide a permanent image of the feature and improve data collection in challenging environmental conditions.

NOTES

SESSION 3

HYDROLOGY AND NUTRIENT INTERACTIONS

CONTROL OF PHYTOPLANKTON BY NITROGEN AND PHOSPHORUS – SCIENCE AND SEMANTICS AND LAKE MANAGEMENT

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Whether reduction in phosphorus (P) alone should be sufficient to reduce growth of phytoplankton in eutrophic lakes is an old question that has seen substantial discussion recently and some controversy. Opponents argue that both nitrogen (N) and P must be reduced. The thesis of my presentation is that the “P vs N & P” controversy encompasses both important scientific and management issues and issues that are semantic as much as scientific. My goal is to distinguish between these two categories and to clarify the semantic disconnects. A focus on the remaining scientific and management issues might make the discussion more manageable and more useful to lake managers. I will illustrate my points with references to some of the excellent, and voluminous, work already published.

Some prerequisites need to be assumed for discussion. I will start with the following statements that I believe would be accepted by proponents on both sides of the debate:

- Phytoplankton require P, and all taxa compete for the same sources
- Phytoplankton require N. All taxa use dissolved N compounds, but only N₂-fixers (for example, some cyanobacteria) can access the additional source of N₂-gas
- Numerous genera of freshwater cyanobacteria and some brackish and marine forms are N₂-fixers
- N₂-fixation alleviates but does not always eliminate N limitation in meso- and eutrophic freshwater phytoplankton

There sometimes are large semantic discrepancies when published work is used and cited. Authors know what they mean and mean what they say. However, work sometimes is cited to support something else altogether, or caveats and qualifying statements are dropped. Important examples of semantic problems that I will discuss are

- Whether “nutrient limitation” refers to nutrients that limit phytoplankton under existing conditions or nutrients that should be restricted to reduce production below existing levels
- Whether the issue is eutrophication of a fresh-water body alone or includes the downstream eutrophication of estuarine and coastal waters
- Whether a reduction in external P loading equates to a reduction in P availability to phytoplankton
- Whether one refers to meso- and eutrophic lakes or generalizes to all lakes

Lake managers can minimize these problems by clear definition of the scope of eutrophication control projects and by accurate use of other authors’ work.

Furthermore, a number of scientific and management questions are important in understanding whether reduction in external loading of P alone or N & P is necessary to control eutrophication. My “short list” of questions to discuss here includes the following:

General

- Can N₂-fixation alleviate N limitation in estuarine and coastal phytoplankton communities?
- Do N₂-fixing cyanobacteria utilize P as efficiently as non-N₂-fixing phytoplankton?

Specific for a water body

- Will reduction in external P loading reduce P availability to the phytoplankton?
- Are blooms of N₂-fixing species preferable to blooms of non-N₂-fixing species?

My conclusion is that there is good support for reduction in external P loading alone to reduce phytoplankton biomass in lakes, even in literature that sometimes is cited for opposing views. If downstream N loading is not an issue, I would apply this conclusion generally to meso- and eutrophic lakes if I can conclude that reduction in external P loading will reduce P availability.

Since many lakes are part of drainage systems where downstream loading is a problem, upstream N loading may need control. In that case, N loading is reduced to improve downstream conditions and not because a lake restoration project otherwise would fail.

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NOTES

SEEPAGE PATHWAYS AND HEAD POTENTIALS AT LAKE WIMAUMA, FLORIDA

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Lake Wimauma is one of the few natural lakes in southeast Hillsborough County. Over decades, it has displayed a wide range of surface elevations and establishing a minimum level for this lake is complicated because potential impacts from Floridan Aquifer drawdown are difficult to determine. The objective of this project was to investigate the hydrology of Lake Wimauma and compare it to another nearby lake, Carlton Lake, to gain insight into the factors affecting and/or controlling lake water level fluctuations. Of particular interest was the evaluation of the possible hydraulic interconnection between lake water and underlying aquifers, e.g., the Floridan Aquifer, through breaches in the intermediate confining layer.

During this 16-month investigation, Lake Wimauma was divided into two separate pools. The lake surface of the East Pool was generally four to five feet above the elevation of the West Pool. A land bridge of approximately 75 yards separated the two pools.

Seepage meters were constructed from 55-gallon steel drum ends, rubber stoppers, rigid tubing, ball valves, and very flexible gallon plastic bags. For each meter, seepage flow was calculated as L/m^2 -day. Placement and use procedures were generally consistent with methods described by Fellows and Brezonik (1980).

Placement strategy for seepage meters considered geophysical anomalies, water level elevation difference between pools, sediment type and thickness, and, once acquired, seepage and piezometer data. Near-shore seepage, which relates the lateral flow of water between the surficial aquifer and the water body, was measured in both pools. For the West Pool, with more discernable geophysical anomalies, seepage was divided into two water budget components, also measuring far-shore seepage which was driven by head difference between the lake and underlying aquifers.

Seepage always was found to flow into the West Pool at the land bridge and usually flowed out of the West Pool along the western shore. Seepage at the near-shore stations on the north and south shores of the West Pool initially showed inflows to the lake but these flows reversed toward the end on the investigation. Seepage flowed into the East Pool more often than it was found to recharge the groundwater. Near-shore seepage values were calculated on a "liters per meter of shore per day" basis, using the flow at each meter and accounting for distances between meters or the shore. A specific length of shoreline was assigned to each station.

Far-shore seepage measurements generally were made at locations beyond the farthest extent of near-shore stations and in water six or more feet deep. Of eight far-shore seepage meters, two were located in thick, organic sediment (i.e., muck) and confirmed the findings of Hirsch and Randazzo (2000) that such sediment can prevent seepage loss from lakes. Four seepage meters in similar sediment of a contiguous area displayed seepage loss values of -1 to -2 L/m²-day, averaging -1.55 L/m²-day. The remaining two far-shore meters showed seepage losses of ~-8 and ~-16 L/m²-day. Lake-bottom areas were assigned to the individual meters or the group of four meters based on sediment type and thickness and bounded by the 6-foot water depth contour.

For a 12-month budget, near-shore seepage contributed +1.23 million cubic feet to the East Pool, equivalent to 13.7 inches per year or 19.7% of the total inflow. In the West Pool, near-shore seepage contributed 1.51 million cubic feet, equalling +5.85 inches per year or 8.9% of total inflow. Far-shore seepage removed an estimated 2.81 million cubic feet from the West Pool, i.e., -10.86 inches per year or 16.3% of total outflow.

During the last three months of the investigation, eight terrestrial piezometers were installed by Geoprobe west and northwest of the West Pool, between the two pools, and southeast of the East Pool. Ten in-lake piezometers were installed in the West Pool and each was monitored for less than two days before removal for reasons of boating safety. Two in-lake piezometers were installed in the East Pool for several weeks. In-lake piezometers were installed by hydraulically jetted them through lake sediments to refusal, approximately eight to 15 feet below the lake bottom.

Isopleths of water table elevations from terrestrial piezometers showed that groundwater flow would be expected to flow toward each pool for each date monitored. When data for each terrestrial and in-lake piezometer were averaged and plotted, the potentiometric low spot appeared below the West Pool, east of the west shore. During this time, most seepage meters in the West Pool, other than at the east shore station, yielded results showing that water was seeping out of the lake.

An interpretation of the potentiometric data and seepage meter readings would indicate that lake water is recharging aquifers below the lake, possibly the Floridan Aquifer through one or more of the geophysical anomalies. However, there is an alternative explanation. If in-lake piezometers in the southern portion of the West Pool did not fully penetrate seepage-retarding sediment, the potentiometric surface of the surficial aquifer might not have been measured. Consequently, a potentiometric valley might exist and slope toward the south and away from the lake. This possibility may have been confirmed by installing a terrestrial piezometer south or southeast of the West Pool but was not possible during the project period because of site-access issues.

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NOTES

HYDROLOGIC FLUXES AND NUTRIENT REGIMES IN TWO BAYOUS OF WESTERN CHOCTAWHATCHEE BAY

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The understudied Choctawhatchee Bay estuary needs sound, scientific research in order to provide a basis for managing this critical resource. The western portion of Choctawhatchee Bay offers an opportunity for comparison between two large bayous, Garnier and Cinco. Both bayous have freshwater input at the head. However, Cinco Bayou and Gap Creek, which feeds into the bayou, are developed to saturation, while large tracts of undeveloped land surround Lightwood Knot Creek and Garnier Creek, the two creeks that flow into Garnier Bayou, and large portions of Garnier Bayou itself. Comprehensive comparisons, taking into account hydrological input, physiochemical and nutrient data, along with land-use and rainfall, can begin to identify biogeochemical differences between the bayous and propose underlying causes, especially as relates to land-use and nutrient loading. Fourteen sampling events, during both ambient and rainfall conditions, took place over the course of 12 months. Samples were analyzed for chlorophyll a, nitrite, nitrate, ammonium, dissolved organic nitrogen and orthophosphate. Separate stream sampling was undertaken to establish nutrient and flow response to low, moderate and high rainfall events. Rainfall data was summed into bayou-specific averages and compared to nutrient concentrations to characterize reaction time of the two bayous. Differences between nutrient regimes and hydrologic fluxes in the two bayous will be discussed in the context of differing land use and watershed characteristics.

NOTES

LAKE WATER QUALITY RESPONSES TO VARIATIONS IN RIVER FLOW IN THE MIDDLE ST. JOHNS BASIN: LAKES HARNEY, MONROE AND GEORGE

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The Middle St. Johns River basin contains three natural run-of-the-river lakes – lakes Harney, Monroe and George – that represent broad, shallow pools along the river's main stem. In addition to varying rates and directions of river flow, which fluctuate in response to rainfall, wind and (in Lake George) tidal effects, these lakes also receive varying inputs of mineralized groundwater from a number of spring systems. Although the three lakes show systematic differences in ambient chlorophyll-a concentrations, which appear related to differences in CDOM levels and hydraulic retention times, they respond in similar ways to fluctuations in river flow. During periods of low river flow (and proportionately greater groundwater influence) all three show relatively high levels of specific conductance and alkalinity, relatively low color, increased chlorophyll-a concentrations, and decreased concentrations of inorganic N and P. During periods of high river flow specific conductance and alkalinity decline, color increases, chlorophyll-a levels decline, and inorganic N and P concentrations increase. Spatial and temporal relationships between nutrient inputs and chlorophyll-a concentrations are thus more complex than in many Florida lakes, due to complicating effects of river flow and color.

These factors, and the systematic differences in annual mean chlorophyll-a concentrations that occur among the three lakes, have a number of important management implications:

- Differences in annual mean chlorophyll-a concentrations between the lakes do not correspond to differences in annual mean TP and TN concentrations;
- Instead, between-lake differences in chlorophyll-a appear to be more associated with other factors (e.g., hydraulic retention times, ambient color levels)
- Management actions will thus need to address the effects of lake flushing characteristics and color, and their interactions with nutrient loads.
- Lake George appears to be more sensitive than the other two lakes to nutrient inputs, due to its lower color and longer hydraulic retention times.

Other broad similarities and differences among the three lakes include:

- **Lake Harney:** During the 1991 – 2007 monitoring period, monthly chlorophyll-a concentrations were positively associated with water temperature and inversely associated with surface water inflows. Water temperature affects phytoplankton metabolic activity and growth rate, while river flow affects hydrologic residence times and levels of water color (and their light attenuation effects). Inorganic N and P concentrations were negatively associated with chlorophyll-a concentrations, presumably due to phytoplankton uptake. TKN, TSS and turbidity levels were positively associated with chlorophyll concentrations, presumably reflecting increased phytoplankton biomass in the water column. The converse patterns were evident during periods with low water temperature, high surface water flow and reduced chlorophyll concentrations. No simple relationships were observed between monthly chlorophyll-a and TN and TP

concentrations, perhaps because dissolved inorganic N and P forms tended to be negatively associated with chlorophyll-*a* concentrations, while organic N and P forms tended to be positively associated. Annual average TSI values generally ranged between 40 and 60.

- **Lake Monroe:** Like Lake Harney, concentrations of chlorophyll-*a* observed in Lake Monroe during the 1991 – 2007 monitoring period tended to reach their highest levels during periods of low surface water inflows, when hydrologic residence times would have been relatively high and color levels (and their light attenuation effects) relatively low. Inorganic N and P concentrations tended to be low at such times, presumably because of phytoplankton uptake. TKN, TN and TP levels were near the upper ends of their ranges, as were TSS and turbidity levels, presumably reflecting increased phytoplankton biomass in the water column. The converse patterns were evident during periods of high surface water flow. Unlike Lake Harney, both corrected and uncorrected chlorophyll-*a* concentrations showed significant positive associations with TN and TP concentrations in Lake Monroe. Chlorophyll-*a* concentrations were also substantially higher in Lake Monroe (averaging about 20 µg/L) than in Lake Harney (averaging 10 – 15 µg/L), and annual average TSI values in Lake Monroe ranged between 50 and 65 during the 1991 – 2007 period.
- **Lake George:** During the 1997 – 2007 monitoring period, monthly chlorophyll-*a* concentrations were positively associated with water temperature and inversely associated with surface water inflows. Inorganic N and P concentrations were negatively associated with chlorophyll-*a* concentrations, presumably due to phytoplankton uptake of the inorganic nutrient forms. TKN, TSS and turbidity levels were positively associated with chlorophyll concentrations, presumably reflecting increased phytoplankton biomass in the water column. The converse patterns were evident during periods with low water temperature, high surface water flow and reduced chlorophyll concentrations. Unlike Lake Monroe, but similar to Lake Harney, no simple relationships were observed between monthly chlorophyll-*a* and TN and TP concentrations, perhaps because dissolved inorganic N and P forms tended to be negatively associated with chlorophyll-*a* concentrations, while organic N and P forms tended to be positively associated. Annual average TSI values ranged between 55 and 64.

SESSION 4

THE RESULTS: BEST MANAGEMENT PRACTICES IN ACTION PART I

EFFICACY OF A LARGE-SCALE CONSTRUCTED WETLAND TO REMOVE PHOSPHORUS AND SUSPENDED SOLIDS FROM A SUB-TROPICAL SHALLOW LAKE

*Ed J. Dunne, Michael F. Coveney, Erich R. Marzolf, Victoria R. Hoge,
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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 phosphorus, nitrogen and suspended solids from incoming lake water. The marsh flow-way has four treatment cells with a total area of 276 ha. Hydraulic loading rate was high and ranged between about 40 and 50 m yr⁻¹ for years 2003 through 2007. During the start-up period the flow-way released total phosphorus (1.9 g m⁻² yr⁻¹), which was mostly soluble reactive phosphorus. However, after this period, the system began to remove phosphorus with maximum retention occurring in 2007 (1.8 g TP m⁻² yr⁻¹). Most of the incoming and retained phosphorus was in particulate forms. The efficiency of particulate phosphorus removal, based on mass removal, was 58%, while total phosphorus removal was about 30%. Total nitrogen and total suspended solids were always removed by the system and median removal rates were 35 g m⁻² yr⁻¹ (26%) and 1,396 g m⁻² yr⁻¹ (93%), respectively. Typically, we found relationships between mass inlet loading rate and outlet water quality, and mass removal rate. Total phosphorus mass removal rate did not reach a maximum. We hypothesize that the practical limit of performance is controlled by hydraulics rather than the system efficiency. In the long-term, to help accelerate nutrient and solids removal from the lake, we will continue to try and increase removal rates.

NOTES

NURF – THE FIRST YEAR

Lance M. Lumbard

Lake County Water Authority, Tavares, FL

The Harris Chain of Lakes comprises more than 300 km² within both Lake and Orange Counties and contains five lakes greater than 16 km² each. Once a world-renowned tourist destination and sportfishery, the Chain has experienced decades of poor water quality and continuous algal blooms as a result of nutrient-enriched discharge, hydrologic alteration, and wetland loss. As a Group I Basin, multiple agencies have been working to meet Total Maximum Daily Load (TMDL) goals established for the chain and recent data indicates the lakes have responded positively.

The Lake County Water Authority began operation of its Nutrient Reduction Facility (NuRF) on March 2, 2009 to assist in the achievement of TMDL goals downstream of Lake Apopka. The NuRF was constructed to remove at least 67% of the total phosphorus (TP) discharged from Lake Apopka into Lake Beauclair and the rest of the Harris Chain. Alum injection is the primary mode of operation and was selected because of its manageability and reliability throughout a range of environmental and hydraulic conditions.

Between March 2, 2009 and February 28, 2010, the NuRF treated 2.3×10^7 m³ (approximately 2.5 times the volume of Lake Beauclair) and removed 873 kg of TP. The NuRF reduced average inflow TP concentration from 88 ppb to 32 ppb which is equal to the target TP TMDL concentration for Lake Beauclair. Alum use during this time totaled 1.1 million gallons at a price of \$795,000. Since the NuRF began operation, Lake Beauclair TP concentration has declined 25% from the prior year but remains more than double the TMDL target concentration. Downstream and in-lake TP sources are still present and additional efforts are underway to further enhance NuRF impacts by removing approximately 1.14×10^6 m³ of nutrient-laden sediments from within the lake.

NOTES

GEOFILTER TUBE TECHNOLOGY HELPS IN SUCCESSFUL RESTORATION OF FISH - POCKET CANAL

Sergio Duarte

Orange County Environmental Protection Division, Orlando, Florida

Maintenance dredging and shoreline restoration of urban lakes and canals is a challenge to lake managers since access for heavy equipment; dewatering space and sediment storage/disposal remain major obstacles. The use of geofilter tubes, constructed of high strength polyester, is the latest technology in the recycling and dewatering of spoil sediments while reducing the impact of dredging excavators & hauling trucks on seawalls, streets and private properties.

Geofilter tubes have been used as desirable alternative to controlling shoreline erosion in place of seawalls by several agencies including; City of Maitland, City of Orlando, and Reedy Creek Improvement District in past years. The main benefit of geotubes is that they do not reflect wave energy as typical hardened structures cause. However, few projects have been engineered to use Geofilter tubes to utilize dredged spoil sediments on-site to create berm/swales to treat pollution associated with stormwater runoff.

The Fish-Pocket Canal Restoration Project conducted for the Windermere Water & Navigation Control District included the hydraulic pumping of 48,000 cu. ft. of sediments along a navigational canal and the installation of 3,800 linear feet of Geofilter tubes to create 29,000 sq. ft of grassy berm/swales. The dredging project restored the original 5 ft depth of the Fish-Pocket Canal established during its construction in the 1950, while recycling the dredged spoil for environmental benefits. The hydraulic dredging of sediments and pumping into Geofilter tubes not only improved canal navigation and stormwater treatment, but also resulted in capital savings of \$455,000, compared to traditional mechanical dredging and berm/swales construction.

NOTES

NUTRIENT REMOVAL EVALUATION OF SUNTREE TECHNOLOGIES CURB AND GRATE INLET FILTER BASKETS WITHIN URBAN RESIDENTIAL WATERSHEDS OF ORANGE COUNTY FLORIDA

Tim Lindsey (Student Intern) and *Ronald Novy*
Orange County Environmental Protection, Orlando, FL

Selecting the most cost-efficient BMP within urban developed watersheds remains to be a challenge for lake managers. Finding efficient nutrient removal BMP's is often complicated by the physical and financial challenges of each location. Curb and grate inlet filter baskets (IFB) have highly desirable physical and cost benefits, yet nutrient removal efficiencies remain relatively unknown. Starting in 2008, the Orange County Lake Management Section began evaluating the effectiveness of IFB's to remove various pollutants from several watersheds in Orange County. The results of this study will assist lake managers in choosing the best BMP for not only preserving our surface water systems, but also in meeting basin load allocations on TMDL waterbodies.

Orange County installed over 400 Suntree IFB since 2008 and all have since been under a monthly cleaning/recording schedule. For this evaluation phase, data from January 2009 through January 2010 was analyzed in order to track any seasonal variations. During this period, the quality and quantity of the material was collected for its physical and chemical make-up. The materials were separated into two fractions for chemical analysis: (1) leaf/trash and (2) sediments (>0.5inch and <0.5 inch, respectively). Each fraction was analyzed for: total P, total-N, leachable-TP, leachable TN, as well as organic content, moisture content and weight fractions. The data was analyzed to investigate seasonal variations, spacial differences between lakes basins, typical nutrient composition and removal rates for both grate and curb IFB's.

While the chemical evaluation are still ongoing, the data evaluated to date shown that IFB are a simple and effective tool in capturing nutrients before they enter the stormwater stream.

NOTES

SESSION 5

MONITORING AND ASSESSMENT -- INDICATORS OF CHANGE

A DETAILED ANALYSIS OF THE HILLSBOROUGH RIVER: THE APPLICATION OF LAKE ASSESSMENT TECHNIQUES TO THE ASSESSMENT OF RIVER REACHES

Jim Griffin and David Eilers

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This paper reports on the results of an adaptation of techniques developed and employed for 10 years to assess lakes in Hillsborough County to river assessments and specifically the Hillsborough River in Hillsborough County Florida. The goal of the [study](#) was to determine if these techniques may assist the University of South Florida's Water Atlas program and Hillsborough County to better understand the general health of river resources through the estimate of plant species diversity, river volumes and general morphology and water chemistry. All the data from the 2009 assessment are now available for public view on the *Hillsborough River and City of Tampa Water Atlas* (www.hillsborough.wateratlas.org) on the [Hillsborough River](#) page and under specific [StreamWaterWatch](#) (SWW) sites. The field methods include: (1) bathymetry to determine bottom contour and extent and quantity of submerged vegetation, (2) identification and mapping of invasive and non-native as well as native aquatic plants; (3) semi-quantitative assessment of submerged vegetation biomass and the parallel determination of nutrients held in vegetation; (4) river water chemistry and (5) the estimate of sediment volume.

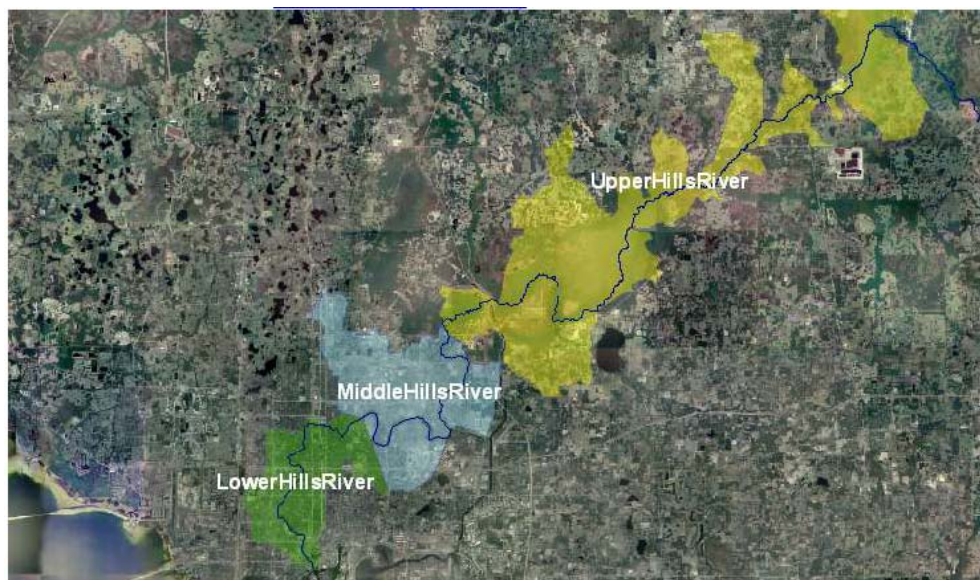


Figure 1. The Hillsborough River was divided into three segments: the UHR (River above Fletcher Ave Bridge), the MHR (between Fletcher Ave. Bridge and Hillsborough River Dam) and the LHR (from dam to mouth of river) as shown.

The bathymetry mapping methods developed for the Water Atlas Lake Assessment project were applied to stream system to first determine if these approaches were viable. Initial application showed the method worked for both narrow navigable streams and for larger streams and river segments. The one issue is that streams tend to change level with a greater periodicity than lakes and bathymetry should be conducted when stream is at its highest normal elevation. Alternatively, bathymetry data should be used with available land surface elevations (LIDAR or other) when available. An example of the results from a river bathymetric mapping effort for the Hillsborough River at Morse Bridget is shown in Figure 1. Full results are available on the [Water Atlas](#).

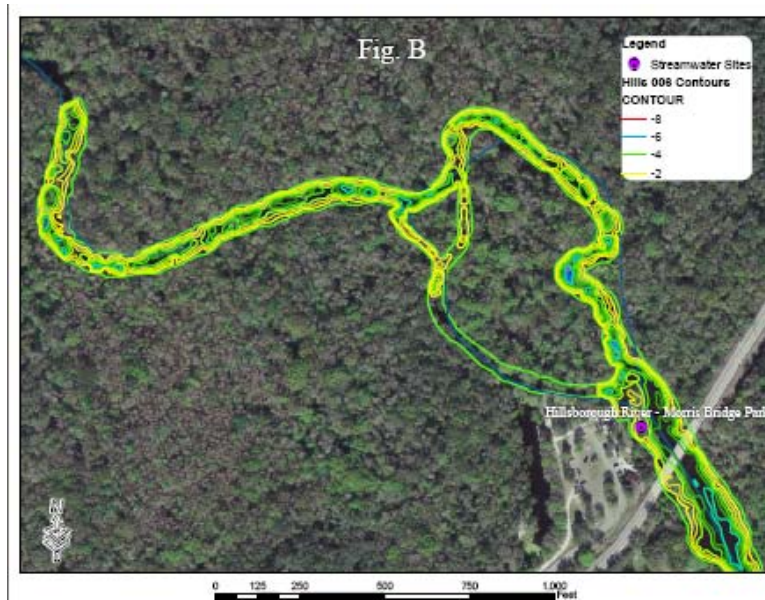


Figure 2. Hillsborough River at Natures Classroom. The western arm was not navigable at the time that the assessment was conducted.

Vegetation is mapped for all reaches and segments of a river assessed. Vegetation mapping stations were established for both banks and within the stream (submerged). In addition to vegetation mapping at least two sediment probe samples were collected and side scanning sonar used to determine bottom type (soft or hard bottom).

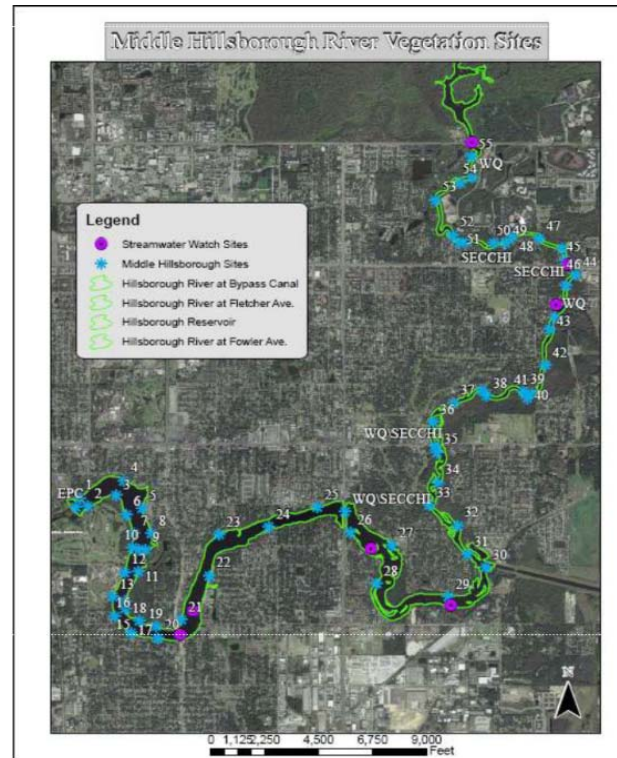


Figure 3. Middle Hillsborough River vegetation sample sites.

Water chemistry samples were taken at sites in all three segments as part of the river assessment. These data and water chemistry sample data collected over the last five years by various agencies for the Hillsborough River were used in the assessment of the rivers water quality and to estimate nutrient loading from Upper River and Middle River segments. This assessment included determining current conditions, temporal changes and spatial changes in water quality. Figure 4 shows one method used to visualize phosphorous concentration changes in the upper and part of the middle river segment. The visualization is created in GIS using an inverse distance weighted (IDW) approach. Higher levels of phosphorus generally correlate to agricultural land use.

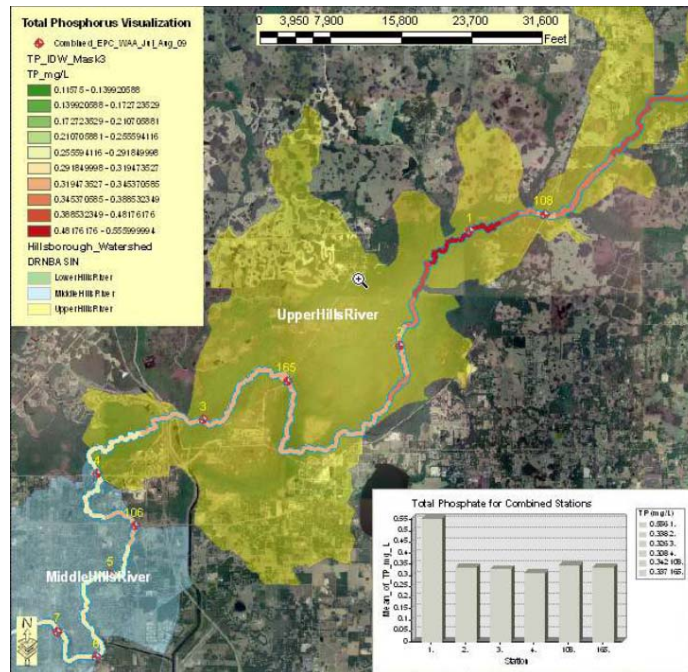


Figure 4. Water chemistry visualization for upper and middle sections of Hillsborough River for phosphorous late July until early August 2009.

The use of sediment probes to estimate sediment volume at various sites within the river was evaluated during this first assessment effort. Generally, the probe allowed determination of soft and hard bottom segments; however, actual estimate of sediment load was not feasible using this approach. This was because the river bottom changes with change in flow and the sediment deposits tend to shift position. More evaluation of this approach is required.

The river assessment methodology adapted from lake assessments methods was determined to be generally feasible. Bathymetric mapping and vegetation mapping were found to be the most valuable adaptations of the method. Water chemistry visualization was considered an approach which will require additional evaluation, but which offers an interesting way to view water quality data taken during sample events that are generally close in time of sampling but taken over a large spatial extent.

NOTES

FACTORS RELATED TO WARMOUTH (*LEPOMIS GULOSUS*) BIOMASS AND DENSITY IN FLORIDA LAKES

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Warmouth biomass and density were positively related to percent area covered with aquatic vegetation in 60 Florida lakes. Warmouth biomass and density were sampled in Lake Baldwin for nine years and found to be higher in the littoral than limnetic habitats. These data support conventional wisdom and suggest that the primary factor affecting warmouth biomass and density in Florida lakes is aquatic macrophytes abundance. Also, data examined from 60 Florida lakes showed that warmouth biomass averaged 10% of the entire fish population but reached as high as 50%. Because warmouth biomass and density can dominate other fishes in some systems they have the potential to direct a large portion of the energy flow through that system. Additional studies should be conducted to examine the ecological importance of warmouth, especially in macrophyte dominated aquatic systems.

NOTES

A REVIEW OF RECENT WETLAND FINDINGS CONCERNING CLAM SHRIMP AND FAIRY SHRIMP WITHIN A WEST-CENTRAL FLORIDA NATURAL AREA

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³EcoAnalysts, Inc., Davis, CA

In 2004, we began sampling tadpoles, benthic macroinvertebrates, and fish from four wetland types (borrow pits, isolated marshes, isolated cypress wetlands, and riverine swamps) as part of a long-term amphibian monitoring project in a natural area managed by the Southwest Florida Water Management District in Hillsborough County, Florida. From 2006 to 2009, we collected more than 40 invertebrate taxa, including clam shrimp [Class Branchiopoda; Orders Laevicaudata and Diplostraca (Spinicaudata)] and fairy shrimp (Class Branchiopoda; Order Anostraca). Branchiopods are considered as the most primitive group of living crustaceans and are separated as a discreet class of Crustacea based primarily on the form of the larvae (Rodgers, 2009). Branchiopods are currently divided into four extant orders: Notostraca (tadpole shrimp), Laevicaudata (smooth clam shrimp), Anostraca (fairy shrimp), and Diplostraca (spiny clam shrimp and water fleas) (Rodgers, 2009; Brendonck et al., 2008). Order Diplostraca is further divided into three suborders: Cladocera (water fleas), Cyclestherida (spiny clam shrimp), and Spinicaudata (spiny clam shrimp) (Rodgers, 2009; Brendonck et al., 2008).

Branchiopoda have evolved across an array of temporary ponds, pools, and saline inland aquatic habitats over all continents, including Antarctica (Brendonck et al., 2008). Their international dispersal coupled with potentially high abundance (sometimes hundreds per cubic liter) has insured their zooplanktonic position as an important food chain link within ephemeral and saline aquatic communities. This would suggest their inherent importance for usage as bioindicators of ecosystem health, particularly in ephemeral sites (Rodgers, 2009). Despite this, currently 29 species of Anostraca are included on the International Union for Conservation of Nature's (IUCN's) Red List under different conservation statuses based on extinction risks (IUCN Red List, 2010).

Our surveys were conducted approximately every three weeks in wetlands containing water from approximately mid-June through October, dependent on the time and duration of the rainy season. A standard survey consisted of ten 1-meter dip net sweeps per wetland. In cases where water depth was greater than 0.5 meters, five sweeps were conducted in the deep zone, and five were conducted in the shallow zone. The biota collected in each sweep was placed in a sorting pan in order that the benthic macroinvertebrates, tadpoles, and fish could be counted and identified.

Since 2006, we collected clam shrimp from three borrow pits, seven cypress wetlands, 16 marshes, and one riverine site. Fairy shrimp were collected from three borrow pits, four cypress wetlands, and ten marshes. Both clam and fairy shrimp were found together in three borrow pits, eight isolated marshes, and four isolated cypress wetlands. In 2009, we collected three female clam shrimp of the genus *Paralimnetis*; this genus is currently represented by three species found in Paraguay, North-Central Mexico, and North Central Texas. This finding indicates either a significant habitat range expansion of one of these described species or potentially a new species. We also collected Alachua fairy shrimp, *Dendrocephalus alachua*, which was last recorded in 1953 near Gainesville, in Alachua County (Dexter, 1953). The Alachua fairy shrimp is currently categorized as threatened in the IUCN Red List and was considered by many to be extinct. The implications of these findings highlight the lack of knowledge of Florida's wetland macroinvertebrate communities in general and branchiopods specifically. This is mainly due to the challenges of surveying ephemeral communities and the lack of long-term research. This concern is exacerbated by the susceptibility of ephemeral wetlands to human development coupled with upland runoff.

We plan to conduct additional surveys of wetlands throughout our study site during the summer of 2010 and hope to collect males of *Paralimnetis*. We are also organizing, summarizing, and analyzing the data collected from 2004 through 2009, as well completing the taxonomic analyses of the specimens that we have collected for identification.

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NOTES

SESSION 6

POSTER SESSION

DEAD ON ARRIVAL? A FRESH LOOK AT ASSUMPTIONS REGARDING IMPINGEMENT AND ENTRAINMENT MORTALITY AT POWER PLANTS.

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Section 316(b) of the Clean Water Act addresses impacts to fisheries due to impingement and entrainment of all life stages of fish and shellfish at power plant cooling water intakes. For the purposes of estimating baseline conditions, the regulatory agencies usually assume that all fish and shellfish that are impinged or entrained are: a) alive prior to reaching the intake, and b) killed by the process of impingement or entrainment. This study examined mortality rates of impinged fish and shellfish at three different power plants in the Southeast US, one on a freshwater river, one on a saltwater bayou, and one on a tidally influenced brackish reach of a river. In addition, proportion of live vs dead larval fish and shellfish were evaluated at two of these plants in order to determine the whether or not all ichthyoplankton are viable prior to being entrained. Results indicated that impingement did not result in 100% mortality as assumed by the regulatory agencies, but rather a high proportion of shellfish survived the process of impingement, and a lower proportion of fish were likely to survive. It was determined that only a small proportion of ichthyoplankton are viable prior to entrainment at the plants. Ability to survive the impingement process and likelihood of being dead prior to entrainment varied by date and species.

NOTES

WATER QUALITY CHANGES FOLLOWING NUTRIENT LOADING REDUCTION AND BIOMANIPULATION IN LAKE GRIFFIN

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Lake Griffin, the most downstream lake in the Ocklawaha Chain-of-Lakes, has suffered for decades from nutrient discharges from muck farms developed on former floodplain wetlands adjacent to the lake. During the agricultural period, total phosphorus loading from the farms averaged about 25 metric tons/year, and total loading to the lake from all sources averaged about 40 metric tons/year. During this period, Lake Griffin was hypereutrophic, with persistent severe algal blooms. Total phosphorus concentrations in the lake during the agricultural period averaged close to 100 µg/L. The heavy phosphorus load resulted in severe cyanobacterial blooms and very limited water clarity. The District began purchase of these farms in 1991 and farming operations ceased by 1994.

Restoration of the farms began in 1995 with creation of new aquatic and wetland habitat on the former farm fields and with substantial reductions in nutrient loading from the former farms to the lake. During 2006-2009, total phosphorus loading from the restoration area averaged less than 1 metric ton/year, and total loading to the lake from all sources was reduced to an average of about 8 metric tons/year, well below the TMDL loading target (12.2 metric tons/year). Also, large-scale removal of gizzard shad was begun in 2002 as a means to reduce recycling of nutrients from the bottom sediments and directly remove nutrients in the shad biomass. During 2002-2008, the gizzard shad harvest removed an average of 1.2 metric tons of biologically-available total phosphorus per year from the lake and prevented the recycling of about 3.5 metric tons/year of phosphorus from sediments to the water column.

Implementation of this restoration strategy has resulted in marked improvement of environmental conditions in Lake Griffin. About 2,500 ha of restored aquatic and wetland habitat now make up the former agricultural areas. There have been substantial improvements in water quality in Lake Griffin since the late 1990s. During 2006-2009, total phosphorus concentrations in the lake averaged about 50 µg/L, and recent concentrations are close to the TMDL target of 31 µg/L. Algal bloom conditions have improved markedly, with chlorophyll-*a* concentrations decreasing from over 200 µg/L in the late-1990s to an average of about 70 µg/L in 2006-2009. There has been a concomitant improvement in Secchi disk visibility from an average below 30 cm in the late 1990s to about 45 cm in 2006-2009, and to over one meter on some occasions. Native submersed aquatic vegetation has expanded in the lake and gamefish stocks have improved to the point that recreational fishing tournaments have resumed on the lake.

Average annual concentrations of total phosphorus and total nitrogen in Lake Griffin are strongly related to external total phosphorus loading ($r^2>0.47$ and $p<0.006$) and to estimated gizzard shad population size (catch per unit effort) ($r^2>0.64$ and $p<0.005$). These nutrient concentrations are not related to changes in lake surface area, mean depth, dynamic ratio, or rainfall. Other water quality variables are strongly related to both total phosphorus and total nitrogen concentrations: chlorophyll-*a* ($r^2>0.84$ and $p<0.001$), Secchi depth ($r^2>0.41$ and $p<0.007$), and total suspended solids ($r^2>0.70$ and $p<0.001$).

NOTES

A 20 YEAR EXTERNAL PHOSPHORUS BUDGET FOR LAKE APOPKA, 1989-2008

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St. Johns River Water Management District, Palatka, FL

Lake Apopka is a shallow 125 km² eutrophic lake and is the headwater for the Ocklawaha Chain of Lakes. Historical excessive phosphorus (P) loadings from farms, industries, and wastewater treatment to the lake are generally held responsible for degrading water quality. In 1985, the Florida legislature directed the St. Johns River Water Management District (SJRWMD) to develop an external nutrient budget as part of a comprehensive restoration effort.

An extensive monitoring effort was executed to indentify and quantify all hydrologic sources and sinks for Lake Apopka. The most significant source of P was farm discharge on the north shore of the lake. Additional sources identified were atmospheric deposition, Apopka Spring, tributaries, basin runoff, and industrial and municipal point sources. Sinks included flow down the Apopka Beauclair Canal, farm irrigation, and seepage.

The 1989 - 2008 P budget reflects significant changes in land use within the basin. Between 1989 and 2002, nearly 20,000 acres of farmland on the lake's north shore were purchased utilizing SJRWMD, state, and federal funding and taken out of agricultural production. Largely due to a reduction in farm pumping, the total annual external loading of P to Lake Apopka was reduced from an average of 69 metric tons (1968-1987) to 30 metric tons (2003-2008).

More rapid reductions would have been possible, however during late 1998, significant numbers of bird species, including threatened and endangered species, died from residual pesticides during temporary flooding of the former farmlands. To reduce the area's attractiveness to bird life, the majority of the area remained drained, while research on safe approaches to further wetland restoration was conducted. This has necessitated increased pumping, however all current discharges from the former Unit 1 and Units 2 of the Zellwood Drainage and Water Control District are currently treated with liquid alum to reduce P loading to Lake Apopka. As additional properties are flooded, discharges should continue to decrease.

To date, approximately 5,000 acres have been returned to marsh habitat. In addition, the Lake Apopka Marsh Flow-Way became operational in late 2003. Since the majority of the lake's TP is in particulate form, the filtration marsh has removed 16 metric tons of TP between 2003 and 2008.

Water quality results indicate that P concentrations and chlorophyll-a levels in Lake Apopka are decreasing through time, which is concomitant to decreases in external

P loading. The external P budget will assist in evaluating past and present P loads to and from the lake and effects of future land use. Knowing the external loading will also provide a template to evaluate recent restoration efforts in the lake and the surrounding basin.

NOTES

RECLAIMED WATER IN THE MIDDLE ST JOHNS RIVER BASIN WATERSHED

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Redirecting effluent from wastewater treatment plants from direct discharge into rivers and lakes to reuse systems is a valuable practice in this era of water supply concern. It reduces stress on aquifers and reduces nutrient loads to increasingly impaired water bodies. However, reclaimed water can have extremely high phosphorus concentrations. Nitrates and TN are also higher than most rivers, lakes and estuaries can assimilate. Combined with high irrigation rates, reuse can generate substantial nutrient loads to waterbodies. Nutrient impairment harms both natural ecosystems and human uses of these systems.

One example of the magnitude of phosphorus loading to the state's waters is found in the Lake Jesup watershed, a large, nutrient-impaired water body along the St. Johns River. A reclaimed water irrigation rate of one inch twice per week has an estimated annual runoff of five metric tons of phosphorus into the lake. This load is equivalent to ~60% of the reduction required under the current TMDL for Lake Jesup. In this poster, quantitative GIS and reclaimed water flows and concentrations are used to estimate nutrient loads and runoff for the entire nutrient-impaired Middle St. Johns River basin.

In the current climate of concern about water supply, the use of reclaimed water for irrigation is an important means to reduce potable water demand. However, because of the potential for excessive nutrient runoff due to over fertilization (resulting from the combination of reclaimed water and regular lawn fertilization), recommended fertilizer applications should be reevaluated and consumers educated how they can save money by using less fertilizer. Further, wastewater utilities should be encouraged to improve treatment efficiency so that excessive nutrient loads distributed via reuse within watersheds and springsheds are reduced. Estimated loads presented will be beneficial in prioritizing this initiative.

NOTES

MAPPING TOTAL PHOSPHORUS CONCENTRATIONS IN WATER BODIES USING LANDSAT TM AND ETM+ DATA

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³Natural Resources Management, LLC, Sylvania, OH

Capturing water quality data for total phosphorus concentrations over entire bodies of water has been a goal of scientists for decades. Current field sampling methods allow for collection of grab and composite samples at discrete points but can not practically be used to gather total phosphorus concentrations over the entire surface water area, mostly due to time and budget constraints. Therefore, representative field samples must be collected and then interpolated for the entire water body, leaving large gaps in the data.

In this study, Water samples were collected in Lake Erie on days of LANDSAT satellite overpass and analyzed for total phosphorous (ppm). The total phosphorous concentrations reported for each sample was then regressed with the dark-object-subtracted digital number ratios from the LANDSAT image for each sample location pixel. Once an algorithm was created, it was used with LANDSAT data to obtain total phosphorous concentrations in water over the entire surface water area of Lake Washington and Lake Champlain.

The results showed that total phosphorus concentrations are able to be predicted for the surface water using LANDSAT satellites. The results also show that when correlating the established algorithms to existing data at various locations, there is a range of variability in the adjusted R^2 analysis that is dependent upon the difference between the time of Satellite overpass and the time of field samples collection. The best-fit regression was obtained when the reported sample collection times were limited to within half an hour of satellite overpass. This study shows that monitoring water quality in water bodies with LANDSAT is practical, correlates well with ground sample data and allows the user to characterize the chemical characteristics of the entire surface water area during a single LANDSAT overpass.

NOTES

CORAL DIVERSITY OF NINE NATURAL REEFS ALONG FLORIDA'S SPRING COAST

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SCUBAnauts International, Tarpon Springs Chapter, Tarpon Springs, FL

Florida's *Springs Coast* holds the second largest area of continuous seagrass beds (approximately 800,000 acres) in the world. Intermixed are hundreds of small reefs and hard bottom habitats, which have received little research attention due to their obscure location. In 2009, 20 youth of the Tarpon Springs Chapter of ScubaNauts International (SNI) began researching this region and conducting over 18 dive missions in the process. Nauts began by exploring a number of reefs sites along the *Springs Coast* to select similar sites for long-term monitoring. Nine natural reefs sites were selected in 2009, which range from 8 miles offshore to 14 miles offshore. All are uncharted systems with no historical ecological data. The 2009 research efforts resulted in general background assessments, which included mapping reef perimeters and characterizing the morphology and vertical height of each reef. Percent cover of major benthic substrates was determined utilizing a 1 m² quadrat along 75 ft transects. Substrate categories included coral, sponge, seagrass, brown algae, green algae, and bare substrate. Reefs located further offshore (15nm) generally exhibited less growth of brown algae (drift algae) than reefs closer to shore. Drift algae can be an indicator of nutrient enrichment and is known to compete with more desirable benthic cover such as coral and sponge. Coral identification and counts were completed at each of the nine reef locations along 75 ft, 1 m wide transects. Eleven species of coral were identified. Offshore reefs (14 miles) exhibited the highest diversity (Shannon Weaver Index, SWI) with an average SWI of 4.6. Lower coral diversity was found at midshore (12 miles) and inshore (8 miles) reefs with their respective average SWI's of 3.6 and 2.1. Offshore factors associated with the higher diversity possibly include higher salinity, consistent temperatures, less boating and anchoring impacts, stronger currents, and more exposure to coral planula transported within the Gulf Stream. Water depth is not likely to be a factor since similar depths were observed between the three groups of reefs, ranging from 10 ft deep (inshore sites) to 15 feet (offshore sites). A geodatabase of the data was created using ArcGIS including positional data, coral species lists, diversity data, and coral photographs. Photographs of many sponges, soft corals, fish, and crustaceans were collected and are being used to develop the first photographic field guide for this region.

The Tarpon Springs Scubanauts will build upon the data collected in 2009 by collecting environmental data at the reef sites including salinity, temperature, and water clarity for the purpose of examining relationships with coral diversity. In addition, the Nauts will implement a more detailed reef assessment, known as the *Atlantic and Gulf Rapid Reef Assessment*. This assessment will add specific information on the size and health of individual coral colonies and will allow use of the data in regional and global comparisons of reef and coral health. The Nauts

also plan to develop a 3D model of each long term reef study site, using underwater imagery draped over bathymetric data. The 3D model will be a useful tool to document all of the flora on the reef including coral, sponges, and macroalgae.

The SCUBAnauts have also recently started a new project on recording sea turtle counts. Three sea turtles are commonly found in this region, including the highly endangered *Kemp's Ridley*. The Nauts are excited to start building the first volunteer-built geospatial sea turtle database (nicknamed *Geoturtle*) for this expansive area of marine waters. With several hundred (estimated) small reef systems in this region, the Nauts will continue exploring these understudied habitats, expanding their ArcGIS and ArcINFO built geospatial database, and documenting the flora and fauna found in these unique systems.

BIO - SCUBANAUTS INTERNATIONAL

The SCUBAnauts International (SNI) program is a 501(c)(3) non-profit youth organization established to increase the attractiveness of science and technology careers in today's youth by exposure to underwater marine and freshwater sciences. SNI consists of a diverse group of young men and women (ages 12-18) mentored by federal, state, private sector, and academic research scientists (from NOAA, USGS, Florida's Fish and Wildlife Conservation Commission, University of South Florida, Florida International University, Southwest Florida Water Management District, and other organizations), who have volunteered their free time. SNI dive operations are conducted under the standard operating procedures of the American Academy of Underwater Sciences (AAUS), and follow strict dive safety protocols, certifications and qualifications. There are currently four SNI chapters: Tampa Bay, Tarpon Springs, Key West and Lake Hitchcock. A total of about 75 youth currently participate. The Tarpon Springs Chapter has been focusing their research activities on exploring and documenting roughly 1 million acres of relatively little studied undersea habitat along Florida's west central Gulf coast. This region is commonly known as Florida's *Springs Coast*. The clear waters of the *Springs Coast* support the second largest area of continuous seagrass in the world and contain numerous uncharted reefs and hard bottom habitats, and yet receives little attention by the research community. The *Springs Coast* study is a unique opportunity for the Tarpon Springs Nauts to be scientific pioneers. The Nauts are utilizing ArcGIS and ArcInfo to map the unique marine environments along Florida's *Springs Coast* and to develop the first geospatial database of their flora and fauna.

NOTES

THE RIGHT TOOL FOR THE RIGHT PLACE: ASSESSING THE USE OF POLYACRYLAMIDE IN A STORMWATER POND

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Seminole County has been assessing the use of existing resources, such as stormwater ponds to help meet Total Maximum Daily Load (TMDL) goals. The County has maintenance responsibilities on over 800 stormwater ponds. The ponds were originally designed to treat stormwater prior to discharge based on state stormwater regulations. The goal of this study was to try and discover opportunities to enhance and improve the treatment capabilities of these traditional wet detention ponds. Adding additional best management practices (BMPs) to existing ponds could provide a low cost tool to meet TMDL goals since partial infrastructure is already in place.

We choose a pond adjacent to Lake Jesup, an impaired waterbody with a nutrient TMDL adopted in 2006. The stormwater pond is located in a City of Winter Springs park and is surrounded by baseball and other athletic fields. The park fields are irrigated with reuse water and the pond has a history of algal blooms throughout the year. The pond discharges directly into Lake Jesup with a nutrient TMDL goal of 1.27 mg/L of total nitrogen and 0.096 mg/L of total phosphorous. The County has been collaborating with the City of Winter Springs and Aquatic Ecosystems to install 2 aerators in conjunction with polyacrylamide Pond Logs in this two (2) acre pond to see if the nutrients and algal blooms could be minimized through additional chemical treatment. Seminole County collected a variety of parameters in the pond pre and post installation of eight (8) Pond Logs. Initial results of this study did not reveal any distinct nutrient trends. It appeared that spikes in pond turbidity and nutrients were related to rainfall events. Given the location of this pond and the amount of runoff it receives after a rainfall event, including continued irrigation of reuse water, the Pond Logs could not sustain a continued reduction in nutrients.

Pond Logs have a long history of success and have proven to be effective BMPs in the right environment. Based on results in this particular pond, it is important to know the inputs to a system, both quantity and quality, and be aware of a BMP's treatment limitations. Given the amount of runoff and additional input of reuse water, additional treatment BMPs (treatment train) are necessary to maximize the treatment capacity of this particular stormwater pond.

NOTES

SESSION 7

WATERSHED MANAGEMENT: RESULTS AND RECOMMENDATIONS

SUSTAINABLE STORMWATER: MAXIMIZING YOUR LOW-COST RESOURCES

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Seminole County has 282 County-owned stormwater ponds and approximately 560 functional ponds which the County provides a shared maintenance responsibility with another entity, typically a homeowner's association. Together, these >800 stormwater ponds represent a significant resource to not only properly handle stormwater quantities, but also provide potential for water quality treatment above the minimum regulatory requirements of stormwater prior to discharge into waters of the State. Historically, the focus has been on attenuation and flood control. Today, however, the potential functionality of stormwater ponds to reduce external loading to impaired waterbodies in response to TMDLs has been recognized. Additionally, for stormwater ponds serving as aesthetic amenities, water quality deterioration within the ponds themselves detracts from the ponds' value. In addition, stormwater may be useful to augment nonpotable water supplies.

Although stormwater ponds are individually inspected for National Pollutant Discharge Elimination System (NPDES) reporting purposes, assessing them as a group to identify and prioritize ponds with the highest potential for water quality treatment, operational maintenance to enhance habitat, stormwater quantity handling or other factors, will result in better management for multiple purposes. A total of 12 criteria were utilized to prioritize the stormwater ponds. The 12 factors were then sub categorized into three sections: 1) potential for water quality improvement, 2) pollutant loading treatment, and 3) retrofit potential. The final step examined the final "short list" of ponds in greater detail to produce preliminary conceptual designs for sustainable improvements for each selected pond. Preliminary BMPs include stormwater harvesting, filtration or chemical treatment of effluent waters, reduced flow to ponds through low impact development methods, stormwater enhancements using shoreline plants or floating islands, and treatment trains. The core principal of this overall pond analysis is to provide the frame work for continued stormwater research opportunities and other potential stormwater treatment resources within the County.

NOTES

INTEGRATED WATER MANAGEMENT FOR MULTIPLE BENEFITS

Mike Britt, P.E.

City of Winter Haven Natural Resources Division, Winter Haven, FL

The City of Winter Haven is at the headwaters of the Peace Creek Watershed, which is located in central Polk County. This watershed receives no inflow of surface or groundwater since it is at the headwaters of the Peace River Basin as well as the Floridan aquifer groundwater basin. With over 50 lakes in the immediate Winter Haven area, including 2 chains of lakes, water resource sustainability is an integral part of planning for the future.

The primary consideration for water resources in the past has been to dispose of water as a waste product through ditching, draining and stormwater outfalls. This watershed has lost up to 9,000 acres of wetlands and 27 billion gallons of storage from past practices. The mindset today is much different in that water resources are considered to be a finite resource. Recent water resource concerns related to water supply, water quality, lake levels, flood protection and natural systems management have been determined to be connected to a long-term loss of hydrologic function.

The Peace Creek Watershed is quickly transitioning into an urban area, but many opportunities exist to restore water resources. With today's focus on economic development, planning for water resource management has to be consistent with economic plans.

The Water Resource Sustainability Conceptual Plan prepared by PBSJ on behalf of the City, takes a close look at the historical hydrology of the area and recommends a conceptual approach for the management of water and economic growth based on this historical function. The proposed conceptual plan not only provides benefits for water resources, but is also gaining wide acceptance from the community as an economic development strategy. The series of proposed water storage areas will be integrated into the community as 'nature parks' with recreational, scenic and economic development opportunities. The basis for the plan is that using the natural system to provide services will be more efficient for meeting long-term goals than structural solutions. Concepts such as mitigation banking, public/private partnerships, conservation land use planning, and amenities creation will enhance the economic potential for the area.

The Winter Haven/Peace Creek Watershed Water Resource Sustainability Plan is one of the most comprehensive approaches to integrated water resources management attempted in Florida. If successful, this approach could provide a road map for other communities to look at water as an integrated resource on a watershed scale that provides multiple benefits to communities.

NOTES

USE OF RECLAIMED WATER TO OFFSET FERTILIZER APPLICATIONS: A COST-EFFECTIVE POLLUTION PREVENTION MANAGEMENT PRACTICE?

Erich R. Marzolf

St. Johns River Water Management District, Palatka, FL

Attempts to limit increasing withdrawals of high quality groundwater and efforts to reduce point source discharges of wastewater to waterbodies have led to the greater use of treated wastewater for irrigation throughout Florida and the U.S. While this reclaimed water has undergone treatment to address a variety of pathogens and contaminants, it remains highly enriched with nitrogen and phosphorus. From a water quality perspective, removing point source wastewater effluent discharges to waterbodies has been responsible for substantial nutrient load reductions and concomitant improvements in water quality. However, the rerouting of reclaimed water for irrigation has increased nutrient inputs onto other areas of the landscape. This reuse has helped offset the demand for potable water; however, the delivered nutrient load has rarely been quantified or reported, thus fertilizer applications have not been reduced to account for this source of nitrogen and phosphorus. In many locations with reuse irrigation, excessive nutrient loading occurs due to the combination of reclaimed water and fertilizer inputs. In a recent homeowner survey within a portion of the Wekiva springshed, reuse customers were found to fertilize their lawns more frequently than residents irrigating with potable water (UCF 2009).

As pollution prevention is generally considered more cost-effective than pollutant removal from the environment, reducing fertilizer inputs of nitrogen and phosphorus in response to the loads delivered via reuse seems to be reasonable management practice. Wastewater utilities have nutrient concentration data for their reclaimed water and even for unmetered reuse customers, a general idea of reclaimed water consumption. Thus, they have the data needed to determine the nutrient load delivered to their reuse customers. The information needed to put this load into fertilizer equivalents is the irrigated area, which homeowners could supply or could be estimated by the utility using parcel information. For watersheds with existing nutrient TMDLs, the implementation of a fertilizer offset program should be a cost-effective BMP for utilities to implement. While for homeowners, reduced fertilizer expense could help offset increasing reclaimed water costs.

Optimizing reuse from both a water and nutrient perspective will accomplish two important goals, preserving valuable potable water supplies and reducing nutrient pollution to waterways.

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NOTES

COPPER IMPAIRMENT IN FLORIDA WATERS: AN OUNCE OF PREVENTION AND POUNDS OF CURES

Ann B. Shortelle, Ph.D. and William A. Tucker, Ph.D.
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Nationally, among metals, copper is second only to mercury as a causative agent for waterbody impairment. Although not a common cause of impairment in Florida, copper is responsible for impairments of numerous waterbodies. There are separate water quality standards for copper in fresh and marine water based upon toxicity to aquatic life. Impairment of coastal marine waters is more common than freshwater impairments. There are many possible sources of copper, however, copper from algaecides and herbicides, commonly applied to surface waters and retention ponds, are widespread in some areas. Attempts made to restrict the use of these products, have been met with mixed reviews from residents as well as those responsible for regulation of pesticides. Florida has not yet issued a TMDL for copper. When this occurs, many interest groups will be focused on the process. Meanwhile, the biotic ligand model is gaining acceptance, and allows for refinement of copper standards on a site-specific basis, which may result in de-listing from the 303(d) list in some cases. This paper examines uses, fate and effects of copper in Florida waters and watersheds, discusses selected site-specific examples, and considers solutions for water quality management.

NOTES

PLOIDY OF GRASS CARP (*CTENOPHARYNGODON IDELLA*) IN THE SUWANNEE RIVER, FLORIDA

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¹Florida Fish and Wildlife Conservation Commission, Eustis, Florida

²Florida Fish and Wildlife Conservation Commission, Lake City, Florida

In February 2010, the Florida Fish and Wildlife Conservation Commission (FWC) collected a sample of 27 grass carp (*Ctenopharyngodon idella*) from the Suwannee River at Manatee Springs and Manatee Springs Run. A total of twenty-one of these grass carp were transported live to a private hatchery and the fish were tested for ploidy via a Coulter Counter. Of these twenty-one fish, five were determined to be diploid and sixteen were determined to be triploid. Diploid grass carp are capable of reproducing under the right environmental conditions; these conditions being a long stretch of flowing water of sufficient velocity to keep grass carp eggs buoyant during their development. While grass carp reproduction has not been documented in the Suwannee River, the environmental conditions in the Suwannee River are similar to the environmental conditions required for successful grass carp reproduction. Positive identification of grass carp eggs or larvae from nekton samples would be diagnostic of successful grass carp reproduction in the Suwannee River.

Although grass carp have not been legally stocked in the Suwannee River, a feral population of grass carp may persist in the Suwannee River due to escapement from permitted stocking sites, escapement from hatcheries, illegal introductions and possibly reproduction. Schools of feeding grass carp could have an impact on spring run vegetation in that they could eliminate preferred species such as hydrilla (*Hydrilla verticillata*) and southern naiad (*Najas guadalupensis*) or prevent re-growth of non-preferred species such as vallisneria (*Vallisneria Americana*). Freshwater springs have been identified as an FWC Wildlife Legacy priority habitat for conservation.

It would be difficult or impossible to remove grass carp from a large system such as the Suwannee River with technology that is currently available. However, there are some recommendations which can be made to aid in the establishment and conservation of aquatic vegetation in spring runs associated with the Suwannee River. Smart et al. (1996) and Smart and Dick (1999) provide some good recommendations for the establishment and protection of aquatic plants in the presence of herbivores. These recommendations center on the use of fencing to allow root systems of aquatic plants to establish without grazing pressure from herbivores and the establishment of local nursery colonies of aquatic plants which are permanently protected from herbivores.

**RESTORATION OF LAKE HOLDEN:
A TRUE SUCCESS STORY USING A MULTI-FACETED
APPROACH TO NUTRIENT LOAD REDUCTIONS**

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¹Environmental Research & Design, Inc., Orlando, FL

²Orange County Environmental Protection Department, Orlando, FL

Lake Holden is a 263-acre land-locked urban lake located in Orange County, Florida. The 741 acre watershed has been densely developed and urbanized with industrial and commercial land use activities on the north end of the land and residential land uses on the south end. Continued inputs of untreated stormwater runoff over many years caused severe water quality degradation in Lake Holden with consistent hyper-eutrophic conditions characterized by elevated nutrient concentrations, severe algal blooms, and oxygen depletion. During the early 1990s Lake Holden ranked second only to Lake Apopka as the most polluted lake in Central Florida.

A hydrologic and nutrient budget was developed for Lake Holden during 1992 which included a summary of nutrient sources and provided recommendations for water quality improvement projects. An aggressive program was initiated to treat runoff inputs through the use of alum stormwater treatment, wet detention ponds, dry detention ponds, SAV planting, CDS units, and street sweeping. In addition, more than 120 curb/grate basket inserts were installed within the basin to collect leaves and debris. The water quality improvement projects were funded primarily by the lakefront homeowners association through a voluntary taxing district with assistance from Orange County and the City of Orlando.

During 2004, a subsequent evaluation was conducted to evaluate the success of the previous projects and to recommend opportunities for treatment of the remaining sources. Since the majority of the feasible runoff sources had been treated, the most significant remaining phosphorus loading to the lake was internal recycling. Alum treatments were conducted during 2005-2006 to sequester internal P sources.

Beginning in 2000, water quality in Lake Holden began to improve from the historic hyper-eutrophic conditions. During the 1990s, annual average total P concentrations ranged from 40-60 ppb, with chlorophyll-a concentrations from 40-60 mg/m³, and Secchi disk depths from 0.5-0.6 m. During 2008, the mean annual total P concentrations in Lake Holden was approximately 10 ppb, with a mean chlorophyll-a of 8 mg/m³, and a Secchi disk depth of more than 2 m. The water quality improvements in Lake Holden provide an excellent example of an extremely effective multi-faceted lake management approach conducted as a partnership between public and private organizations.

NOTES

SESSION 8

POTENTIAL METHODS TO DEVELOP SITE SPECIFIC ALTERNATIVE NUTRIENT CRITERIA FOR LAKES

WHAT DETERMINES NUTRIENT CONCENTRATIONS IN FLORIDA LAKES: NATURAL FACTORS OR HUMAN ACTIVITIES?

Dana L. Bigham, Roger W. Bachmann, Mark V. Hoyer, and Daniel E. Canfield, Jr.
Florida LAKEWATCH, School of Forest Resources and Conservation,
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The proposed EPA nutrient standards for Florida are based on the assumption that any Florida lake that is eutrophic (has an average chlorophyll concentration higher than 20 micrograms per liter) is impaired by excess nutrients due to human activities. We tested this hypothesis using a database of 1406 Florida lakes. For comparison we used data on 30 DEP benchmark lakes and also paleolimnological data from 51 Florida lakes. The group of 30 DEP benchmark lakes is distributed throughout the State and located in watersheds with minimal human development. The 51 Florida lakes with paleolimnological data were obtained courtesy of Tom Whitmore. We found: 1) Natural variability as represented by the 47 EPA lake ecoregions (Griffith et al. 1997) explained about 45% of the variance in total phosphorus concentrations, 2) There is no correlation between human activities around lakes as measured by the Landscape Development Intensity index (Brown and Vivas 2000) and total phosphorus concentrations (Figure 1), 3) There is no statistical difference between the presettlement phosphorus concentrations and modern phosphorus concentrations as measured by paleolimnological methods in a sample of 41 Florida lakes (Figure 2), and 4) There is no statistical difference between the total phosphorus concentrations in the 30 Florida benchmark lakes and the rest of the Florida lakes in our sample with a large variety of human activities around their lakeshores. The conclusion is that for most Florida lakes, as a group, the current concentrations of total phosphorus are not significantly different from those in presettlement times, and that most Florida lakes with high phosphorus concentrations are due to natural factors rather than human activities.

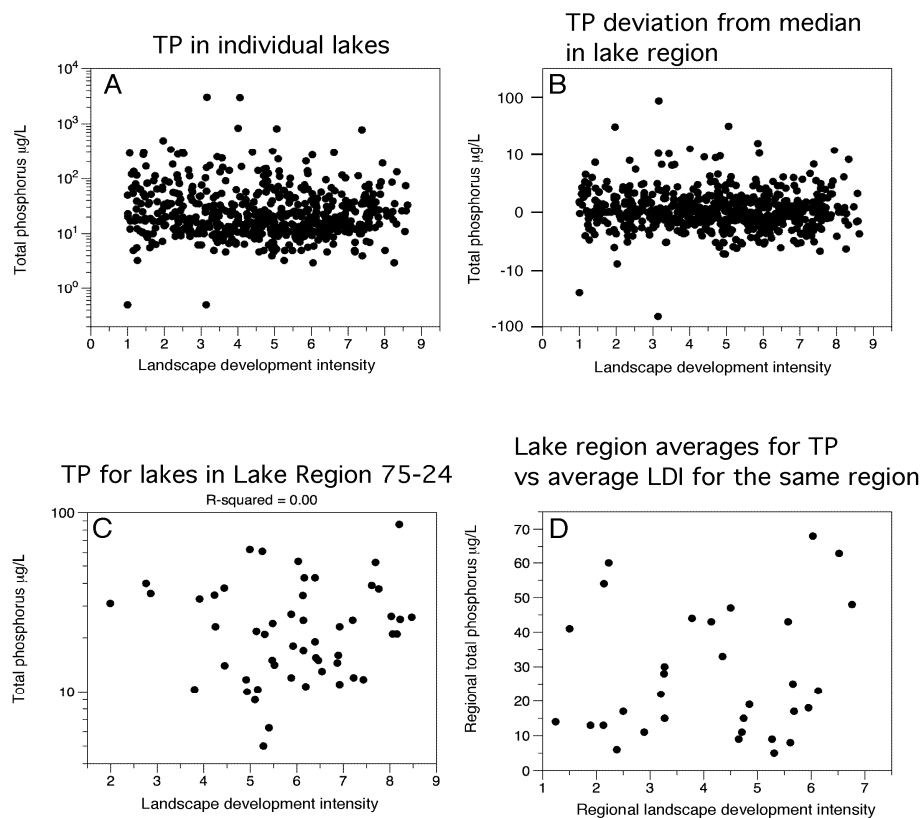


Figure 1 (A-D). Total phosphorus concentrations ($\mu\text{g/L}$) and the landscape intensity index (LDI) for individual Florida lakes (2A), deviation from the median in the given USEPA Florida Lake Region (2B), in a specific Florida Lake Region (75-24) (2C), and Florida Lake Region averages compared to LDI averages (2D).

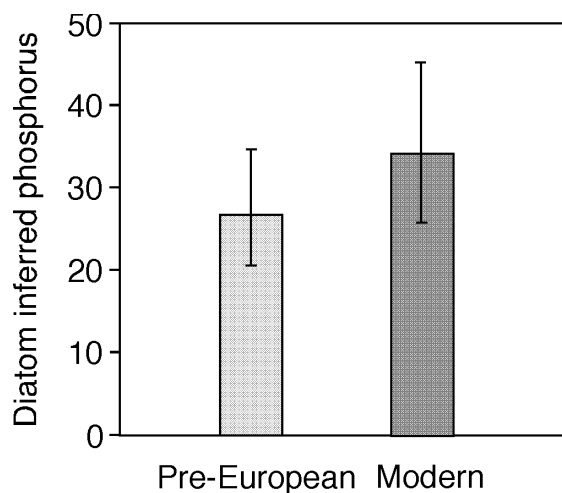


Figure 2. Concentrations of phosphorus inferred from diatoms found in sediment core samples from 41 Florida lakes. The error bars represent 95% confidence limits on the means. There is no significant difference between the Pre-European and modern phosphorus concentrations for this group of Florida lakes.

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WHAT IS THE BEST WAY TO SET NUTRIENT STANDARDS FOR FLORIDA LAKES?

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University of Florida, Gainesville, FL

The US EPA has proposed nutrient standards for Florida lakes based on the false assumption that all eutrophic lakes in Florida are impaired by human activities that are artificially raising the concentrations of phosphorus and nitrogen in the water. The result is that a lot of resources will be devoted to trying to reduce nutrients in lakes that naturally have high nutrient concentrations. We have developed an alternative procedure to set nutrient standards that takes into account the natural variations in nutrient concentrations in lakes among the 47 EPA lake ecoregions for Florida. While consideration is given to the relationships between nutrient concentrations and biological variables like algal populations, algal toxins, aquatic plants, fish, and aquatic birds, we have based our standards on what Florida lakes would be like without human development in their watersheds. We started with the distributions of TP and TN in the 45 lake regions with lakes in them and combined similar lake regions to obtain 9 groupings of lakes with similar characteristic. We then developed our standards to set off the top 10% of the lakes in each of these groupings as potentially impaired. Our goal is to have a set of standards that will focus on the real problem lakes and at the same time protect lakes that currently have nutrient concentrations below the proposed standards. The proposed standards are listed in the following table.

For the proposed EPA nutrient criteria

63 % of the lakes failed at least one of the baseline criteria
38 % of the lakes would fail after we modified the TP and/or the TN criteria within the designated boundaries
12 % of the oligotrophic lakes would not be protected because their alkalinity exceeds 50 mg/L as CaCO₃

For our proposed nutrient criteria

6 % of the lakes failed for the baseline phosphorus criteria alone
6 % of the lakes failed for the baseline nitrogen criteria alone
4 % of the lakes failed for both the baseline phosphorus and nitrogen criteria
16 % of the lakes failed for one reason or another

41 % of the lakes are potentially oligotrophic
3 % of the potentially oligotrophic lakes and are protected by a baseline TP or TN standard and 100% would be protected with our site specific criteria

Proposed nutrient criteria for total phosphorus and total nitrogen in Class I and Class III Florida lakes based on the EPA lake regions. In the last column N is the number of lakes in the sample used to establish the criteria.

A. Baseline criteria

EPA Lake Region Numbers	TP mg/L	TN mg/L	N
65-03	0.005	0.479	15
65-05	0.011	0.533	6
75-04, 75-09, 75-14, 75-15, 75-20, 75-33	0.022	0.960	197
65-01, 65-02, 75-01, 75-03, 75-05, 75-11, 75-12, 75-16, 75-19, 75-23, 75-24, 75-27, 75-32, 76-03	0.045	1.20	543
75-02, 75-17, 75-29, 75-31, 75-34, 76-02	0.082	1.50	103
65-04, 75-06, 75-08, 75-10, 75-13, 75-21, 75-22, 75-26, 76-01	0.097	1.66	416
75-18, 75-35	0.125	1.96	15
75-07	0.313	2.79	49
65-06, 75-25, 75-28, 75-30, 75-36, 75-37, 76-04	0.354	2.45	93

B. Site specific criteria.

Oligotrophic lakes will be defined as those that have 1) a long term average of less than 6 mg/L of chlorophyll and 2) less than 30 % coverage by surface area of submersed aquatic macrophytes. The site-specific criteria for total phosphorus will be the long-term average total phosphorus concentration in that lake and the site-specific criteria for total nitrogen will be the long-term average total nitrogen concentration in that lake.

NOTES

CHALLENGES ASSOCIATED WITH THE DEVELOPMENT OF SITE SPECIFIC ALTERNATIVE CRITERIA FOR THE WINTER HAVEN CHAIN OF LAKES

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PBS&J, Tampa, FL

The Winter Haven Chain of Lakes (WHCL) system includes a wide variety of lakes that vary from those with low levels of tannins and high levels of chlorophyll-a to those with high levels of tannins and low levels of chlorophyll-a. For those lakes in the lower elevations with swamp-lined shorelines, nutrient concentrations do not correlate very well with chlorophyll-a concentrations, as tannin levels appear to moderate the transformation of nutrients into phytoplankton. For lakes at higher elevations, with sandy shorelines, phytoplankton levels appear to be more sensitive to nutrient availability than the “typical” Florida lake. Not only do lakes within the WHCL respond differently to nutrients, depending upon other characteristics of the lake, their pre-development condition can vary substantially from lake to lake. Given such variability in both pre-development conditions and current-day nutrient sensitivity, Site Specific Alternative Criteria (SSAC) can be important tools for setting location-specific water quality goals.

FDEP allows for the development of two types of SSAC. A Type-I SSAC is based on the demonstration that locally-developed water quality criteria are more appropriate for the lake(s) in question than default values from various regulatory agencies (i.e., FDEP or EPA). In the WHCL, paleolimnological techniques have shown that a variety of lake conditions existed prior to human alteration of the WHCL system; some lakes had lower historical chlorophyll-a levels than existing standards, and some had higher chlorophyll-a levels than standards.

Type II SSACs are based on the demonstration that current or proposed water quality conditions could fully support a healthy and well-balanced aquatic community, even if these conditions are different from existing criteria and even in the absence of paleolimnological evidence of the historical occurrence of alternative conditions.

Data from the WHCL will be used to illustrate the opportunities and challenges associated with the use of SSAC for developing water quality goals and conceptual restoration projects for the WHCL system.

NOTES

USING THE MORPHOEDAPHIC INDEX, WATER COLOR, AND COMPENSATION DEPTH TO DEVELOP NUMERIC NUTRIENT CRITERIA FOR LAKES

Ed Lowe, John Hendrickson, Larry Battoe, and Mike Coveney
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EPA has proposed uniform numeric nutrient standards for each of three categories of lakes: 1) acid clear, 2) alkaline clear, and 3) colored. The proposed chlorophyll *a* standard for the first class is 6 ug/L as a geometric mean while for the latter two classes the standard is 20 ug/L. Given the wide range in trophic states found in Florida lakes, this coarse categorization leads to under-protection of many lakes and over-protection of others. We propose that a continuous model of trophic state provides a better basis for numeric nutrient standards. We developed a continuous, empirical model of trophic state based on two parameters: 1) an index of inherent lake productivity, the morphoedaphic index {MEI = Alkalinity (meq L⁻¹)/mean depth (m)} and 2) water color (pcu). We fit a multiple regression model to data for northeast Florida lakes representative of the range of variation along two environmental gradients, acidic to alkaline and clear to colored. For each lake, two conditions were estimated: natural background and the upper limit of designated use (ULD). The ULD was estimated as the concentration of chlorophyll *a* at which the compensation depth was reduced by 10%, or ULD was derived from total maximum daily loads or pollutant load reduction goals where these were set for the lake. The MEI-color models were highly significant. Our predicted ULDs for annual mean TP and chlorophyll *a* indicate lake types where categorical criteria may be insufficiently protective, or at the other extreme, over-protective and potentially un-attainable. In order to protect the aquatic biodiversity of Florida's lakes, we believe it is necessary to preserve the rich spectrum of trophic states. We propose that this protection requires that numeric nutrient criteria restrict deviation from the natural background trophic state. Because transparency can control the balance between phytoplanktonic and benthic primary production in shallow lakes, ULDs should be set to limit degradation of the compensation depth.

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SESSION 9

MONITORING AND ASSESSMENT OF FLORIDA'S AQUATIC RESOURCES PART I

MAPPING CHANGES IN WOODY VEGETATION COVER OVER THE CHOCTAWHATCHEE BAY AREA AND ITS SUBSEQUANT EFFECTS ON WATER CHEMISTRY OF THE ESTUARY SYSTEM

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Urbanization replaces the extent natural resource base (e.g., forests, wetlands) with an infrastructure that is capable of supporting humans. One ecological consequence of urbanization is higher concentrations of nitrogen (N) and phosphorus (P) in streams, lakes, and estuaries. The greatest increases in N and P are more likely to occur where urbanization replaces forest rather than agriculture. Studies of the relationship between land cover and the amount of N and P in water bodies show that high proportions of forest are needed to maintain low amounts of N and P. Using Landsat TM Imagery, this study estimates the amount of tree cover in the Choctawhatchee Bay Area and aids in the assessment of how tree clearing relates to nutrient concentrations in the receiving estuary. Radiometrically corrected Landsat TM imagery (bands 3, 4, and 5) from dry season periods from the 1980s, 1990s, and present were used to detect woody vegetation change using maximum likelihood algorithms used with an unsupervised land classification followed by a change detection. Water chemistry data including total phosphorus, chlorophyll, total nitrogen, and Secchi depth were compiled from multiple state agencies and projects over a time spread of 40 years. Water chemistry changes in Choctawhatchee Bay in response to changes in woody vegetation cover throughout the Choctawhatchee watershed will be presented.

NOTES

LAKE MORPHOLOGY: APPLICATION OF SPATIAL ANALYSIS TO BETTER MANAGE AND UNDERSTAND LAKE MORPHOLOGIC DATA

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Morphology is the study of physical structures. When applied to lakes, it involves the study of such spatial elements as depth, volume, shoreline, length and width. The measurement of a lake's morphology may be easily accomplished today by employing spatial analysis techniques and through the use of bottom sounding methods and should be incorporated into any lake assessment. This paper discusses the techniques employed and refined in the University of South Florida's Water Atlas Lake Assessment Project and reports the findings from the 2006-2009 series of lake assessments. The paper also includes a model developed for morphologic spatial analysis and examples of application to lakes in Polk County.

The Lake Assessment Project began in 1998 with lakes in Hillsborough County Florida and was carried out through the support of the Southwest Florida Water Management District, Hillsborough County and, recently, Polk County. The goal of the morphological element of the study was to determine lake area, depth, mean depth and volume and for Polk County lakes, develop a stage volume relationship for the lake and extend that relationship to the lake margin. A combination of spatial analysis and measurement were used.

The method includes pre-field, screen-digitizing of lake perimeter from the latest aerial photographs; lake bathymetry employing a small boat or kayak equipped with a Lowrance LCX-26C HD Fish-finding Sonar & Mapping GPS system for collection of three dimensional (3D) spatial data; post field analysis to develop bathymetric maps of lakes and determine the lake volume and lake volume below specific lake stages (lake elevation above the North American Vertical Datum, 1988 (NAVD 88)). Raw bathymetric data is processed using a custom Microsoft Excel workbook which removes uncorrelated values, converts Lowrance positional data to a geographic coordinate system value (latitude and longitude). The result of this process is a clean file of horizontal and vertical data points (XYZ) which can then be used in the spatial processing steps required to build a bathymetric map of the lake. Spatial analysis includes the creation of a Triangulated Irregular Network (TIN) and then processing the TIN to determine lake volume and creating a raster-format bathymetry map and contour map for each lake.

As stated earlier, for Polk County the project also included the development of a stage to volume table and graph to better understand the storage volume of a lake. Lake bathymetry raster data and LIDAR derived, lake margin raster data are combined to produce a single raster that includes elevations above the NAVD 88 base elevation for a lake and within a 300 foot margin around the lake as shown in Figure 1. A set of spatial models are used to produce the raster and to create the text file that is used to develop the

stage-volume table. These models allowed for more efficient spatial data processing and ensured repeatable and accurate analysis results.

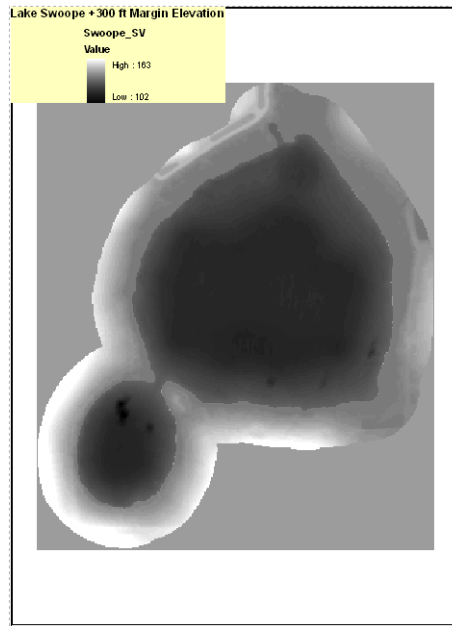


Figure 1. Resulting lake-lake margin raster required for stage-volume determination.

The final product is a stage-volume table that provides the elevation of the lake surface above NAVD 88, and the lake volume at that elevation. It is determined by iteratively calculating lake volume at increasing elevation from the lake bottom and then extending the calculations beyond the lake perimeter to the surrounding lake margin. This extension allows estimation of possible storage within the lake's watershed at elevations above the lake elevation at the time of the bathymetric mapping event.

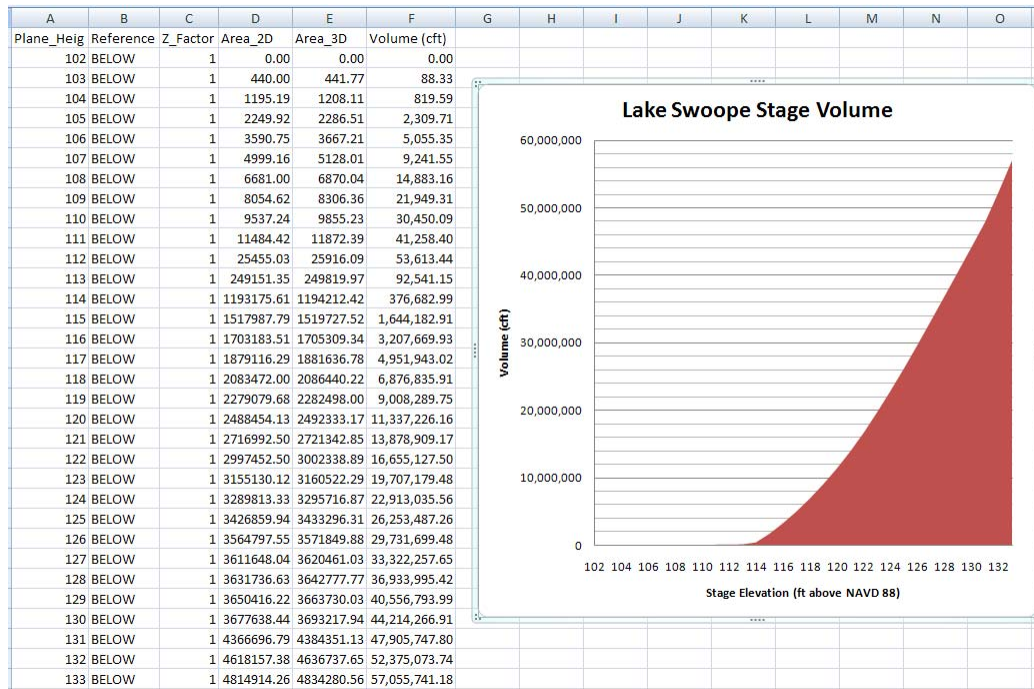


Figure 2. Stage-volume model output for Lake Swoope in Polk County.

NOTES

QUANTIFICATION OF SEAGRASS ABUNDANCE IN CHOCTAWHATCHEE BAY, FLORIDA USING LANDSAT TM IMAGERY.

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According to historic studies of seagrass acreage on Choctawhatchee Bay, it appears that the bay has supported varying amounts of seagrass in the last 50 years. Seagrass areas have declined in several locations since the 1950s. The abundance of seagrass is highly sensitive to environmental disturbance. The Choctawhatchee bay area is experiencing increases in population growth combined with increased land development and recreational usage of its waterways. Mapping and monitoring of seagrass beds is an expensive undertaking. The accuracy of a more cost-effectiveness remote sensing approach needs to be evaluated. Remote sensing techniques have been successful in mapping coral reef and seagrass areas in shallow, clear coastal waters. The U.S. Geological Survey, National Wetlands Research Center conducted an extensive survey of the submersed aquatic vegetation in the Choctawhatchee bay area in 1992 and 2003. These data along with an extensive field survey conducted by the Choctawhatchee Basin Alliance (CBA) in July of 2009, have been used to make a model to retroactively map seagrass coverage in the bay. Arial changes in sea grass coverage will be presented as well as water quality parameters. Cost-benefit and monitoring considerations will be discussed.

NOTES

SEAGRASS COMMUNITIES OF FLORIDA'S SPRINGS COAST - A COMPARISON OF THE 1985, 1999, AND 2007 MAPS AND COVERAGES

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INTRODUCTION

Previous seagrass mapping efforts of the Big Bend Region of Florida estimated inshore to midshore seagrass beds at nearly 800,000 acres and the offshore seagrass coverage at 1,000,000 acres (Dawes *et al* 2004). These combined regions of inshore, midshore, and offshore seagrass place them among the largest seagrass communities in the world (Iverson and Bittaker, 1986). Seagrass of this region is intricately linked to the sustainability of coastal fisheries, crustaceans, shellfish, mammals, and macro-invertebrates. Detailed information on seagrass is needed for the management and protection of these marine resources. This project focused on the southern half of Florida's Big Bend Region, known as the *Springs Coast* and resulted in the first seagrass maps of both inshore and midshore waters (500,000 acres) using high resolution digital imagery (collected in April 2007). This region of Florida has had much less research attention than other coastal areas, and it is critical to establish a detailed inventory of its seagrass so that changes and impacts to this valuable habitat can be detected. The project serves to monitor the long term health of seagrass beds and to promote informed management decisions of this complex system of estuaries, bays, and marine waters.

METHODS

The imagery for this project was collected using an Intergraph Digital Mapping Camera (DMC) and Applanix Inertial Measurement unit (IMU) utilizing airborne GPS procedures. Image resolution was 1 ft. Conditions were measured in the field prior to flights to determine if conditions were suitable for image acquisition. Data on seagrass percent cover, water clarity, and depth was collected at 60 stations during a 4 week window around the imagery acquisition. The stations were equally spaced at four mile intervals across the 500,000 acre project area. The data was used as background for field verification and also testing final mapping accuracy.

Roughly 96 stations were visited during ground truthing exercises to verify seagrass density. Seagrass cover was classified using the Florida Land Use and Cover Classification System (FLUCCS). Seagrass categories included dense (FLUCCS 9112), sparse to medium (9111), and patchy (9113). Unvegetated areas were classified as bays and estuaries (5400), tidal flats (6510), or oyster bars (6540). Land was classified as either spoil islands (7430) or unclassified land. The mapping unit for all categories was 0.5 acres. An accuracy assessment was completed by field verification of 130 randomly generated polygons. The project area was divided into four segments as follows: Anclote River to Pithlachascotte River, Aripeka to Hernando Beach, Weeki Wachee River to Chassahowitzka River, and Homosassa River to Crystal River.

DISCUSSION

Little data or imagery has been collected of the seagrass and other benthic communities of the midshore to offshore (beyond 6 miles) waters of the Springs Coast. Prior to this project, the most recent imagery for offshore areas was collected in 1985 (Continental Shelf Associates 1985). The broad shallow coastal shelf along the Springs Coast permits the development of an extensive seagrass community and is geologically characterized as drowned karst with limestone at or near the surface (Mattson 1995, Wolfe 1990).

The 2007 imagery provided the first detailed images of offshore waters of the Springs Coast. The imagery revealed an assemblage of seagrass greater in complexity than interpreted and mapped in 1985 by Continental Shelf Associates, Inc (CSA). CSA classified the offshore waters from 6 miles to 14 miles offshore as a monotypic stand of dense seagrass. The 2007 imagery shows this region to contain a mix of varying levels of seagrass cover (from dense to bare bottom) that intertwine with areas of exposed limerock. An example of these complex variations in seagrass density is shown in Figure 1. Field data collected during the project suggests that these complex variations in density are associated with differences in sediment substrates and thickness. The darker strands in Figure 1 were dense seagrass growing in deeper clay or muddy sediment. Areas that contain a higher percentage of clay sediments generally support denser seagrass beds. The lighter colored areas depicted sparse or patchy seagrass growing in a thin veneer of sediment on top of limerock.

Unique large isolated strands of dense seagrass beds were revealed in the northern offshore portion of the project area, 12 miles west of Crystal River (Figure 2). Sediments within these dense strands of *Syringodium* are predominantly soft clay sediment 6 to 8 inches in depth. Areas adjacent to these meandering river-like strands were predominantly macroalgae and sparse seagrass growing within sand or sand and shell. Other unique features observed throughout the offshore imagery were large circular areas of dense seagrass. These circular dense beds are likely solution basin depositional areas that occur within this karst region (Wolfe 1990). Some of these features are large comprising 200 acres.

RESULTS

A comparison of the total acreages of seagrass mapped for each of the project area segments is shown in Table 1. Both the Aripeka segment and the Weeki Wachee segment contained the largest area of continuous seagrass. These segments are within the center of the Springs Coast Region. Seagrass cover was found within 379,016 acres of 494,404 total acres mapped, or 77% of the total project area.

A complete summary of the coverages by segment and for the total project area is shown in Table 2. In general, dense seagrass comprised 272,772 acres or 63% of the 431,323 acres of submerged bottom mapped. Seagrass within the sparse to medium classification comprised 87,393 acres (20%), patchy seagrass comprised 18,851 acres (4%), and bare substrate comprised 52,305 acres (12%). Dense seagrass was the dominant seagrass cover type within all four segments, with the Aripeka segment and Weeki Wachee segment containing the largest area and percentage of dense seagrass (68% and 73%, respectively). In contrast, the Anclote segment and Homosassa segment, contained larger areas of non-vegetated or bare substrate (24% and 21%, respectively).

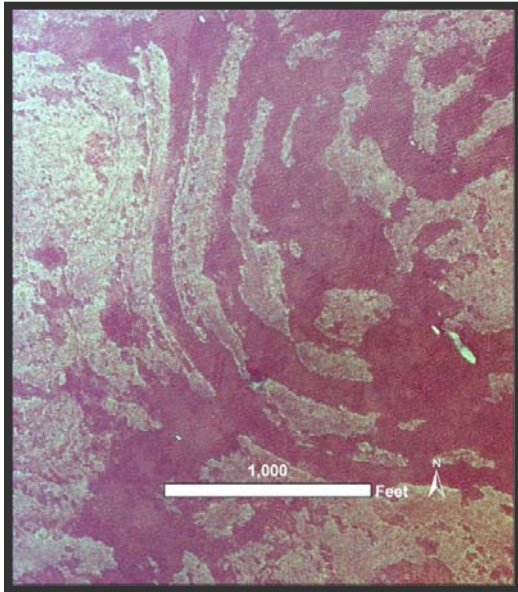


Figure 1. Alternating dense and sparse seagrass offshore 8 miles offshore Hernando County, depth 10-12 feet.

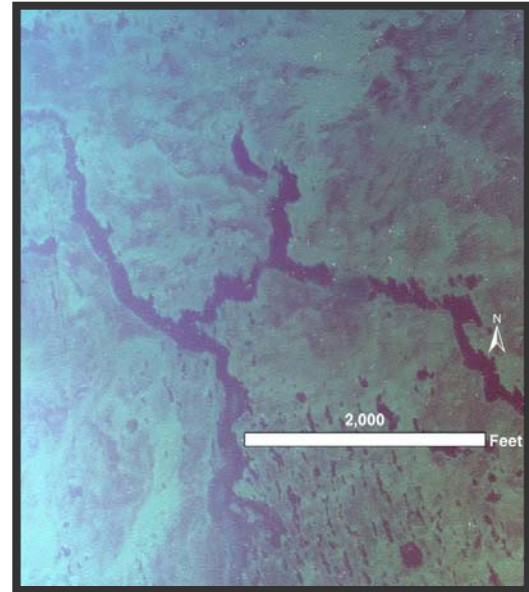


Figure 2. River-like strand of dense offshore *Syringodium* 12 miles offshore Citrus County, depth 12 to 14 feet.

Table 1. 2007 seagrass habitat area (acres) by estuarine segment. Continuous seagrass is the combination of dense seagrass and sparse to medium seagrass.

Seagrass Type	Anclote to Pithlachascotee	Aripeka to Hernando Beach	Weeki to Chassahowitzka	Wachee	Homossasa to Crystal River	All Regions
Patchy Seagrass	5,903	4,138		4,401	4,408	18,851
Continuous Seagrass	40,422	94,316		137,526	87,896	360,165
All Seagrass	46,325	98,454		141,927	92,304	379,016

Table 2. 2007 seagrass habitat area (acres) and non-vegetated benthic habitats by major estuarine segment.

Habitat Type	Anclothe to Pithlachascotee	Aripeka to Hernando Beach	Weeki Wachee to Chassahowit zka	Homossasa to Crystal River	All Regions
Seagrass					
Dense Seagrass	36,221 59%	76,855 68%	100,825 73%	58,870 50%	272,772 63%
Patchy Seagrass	5,903 10%	4,138 3%	4,401 4%	4,408 4%	18,851 4%
Sparse to Medium	4,201 7%	17,461 25%	36,701 17%	29,026 25%	87,393 20%
<u>All Seagrass</u>	<u>46,325</u>	<u>98,454</u>	<u>141,927</u>	<u>92,304</u>	<u>379,016</u>
Non- vegetated - Open Water, Tidal Flats, and Shoals	14,575 24%	7,091 4%	5,759 7%	24,881 21%	52,305 12%
<u>Total Area of Submerged Bottom</u>	<u>60,902 100%</u>	<u>105,547 100%</u>	<u>147,688 100%</u>	<u>117,186 100%</u>	<u>431,323 100%</u>
Total Project Area	74,305	110,694	163,335	146,067	494,402

Dense seagrass beds extend well beyond the western boundary (further offshore than 14 nm) of this project's study area. These dense beds are primarily located within the shallow offshore zones of Aripeka and Weeki Wachee segments, where water depth increases at a gradual rate of 1 foot per mile. The shallow depth (< 20 ft), good water clarity, and adequate light penetration support seagrass growth in these offshore waters (Zieman and Zieman 1989).

SUMMARY

The higher resolution 2007 imagery provided an opportunity to map variations in seagrass density at a higher level detail than previous efforts that used lower resolution film imagery (Kolasa and Craw 2009). The resulting maps revealed a complex assemblage of seagrass beds within both the inshore and offshore region of the Springs Coast. In general, dense seagrass comprised 272,772 acres or 63% of the 431,323 acres of submerged bottom mapped. Seagrass within the sparse to medium classification comprised 87,393 acres (20%), patchy seagrass comprised 18,851 acres (4%), and bare substrate comprised 52,305 acres (12%). The

completed 2007 seagrass coverage and its higher level of level of line work and detail will provide a solid baseline to monitor future changes and potential impacts to this valuable habitat. Future imagery acquisition and map production is planned to be repeated in 2012 and will include a change analysis between the 2007 and 2012 coverages. Since the current and past mapping efforts did not extend far enough offshore to capture the deep edge of seagrass beds in this region, the imagery collection would need to be expanded in 2012 to capture these areas. These beds serve as a bridge for groupers and other important fish and shellfish species as they migrate in and offshore, and currently little information is available for this offshore region (14 nm to 25 nm offshore).

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NOTES

CALIBRATION OF THREE FLORIDA BIOLOGICAL INDICES USING THE BIOLOGICAL CONDITION GRADIENT APPROACH

Russ Frydenborg

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The Florida Department of Environmental Protection (FDEP) has calibrated multi-metric indices for stream invertebrates, lake plant communities, and stream periphyton, using the Biological Condition Gradient (BCG) concept. We conducted a series of workshops, using the framework of Davies and Jackson (2006), where we convened a group of scientists who possessed expertise in aquatic ecology and the taxonomy of the organisms in question (invertebrates, macrophytes or algae). This panel reviewed, as individuals, taxonomic data from a subset of samples across a human disturbance gradient and provided scores for those samples using the BCG framework (see below). The groups then discussed the logic for each individual's choice of category, and based on the ensuing discussion, panel members were then given the opportunity to modify their score. It is critical to note that the experts had no knowledge of the index scores, site location (other than general sub-ecoregion), or any other physical, chemical, or site disturbance information. Thus, they made their decisions solely on the basis of the attributes of biological community structure and function they could infer from the taxonomic data.

The BCG concept definitively describes how ten ecological attributes change in response to increasing levels of stressors. These ten attributes are: Historically documented, sensitive, long-lived or regionally endemic taxa; Sensitive and rare taxa; Sensitive but ubiquitous taxa; Taxa of intermediate tolerance; Tolerant taxa; Non-native taxa; Organism condition; Ecosystem functions; Spatial and temporal extent of detrimental effects; and Ecosystem connectance.

Based on the above attributes, the BCG model segregates biological condition into six tiers that FDEP believes are especially useful for biological criteria development efforts:

- 1) Native structural, functional, and taxonomic integrity is preserved; ecosystem function is preserved within the range of natural variability;
- 2) Virtually all native taxa are maintained, with some changes in biomass and/or abundance; ecosystem functions are fully maintained within the range of natural variability;
- 3) Some changes in structure due to loss of some rare native taxa; shifts in relative abundance of taxa, but sensitive-ubiquitous taxa are common and abundant; ecosystem functions are fully maintained through redundant attributes of the system;

- 4) Moderate changes in structure due to replacement of some sensitive–ubiquitous taxa by more tolerant taxa, but reproducing populations of some sensitive taxa are maintained; overall balanced distribution of all expected major groups; ecosystem functions largely maintained through redundant attributes;
- 5) Sensitive taxa are markedly diminished; conspicuously unbalanced distribution of major groups from that expected; organism condition shows signs of physiological stress; system function shows reduced complexity and redundancy; increased buildup or export of unused materials; and
- 6) Extreme changes in structure; wholesale changes in taxonomic composition; extreme alterations from normal densities and distributions; organism conditioning is often poor; ecosystem functions are severely altered.

The BCG model was extensively tested by USEPA by determining how consistently a regionally diverse group of biologists, including a representative from FDEP, assigned samples of macroinvertebrates or fish to the six tiers. The BCG model is consistent with ecological theory and enables ecologically relevant interpretations of the response of aquatic biota to stressors. Based upon three independent calibrations of Florida’s biological indices, as well as input from several National BCG Workshops, FDEP has determined that sites associated with BCG scores of 5 and 6 do not meet the criteria for our State’s designated use of “healthy, well balanced communities of aquatic flora and fauna.”

FDEP believes that the BCG is useful for many purposes, including numeric nutrient criteria development and stressor identification. Use of the model may result in the determination that acceptable levels of nutrients may (or may not) be higher than historic background conditions, since well defined biological response endpoints are used for the assessment. Also, because biological communities respond to all sources of stress (natural and anthropogenic), the model offers a mechanism to evaluate potential stressors and control for confounding variables during the assessment process. Finally, since the BCG model is based upon sound, nationally accepted ecological concepts, criteria developed based upon it will be scientifically and legally defensible.

NOTES

EFFECTS OF A CATASTROPHIC FOREST FIRE ON THE TROPHIC PARAMETERS OF AN OUTSTANDING FLORIDA WATER

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In nature, ecosystems are subject to subtle or gradual changes all the time, but sometimes nature provides periodic disturbance events or a single stochastic event that alter the ecosystem's relative "stability". Stochastic events such as wildfires can affect different ecosystem components such as changes in the hydrology, the nutrient budget and changes in water quality. Fire events have been a frequent and important mechanism of disturbance in Florida as well as the rest of North America for many centuries. The most visible effects of fire are the loss of vegetation and increase of soil erosion but the less obvious but equally important effects of wildfires occur after the fire is extinguished. For example, fires have the greatest potential to change nutrient losses from the watershed but few studies highlight its importance on the aquatic environment. In this study, the changes in trophic state parameters (e.g., phosphorus) due a wildfire event in 2007 are discussed for the Santa Fe lake group (Little Santa Fe, Santa Fe and Melrose Bay; outstanding Florida waters located in Alachua County). The availability of long-term data permits a documentation of the effect and duration of the 2007 Dairy Road fire that occurred in the Santa Fe Swamp. This study is of great importance for understanding the importance of stochastic events on Florida's water resources.

NOTES

SESSION 10

TECHNIQUES AND TOOLS FOR WATER QUALITY ASSESSMENT

WATER QUALITY MODELING OF LAKE JESUP USING QUAL2K: PART IV – RETURN OF THE SECCHI

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A water quality model of Lake Jesup was developed using the EPA QUAL2k model. The model was originally calibrated to in-situ water quality data from 1991-2003. The calibration has been updated using a more extensive data set that spans the 1960's to 2009. The nutrient loading estimates have also been updated to reflect recent data that has been collected. The updated model was used to investigate load reduction scenarios and to try and answer the seminal question “what bang do we get for our capital buck?”

NOTES

DESIGNING A DYNAMIC DATA DRIVEN APPLICATION SYSTEM FOR ESTIMATING REAL-TIME LOAD OF DOC IN A RIVER

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Understanding the dynamics of naturally occurring dissolved organic carbon (DOC) in a river is central to estimating surface water quality, aquatic carbon cycling, and global climate change. Currently, determination of DOC in surface water is primarily accomplished by manually collecting samples for laboratory analysis, which requires at least 24 hours or longer. In other words, no effort has been devoted to monitoring real-time variations of DOC in a river due to the lack of suitable and/or cost-effective wireless sensors. However, when considering human health, carbon footprints, total maximum daily loads, effects of urbanization, industry, and agriculture on water supply, timely DOC information may be critical. We have developed here a new paradigm or a dynamic data driven application system (DDDAS) for estimating the real-time load of DOC in a river. This DDDAS consists of the following four components: (1) a Visual Basic (VB) program for downloading US Geological Survey real-time chlorophyll and discharge data from the internet; (2) a STELLA model for evaluating real-time DOC load based on the relationship between chlorophyll *a* and DOC as well as on the river discharge; (3) a batch file for linking the VB program and STELLA model; and (4) a Microsoft Windows Scheduled Tasks wizard for executing the model and displaying output on a computer screen at selected timeframes. The DDDAS was validated using field measurements with a good agreement prior to its application. Results show that the real-time load of DOC in the river varied from positive to negative with a range from -13,143 to 29,248 kg/h at the selected site. The negative loads occurred because of the back flow in the estuarine reach of the river. The cumulative load of DOC in the river for the selected site at the end of the simulation (178 hours) was about 1.2 tons. Our results suggest that the DDDAS developed in this study was useful for estimating the real-time variation of DOC in a river ecosystem.

NOTES

**THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT'S
AMBIENT LAKES MONITORING NETWORK:
USING FLORIDA LAKE REGIONS TO DEFINE EXPECTED
WATER QUALITY IN LAKES**

Chris Barnes

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The Southwest Florida Water Management District (District) established the Ambient Lakes Monitoring Network (Network) in 1994 as a cost-effective method of collecting data for lake management decisions. The Network consists of 327 lakes representing approximately 18% of major lakes in the District and 50% of lake surface area. Network lakes are sampled twice per year (wet and dry season) on a three-year rotating basis. Field readings are taken for temperature, pH, dissolved oxygen, salinity, specific conductance, and transparency; and water samples are tested for chlorophyll, nitrogen, phosphorus, ammonia, orthophosphate, sulfate, color, turbidity, and total suspended solids. While this is a low-intensity sampling regime, District staff are able to detect possible impairments by grouping data according to the Florida Lake Region (Region) classification system established by Griffith *et al.* (1997). Data for Network lakes within a Region are used to generate expected levels of water quality for that Region, creating a reference even for lakes never previously sampled. The results of sampling events for any Network or non-Network lake in the Region may then be compared to expected levels to determine possible impairment. Lakes which deviate from established Regional expectations are then subject to more intensive monitoring to confirm their level of impairment and determine whether intervention is warranted. Grouping lakes by Region has the potential to be an efficient and effective method of managing lakes throughout Florida. Given the inherent financial constraints on sampling programs, development and refinement of this type of monitoring program is a worthwhile investment.

NOTES

THE RELATIONSHIP BETWEEN LAND USE AND STORMWATER QUALITY IN A PHOSPHATE RICH WATERSHED IN NORTH CENTRAL FLORIDA

Jian J. Di and Erich Marzolf

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Fifty eight storm water quality samples from four stations representing four different land uses were collected in the Newnans Lake Watershed located east of Gainesville, Florida. The four land uses are Forest, Industrial, Range/Open Space, and Agricultural respectively. These samples were collected between July 2007 and August 2008, using a fully automated Isco® Avalanche sampler system. At each station, four flow-weighted water quality samples were collected during each storm event: two samples from the rising limb of the hydrograph, one sample at the peak of the hydrograph, and one on the recession limb of the hydrograph. Total nitrogen (TN), total phosphorus (TP), and total organic carbon (TOC) were analyzed. The event mean concentration (EMC) for each of the water quality parameter is calculated by averaging its concentration in each of the four samples.

TP EMC was the highest at the agricultural land use (TP = 0.842 mg/L), followed by the industrial land use (TP = 0.295 mg/L), and then at the range/open space dominated land use (TP = 0.259 mg/L). Forest dominated land use had the lowest TP EMC (TP = 0.227 mg/L). This sequence of land uses (Agricultural > Industrial > Range/Open Space > Forest) is similar to other studies conducted in Florida (Harper 1994, Hendrickson and Konwinski 1998).

The TP EMCs from this study are compared with the EMCs estimated by Harper in 1994 and Hendrickson in 1998 for the similar land uses. Overall, the TP EMC from this study is higher than reported in the literature. For example, the agricultural land use TP EMC is more than twice the reported literature value (0.842 mg/L from this study vs. 0.344 mg/L in Harper 1994). The forest land use TP EMC is more than three times higher than found by Hendrickson (1998) in the Lower St. Johns River Basin (0.227 mg/L vs. 0.06 mg/L). The phosphate rich Hawthorn Formation is widely distributed in the Newnans Lake watershed. In some areas within this watershed, this formation is located close to or at the land surface. The interaction between surface water and the Hawthorn is presumed the main cause of much higher P runoff than reported in other studies for similar land uses.

TN EMCs from this study are also compared with the EMCs estimated by Harper (1994) and Hendrickson (1998). In contrast to the TP EMCs, the TN EMCs from this

study are not consistently higher than the literature values for their respect land uses. For agricultural land use, TN EMC values are almost the same between this study and the Harper (1994) study. The TN EMC is lower for industrial land use, and higher for both forest and range/open space land uses as compared to the Hendrickson (1998) study.

These findings suggest that TP EMC generally relate to the land use, yet localized geological and soil conditions can play an important role in effecting nutrient runoff. Those localized conditions need to be taken into account when modeling watershed nutrient loading and developing site specific nutrient criteria.

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NOTES

SESSION 11

MONITORING AND ASSESSMENT OF FLORIDA'S AQUATIC RESOURCES PART II

USE OF PRESSURE-SENSING DATA LOGGERS TO ESTIMATE STORMWATER RUNOFF AND OTHER WATER BUDGET COMPONENTS

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Pressure-sensing data loggers are used to measure the height of water above them. These devices can be useful in developing water budgets for lakes and gaining an understanding of the driving forces for water movement near water bodies. Solinst® Leveloggers® were used in a number of ways for water budget development and other purposes at Lake Wimauma and Carlton Lake.

Lake Wimauma and Carlton Lake are approximately five mile apart in southeast Hillsborough County where there are few natural lakes. Both lakes exhibit the same periodicity in lake surface elevations but the amplitude is much greater for Lake Wimauma. The objective of this project was to investigate the hydrology of Lake Wimauma and compare it to Carlton Lake to gain insight into the factors affecting and/or controlling lake water level fluctuations. Of particular interest was the evaluation of the possible hydraulic interconnection between lake water and underlying aquifers through breaches in the intermediate confining layer.

During this 16-month investigation, Lake Wimauma was actually two separate pools. The lake surface of the East Pool was generally four to five feet above the elevation of the West Pool and a land bridge, approximately 75 yards wide, separated the two pools.

Leveloggers recorded water levels to one-hundredth of a foot. Data were corrected for changes in atmospheric pressure because such changes can affect apparent water depth readings. Because of the vast amount of Levelogger data collected, typically at 15-minute intervals, some data were reduced to one-hour averages and some 1-hour averages (from 11:00 to 11:45 PM) were used as daily lake stage elevation values.

Leveloggers provided lake surface elevation data that were used with topographic data to calculate monthly change in lake volume for each water body as elevation changes occurred. Carlton Lake and the West Pool of Lake Wimauma both had surveyed staff gages present and the monthly readings from these staff gages provided data that agreed well with Levelogger data.

Leveloggers were used in Carlton Lake and the West Pool of Lake Wimauma to record rainfall. Four-inch diameter and 4-foot long polyvinyl chloride pipes were fitted with a water tight end cap and secured vertically with the open end positioned to catch falling rain. A Levelogger was placed in a fixed position near the end cap and water was

added to the pipe to a level that completely covered the Levellogger. These simple rain gages consistently showed rain events that exceed approximately 0.08 feet. For lesser rain events, or when no rain occurred, the imprecision of barometrically-correct Levellogger data appeared to make rainfall quantification less reliable. Consequently, distance-weighted, averaged values from the three closest rainfall measurement stations were used to determine precipitation for the water budget of each lake.

Plotting both rain gage data and lake stage data against time allowed direct runoff, or stormwater runoff, to be estimated during the 12 to 48 hours following storm events. For each water body, rain events of 0.08 to 0.10 feet and greater were evaluated for runoff, defined here as the change in lake stage that could not be attributed to rain falling directly onto a lake. Although near-shore seepage quite likely would occur during this short time interval, it was assumed to be a minor portion of the non-rainfall component. Runoff values were summed by month for use in the water budget calculation.

Rainfall events were assessed on an individual basis because of the relatively few rain events during the investigation and the variables of rain duration and intensity and antecedent soil conditions. However, a few pertinent observations might be made about the events with greater rainfall. For example, at the West Pool, four storm events of 2.04 to 3.96 inches showed that the most notable post-rain changes to lake stage occurred within a day of each rain event. Direct rainfall to the lake surface appeared to account for 65 to 80 percent of the increase in elevation, with runoff, and possibly overflow from the East Pool, contributing to the remainder of the lake stage change.

Rain and runoff impacts to the East Pool of Lake Wimauma were complicated by whether or not overflow across the land bridge to the West Pool was occurring. On August 15, 2008, overflow was observed and approximately two inches of rain fell over approximately 11 hours. The East Pool lake stage increased by approximately 1.5 inches, i.e., less than the rain amount, during the rain event, and then fell to near the pre-rain event level over the next four days.

On July 1, 2009, the East Pool was not at the overflow elevation and rain of almost 4 inches fell in a 2- to 3-hour period. Most of the post-rain lake stage change occurred in the next day, with a lesser increase occurring the following day. Without overflow occurring, the change in lake stage was almost twice the amount of the rain.

For three rain events ranging from 1.68 to 3.72 inches at Carlton Lake, direct rainfall appeared to account for approximately half to two-thirds of the change in lake stage, while runoff accounted for the remaining third to one-half. Obvious, rain-related, lake stage change appears to end within a day of the rain event.

In-lake piezometers were installed to measure the potentiometric surface of water beneath the lake-sediment layer. Because boating sometimes occurs at night in the West Pool, it was desirable for boater safety to minimize piezometer deployment time. Levelloggers were placed within in-lake piezometers to document rates of falling or rising water levels and to establish whether water had reached its equilibrium elevation.

NOTES

RATING IMPROVEMENT AND UNCERTAINTY ANALYSIS FOR FLOW AT G381B_C AND G381E_C OF STORMWATER TREATMENT AREA 3/4

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Stormwater Treatment Area 3/4 (STA-3/4) operated by South Florida Water Management District (District) is designed to remove pollutants such as phosphorus and nitrogen from the agricultural water before discharging it into the everglades. Culverts perform the most important function in the STA-3/4. They convey flow in and out of cells to facilitate the water treatment process. By the Everglades Forever Act (1997), pollutant removal rates of the STA-3/4 must be monitored to ensure continuous flow of good quality water to sustain ecosystems downstream. It is therefore important to ensure that each culvert in the STA-3/4 has the best flow rating. A review of computation methods of STA-3/4 structures showed that culverts G381A_C, G381B_C, G381C_C, G381D_C, G381E_C and G381F_C flow ratings underestimate flow through the structures. Since these structures are water quality sampling stations, it is important to redevelop the flow ratings to ensure accurate estimation of phosphorus outflow from Cell 3B.

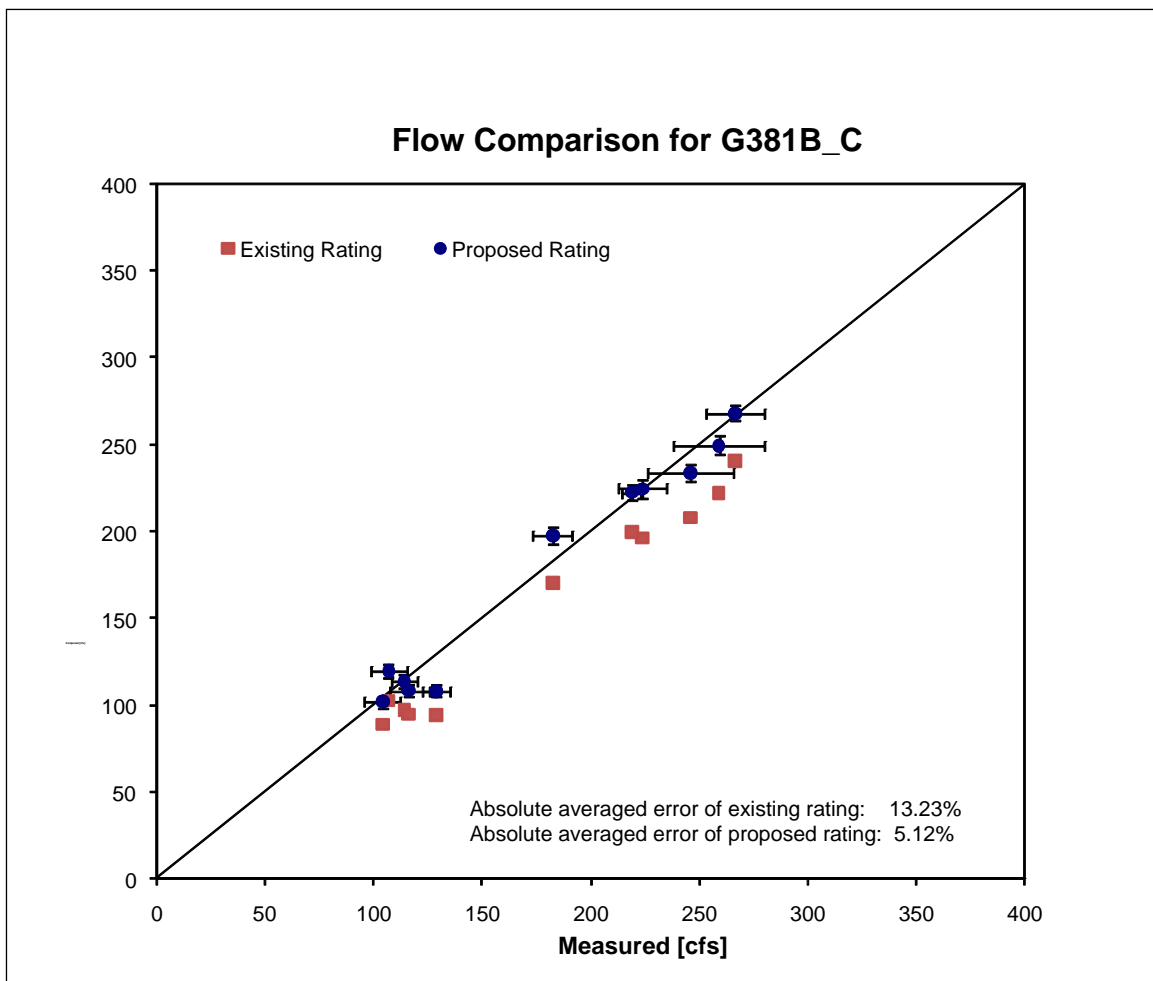
Control Structures G381A-F are a series of six gated concrete box culverts located along Cell 3 discharge canal. Each of the G381A-F structures consists of a single 8-ft wide by 8-ft high reinforced concrete box barrel approximately 102-ft long. The invert elevation of each structure is 2 ft NGVD. The structures have a nominal design flow capacity of 282 cfs (maximum design headwater is 16.8 ft NGVD and maximum design tailwater is 16.1 ft NGVD). Local and remote operation of the gates is possible. Remote operation via telemetry is from the District's West Palm Beach Operations Control Center. Headwater, tailwater and gate position information are available to the remote operators, while headwater and tailwater staff gauges and gate position indicators are available for local operation.

In Flow Program, G381A_C and G381C_C have been setup to use headwater and tail water stages from G381B_C. Similarly, G381D_C and G381F_C use stage data from G381E_C for flow computations. Given that the two culvert groups have similar hydraulic characteristics, flow rating for the stations with stilling wells is assumed to be the same for the stations which use their stage data. A total of thirty-seven measurements have been taken at G381B_C and G381E_C since the structures were commissioned in 2003. Comparisons between Flow Program discharges and field measurements indicate the average error of existing flow ratings at G381B_C and G381E exceed 10%. Under such circumstances rating improvement is deemed necessary.

To improve the ratings, the discharge coefficient for the dominant flow type was optimized to produce a better match between computed and measured discharges. An assessment of the impact of the new equations showed a mean annual volume difference

of 13.07% and 2.09% between the new and existing rating for G381B_C and G381E_C respectively. The volume difference for G381B_C exceeded the 5% threshold required to change historical flow data. Thus, it was recommended that G381B-C flow data in DBHYDRO be recomputed with the new coefficient and reloaded accordingly to ensure the public has access to the best flow estimations at the culverts.

In order to estimate the sensitivity of rated discharges to rating parameters and other input factors, an uncertainty analysis was conducted on the proposed rating for G381B_C. Due to limited streamgauging data, Monte Carlo model was used to provide a complete spectrum of various scenarios. The following figure illustrates the overall uncertainty related the ratings.



NOTES

THE EFFECT OF SALINITY PULSES ON SUBMERGED AQUATIC VEGETATION IN THE LOWER ST JOHNS RIVER

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Water supply demand and the need to potentially withdraw water from the river prompted the St Johns River Water Management District to examine potential ecological effects stemming from surface water withdrawals. One component of this large study investigated effects of salinity on submerged aquatic vegetation (SAV). The April to September SAV growing season during 2008 and 2009 was monitored on a weekly basis at an oligohaline and a freshwater site. A 10 by 10 point grid system was used to determine changes in grass bed condition. At each point canopy height, percent cover and water depth was measured. In addition, a USGS permanent monitoring station recorded salinity every 15 minutes. Geostatistical mapping was conducted to provide a visual representation of the grassbed dynamics, which were subsequently related to salinity and laboratory data.

Concurrent with the *in situ* monitoring, stress enzyme testing on plant blades of *Vallisneria americana* collected at each site show that over the period of each growing season, the decline of grassbed length followed high salinity spikes. When the plant is exposed to stress, such as in an increase in salinity, electron transport chains are impaired. This results in the accumulation of reactive oxygen species (ROS). These ROS can catalyze the degradation of the proteins. The plant copes with the ROS by up regulating superoxide dismutase as well as catalase to help convert the ROS to a more stable molecule (Touchette, 2007). Probes show high levels of ROS just after a 24 hour exposure to 15ppt of salinity (figure 1).

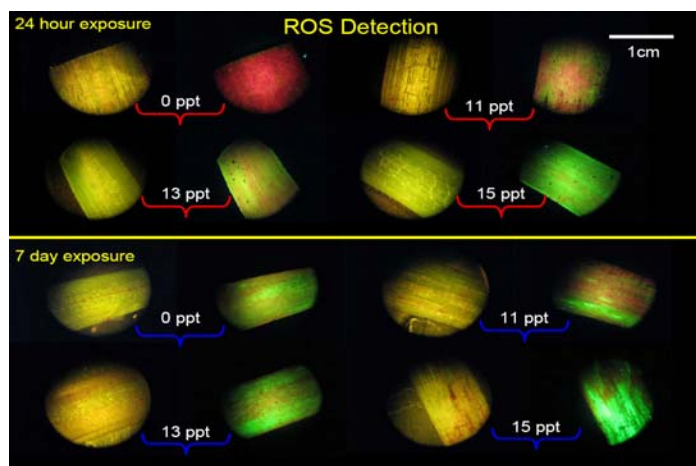


Figure 1. ROS detection probes on *Vallisneria* plant blades

Decreases in protein content at the freshwater site after high salinity spikes were greater than at the oligohaline site. At the oligohaline site, the salinity pulses are greater and more frequent. As a consequence, the SAV appear to be more acclimated to salinity fluctuations. The freshwater site is generally less than 1 PSU; hence, effects of moderate salinity spikes were more apparent.. Alternatively, SAV population at the oligohaline site may be more acclimated and did not show dramatic protein changes.

ROS as well as catalase levels can help determine critical salinity exposure levels as well as the duration that *Vallisneria* can sustain before negative effects occur. Figures 2 and 3 show the catalase levels at each site for 2009.

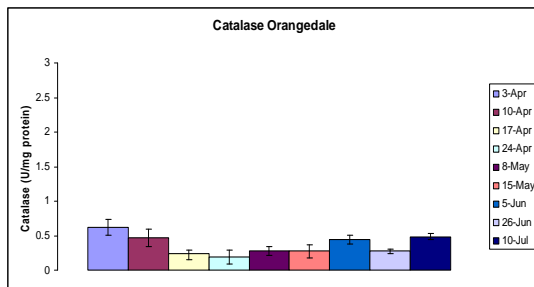


Figure 2. Catalase levels for Orangedale

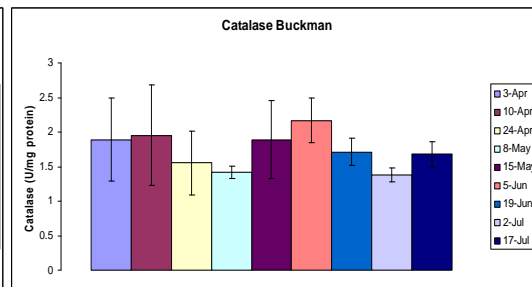


Figure 3. Catalase levels for Buckman

Both the water quality and laboratory studies allowed for better predictions regarding potential system-wide SAV responses to increased salinity exposure.

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NOTES

FLORIDA LAKEWATCH'S ROLE IN THE FLORIDA LONG-TERM MONITORING PROJECT

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Florida LAKEWATCH (FLW) is a lake-monitoring program in the Program for Fisheries and Aquatic Sciences in the School of Forest Resources and Conservation at the University of Florida. FLW focuses on monitoring statewide water quality as well as aquatic plant and fish communities. In 1999 a cooperative effort with the Florida Fish and Wildlife Conservation Commission was started with the goal of creating a long-term database for plants, fish, and water chemistry on 32 lakes. This effort was expanded in 2006 to 52 lakes statewide. The lakes in the project were selected for their historical data as well as wide range of trophic states and aquatic macrophyte abundances. Fish and aquatic macrophytes surveys and water chemistry sampling are conducted and analyzed on regular intervals throughout the year. These data are used to examine long-term trends and changes in fish community metrics based on lake trophic state, water chemistry, and plant communities.

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SESSION 12

THE RESULTS: BEST MANAGEMENT PRACTICES IN ACTION PART II

HOW TO COMBAT THE DETRIMENTAL EFFECTS OF EUTROPHICATION, CONTROL ALGAE BLOOMS AND MEET WATER QUALITY STANDARDS

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

While aesthetic effects caused by eutrophication may be unpleasant, this does not begin to compare with the detrimental effects that turbid ponds, lakes, and various water bodies can have on the health of humans, aquatic organisms, and the overall ecosystem. Negative effects include fine particulates that are a point of attachment for contaminants including nutrients, bacteria, heavy metals, pesticides, and endocrine disruptors. These particulates make up turbidity which we measure in units called Nephelometric Turbidity Units (NTU's).

Various studies have shown that measurements as low as 10-100 Nephelometric Turbidity Units (NTU's) will result in aquatic organisms showing signs of stress. This happens through increased turbidity levels causing decreased light, food and oxygen, mechanical effects, and temperature increases due to darker water.

Every pond and lake is its own separate ecosystem in which organic turbidity, such as algae and other aquatic plant life, is natural and can hold beneficial roles. However, if algae begins to grow exponentially due to cultural eutrophication and algae blooms occur or a pond holds a toxic algae, the health of the pond and the organisms that reside within it can be threatened. High nutrient levels, such as phosphorous that produce algae blooms, will eventually lead to vegetation that dies and decays, which in turn uses up available dissolved oxygen. Fish need oxygen to survive and if oxygen is depleted, fish kills can result.

Once we understand the effects of turbidity 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 up the system. 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 significantly reduce sediment and nutrients (both organic and inorganic turbidity) from moving into a waterbody as well as reducing the amount of sediment and nutrients already within a given waterbody. Two possible solutions are as follows: (1) capture or retain the sediment and nutrients before they 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 known 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 it is not transported into our waters and, if it has already been transported into our waters, to perform water clarification to reduce turbidity. Such Polymer Enhanced systems will include: soil stabilization applications (including polymer enhanced soft armoring), dewatering systems, pond and lake clarification including nutrient (primarily phosphorous) reductions, de-mucking, and SRBs (Sediment Retention Barriers).

NOTES

EVALUATION OF STORMWATER POND FUNCTIONALITY THROUGH ALTERNATIVE DESIGNS FOR ECOSYSTEM FACILITATION

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INTRODUCTION

Wet Detention Ponds are designed to act as a pollution sink, relying on sedimentation with biological removal as the primary method of pollution removal from stormwater runoff. Nitrates and available phosphorus in these ponds lead to algal blooms that are most often controlled with herbicides. Copper –based herbicides reduce microbe populations required for natural pollution removal and prevents new growth of beneficial aquatic plants. This disrupts the nitrogen cycle, an issue listed as one of fourteen, “Grand Challenges for Engineering” by the National Academy of Engineers in 2008. Large-scale, simultaneous algae die-offs from treatments can create conditions of low oxygen that allow for phosphorus release from sediment. Ultimately, the nutrients remain in the system and sediment build-up from algae slows organic degradation under anaerobic conditions. These observations support the findings that retention ponds have been documented to achieve about half of the intended 80% removal rate for nitrogen specifically (FES).

The hypothesis proposed is that standard wet detention ponds designs are often maintained with herbicides that reduce pollution removal and disrupts the nitrogen cycle. Some ecological engineering techniques can be combined to enhance the ecology of the pond and increase the habitats of littoral, or shallow, regions of the pond. A functioning system achieving maximum pollution reduction can be achieved by facilitating microorganism habitats.

METHODS

The process for retrofitting wet detention ponds is done by facilitating ecosystems in the littoral, or shallow, regions. Facilitation involves non-chemical, invasive plant control and some minor structural alterations along the pond shorelines. Two retention ponds in a condominium neighborhood in Orlando, Florida have been planted with a variety of native aquatic plants so that biodiversity may play a role in limiting the nutrients and create habitat for beneficial microbes. Samples of nitrates and phosphorus were taken in March 2009 and 2010, from the two experimental ponds and compared to a third pond that has remained under chemical control. To facilitate biological removal of nitrates and physical removal of phosphorus, the littoral regions of the ponds have been vegetated and retrofitted with raised mud-platforms that create in-situ islands and meandering river designs. These zones allow for native plant growth to support the habitats of beneficial microbes. The islands serve as denitrification zones and the water flow ways for nitrification.

RESULTS

The two experimental ponds have been maintained without herbicides through manual removal of excessive algae since March 2009. Mostly qualitative data has been collected so far to monitor the ecosystem progression once chemical controls are ceased. There is new growth of native plants that would not otherwise occur with chemical maintenance. Physical removal of algae has become unnecessary for the pond with the lowest level of phosphorus. The preliminary assessment was based on biodiversity increases of beneficial plants and desirable invertebrates for the purposes of recognizing water quality to qualify for continued research further investigate the utilization of these methods for decentralized stormwater management. There needs to be further examination of this method for total nutrient removal by weight and time requirements for organic matter degradation capabilities.

CONCLUSION

The pollution threat to Florida's lakes and rivers is tremendous since these systems have been incorporated into most of the development in Florida during the development boom between 2001-2008. The increasing utilization of natural ecosystems for pollution control that have overestimated pollution removal capabilities is a dormant crisis that water management districts have only begun to investigate, according to the St. John's Water Management District.

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NOTES

LAKE JACKSON SHORELINE RESTORATION – SOME UNINTENDED BENEFITS

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INTRODUCTION

Lake Jackson, a 3400 acre lake in Sebring, is the most urbanized lake in Highlands County. Of more than 10 miles of shoreline, the 2 miles uninhabited border US 27, making it a centerpiece for the county. This particular area of the shoreline had been relatively unmanaged for many years and the result was an extremely thick monoculture of Primrose Willow, causing decreased bird activity, suppression of the native seed bank, and reduced aesthetics.

In an effort to revitalize the shoreline, the Highlands Soil and Water Conservation District and Highlands County lake management staff designed a plan in 2007 to restore native vegetation and littoral zone function to a 1.2 mile stretch of the lake's shoreline.

TASKS COMPLETED

The restoration plan included removing approximately 50 percent of the overgrown vegetation, leaving more than 15 Carolina Willow preservation areas, which provide food, protection, and bird roosting habitat. A four-inch scrape of the soil on the high water terrace removed the majority of the primrose seed bank and exposed the underlying native seed bank of rushes, cordgrass, buttonbush, pickerelweed, saggitaria, and other beneficial species.

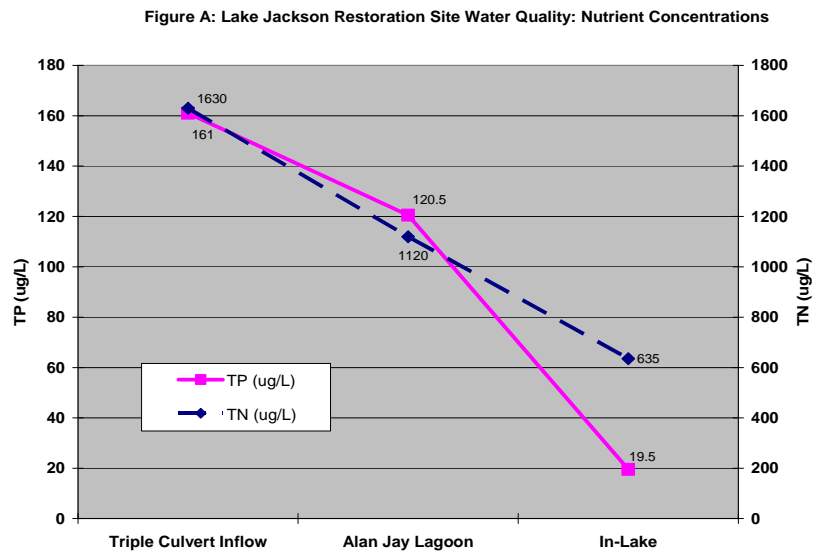
A series of herbicide treatments occurred between November 2007 and July 2009 to keep the regrowth of undesired species to a minimum. During this time period, staff identified the major sources of nutrient loading to the lake, and began monitoring water quality of runoff, seepage, and the lagoons.

The revegetation phase of the project included installation of native wildflower plots, 800 Sand Cordgrass stems, 400 stems of Golden Canna and over 600 stems of Giant Bulrush planted along the outer sand bar of the site

RESULTS OF RESTORATION WORK

There were obvious positive outcomes which included a noticeable increase in user activity by anglers and nature enthusiasts, as well as a major spike in wading bird activity. Less noticeable results included water quality improvements. Data gathered by staff (see Figure A) indicated that the lagoons (dredge-hole remnants from roadway improvements) were potentially sequestering significant amounts of nutrients coming from stormwater runoff and seepage. In-Lake water samples showed Phosphorus

concentrations 88 percent lower than the in-flows to the lagoon sampled by staff.



Testing of the flow of water from the under-highway culvert providing water from the bayhead showed phosphorus levels of 161 µg/L. Total nitrogen levels were in excess of 1400 µg/L. These sources of nutrients will continue to be monitored as project staff works to reduce the loading and continue the lagoon sequestering in an effort to control exotic and nuisance vegetation regrowth.

At project completion, staff estimated that the project achieved an approximate 50% success of vegetation planted.

CONCLUSION

Using the data and observations from this project, staff drafted a long-term management plan of the site in conjunction with previous agreements between the Highlands County Aquatic Weed Control Program and The Florida Fish and Wildlife Conservation Commission's Aquatic Plant Bureau. This plan gives guidance to the City of Sebring as it assumes the long-term responsibilities of the site and includes recommendations regarding cycles of vegetation management.

The Lake Jackson shoreline restoration proved to be a successful project, and provided staff with data and observations that will be used to implement similar projects on other waterbodies in Highlands County. This project was completed within the budget of \$101,000 provided by five funding entities (Highlands County Tourist Development Council, Recreation and Parks Advisory Commission, City of Sebring, Highlands Soil and Water Conservation District, and Florida Lake Management Society: Love Your Lake Grant), and successfully restored the littoral zone of Lake Jackson.

NOTES

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

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I conducted a pilot study with the goal of tracking the processes that take place during the startup of an aeration system. An existing system was turned off in the early spring, and the lake stratified normally as summer progressed. The system was restarted in June, after the lake had fully stratified. Several water quality parameters were examined during and following startup in order to further our understanding of how aeration may help control algae growth and otherwise benefit the lake. Water column ammonia and phosphates declined over the study period, which can be attributed to the measured increase in oxidation-reduction potential at the sediment-water interface resulting from increasing dissolved oxygen. Considerations before installing aeration, especially in reference to salinity gradients, and proposals for future investigations will also be discussed.

NOTES

A SIMPLE APPROACH FOR THE REMOVAL OF OIL, GAS, AND OTHER HYDROCARBONS FROM STORMWATER RUNOFF

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Oil/gas spills by individuals happen frequently each year. Many of the spilled hydrocarbons enter surface waterbodies via stormwater runoff and can lead to a deterioration of water quality. Presently, most entering hydrocarbons are not removed from waters because of the diffuse nature of the inputs. A sorbent material called styrene-butadiene-styrene (SBS) was evaluated for its ability to absorb oil, gas, and diesel fuel from stormwater runoff. Lab tests and field tests were conducted and in all cases, SBS efficiently absorbed the hydrocarbons from water. Once absorbed, the SBS became a gel-like solid that was not highly flammable. SBS in booms is recommended for hydrocarbon removal from stormwater.

NOTES

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