Florida Lake Management Society
1999 Annual Conference
Program & Proceedings

Safety Harbor Resort and Spa
Safety Harbor, Florida
May 26 - 28, 1999

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Requests for additional copies of this program and information about the society may be sent to the following address: Florida Lake Management Society, Attn. Shiela Medley, PO Box 92448, Lakeland, FL. 33804-2448.

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Applied Aquatic Management, Inc. Established in 198 1, Applied Aquatic Management, Inc./ Weed-Tech provides both lake and waterway management services, wetland and mitigation management, selective vegetation control, exotic species control, and right of way and industrial weed control services to individuals, developers, homeowners associations, golf courses, mobile home parks, industry and government entities.

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Environmental Research & Design, Inc. (ERD) is an environmental engineering firm which specializes exclusively in projects related to lake management, water quality, and stormwater. Virtually all work efforts performed by ERD involve research projects or studies related to lake restoration, water quality, stormwater management, sediment characterization, and sediment water column interactions. In, addition to engineers, scientists, and design professionals, ERD also maintains a fully equipped research laboratory which is certified by the FDEP and the Florida Department of HRS. ERD owns a wide variety of field monitoring equipment for hydrologic, stormwater, surface water, groundwater, and sediment sampling and analysis. ERD has developed a quick reputation for a high quality and detailed product, completed in a timely manner and has received awards for technical excellence and innovative stormwater practices.

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Peter R. Gerbert is an award-winning, creative wildlife artist with a passion for portraying the Earth's wild beauty with sensitive, lifelike detail. His work has appeared in several

prominent newspapers and in *Wildlife Art* magazine. He has done three original paintings for Bits *and Pieces, Inc.* of Boston, Massachusetts. He is presently working with the Florida Wildlife Federation on a series of art products. Mr. Gerbert currently practices art from his studio on his wooded acreage in Hernando County, Florida. He is actively involved with art galleries and wildlife theme parks throughout Florida.

Peter R. Gerbert; 33324 Rowntree Dr.; Dade City, FL. 33523-9246; 1-800-700-7106; www.bestware.net/gerbertart/; gonewild @gate. net

Scheda Ecological Associates, Inc., founded in Tampa in 1990, provides a variety of professional services, including comprehensive ecological assessments, water quality monitoring, habitat mapping, wetland and wildlife studies, mitigation and habitat restoration design, seagrass mapping, environmental permitting, and land use planning and management. Our experienced professional staff has conducted numerous studies, including extensive field reconnaissance, impact analysis, reporting, and regulatory liaison for both public and private sector clients. Our corporate experience ranges from site evaluation planning and permitting for large-scale developments to resolution of minor permitting issues for small business owners and residential landowners. SEA is woman-owned and currently certified as a Disadvantaged or Woman Owned Business Enterprise (DBEIWBE) with the Florida Department of Transportation, the Florida Department of Management Services, Hillsborough County, Palm Beach County, and the City of Tampa. Our professionals have over 123 years of combined career experience and bring both practical consulting experience and knowledge of the regulatory agency framework to each task. Key staff members have formerly worked for the U.S. Army Corps of Engineers, the Florida Department of Environmental Protection, and the Southwest Florida Water Management District and provide extensive regulatory experience to our clients. Our environmental experience complements many engineering teams working on a variety of projects.

Scheda Ecological Associates Inc.; 4013 East Fowler Avenue; Tampa, FL. 33617; (813)971-3755; scheda@gate.net

Southwest Florida Water Management District. The mission of the Southwest Florida Water Management District (The District) is to manage the water and water-related resources within its boundaries. Central to the mission is maintaining the balance between the water needs of current and future users while protecting and maintaining the natural systems that provide the District with its existing and future water supply.

The Governing Board of the Southwest Florida Water Management District assumes its responsibilities as authorized in Chapter 373 and other chapters of the Florida Statutes by directing a wide-range of programs, initiatives, and actions. These programs include, but are not limited to, flood control, regulatory programs, water conservation, education, and supportive data collection and analysis efforts.

Southwest Florida Water Management District; 2379 Broad Street; Brooksville, FL. 34609-6899; (800)423-1476; www.swfwmd.state.fl.us

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BCI, Inc. is a multi-disciplinary, employee-owned engineering and environmental consulting firm with offices in Lakeland and Fort Myers, Florida. The current staff of 65 includes such specialities as Water Resources, Lake Restoration, Mining, Geotechnical Engineering, Geologic Hazards/Contamination, Surveying, Ecological, Environmental, Infrastructure, and Design. The firm is committed to offering the best available technology to its clients.

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Environmental Consulting & Technology, Inc. (ECT) is a full-service environmental consulting firm headquartered in Gainesville, Florida with offices throughout Florida and Michigan. ECT's lake restoration services include feasibility studies; conceptual restoration design, engineering design, and bid document preparation; construction oversight; habitat enhancement (including revegetation); fish population control; federal, state, and local permitting associated with restoration; post-restoration monitoring; and public participation and education service. ECT is currently directing lake restoration projects in Florida and Michigan with projects as large as $12 million.

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Environmental Research & Design, Inc.; 3419 Trentwood Blvd., Suite 102; Orlando, FL 32812; (407)855-9465

Post, Buckley, Schuh & Jernigan, Inc. (PBS&J) is a full service consulting firm with a presence throughout the nation and the world. The staff of the Ecological Sciences Department has experience in lake restoration, watershed and land management, water quality monitoring, fisheries management, wetland restoration and creation, as well as regulatory compliance. PBS&J's experience includes design, implementation, assessment of weed and algae control measures, dredging programs, aeration systems, aquascaping, and fishery manipulation. In addition, PBSU has experience in stormwater management and implementing Best Management Practices (BMPs).

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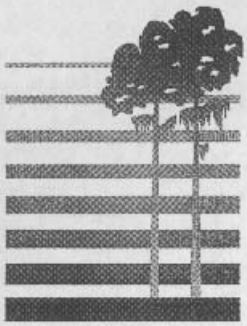

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SEA's environmental professionals have over 123 years of combined career experience working with both public and private sector clients. Our team of professionals are experienced in the fields of limnology, wetland and terrestrial ecology, coastal ecology, watershed planning, resource management, wildlife biology, remote sensing, wetland maintenance and monitoring, water quality, air quality, public health, biometry, and CADD capabilities.

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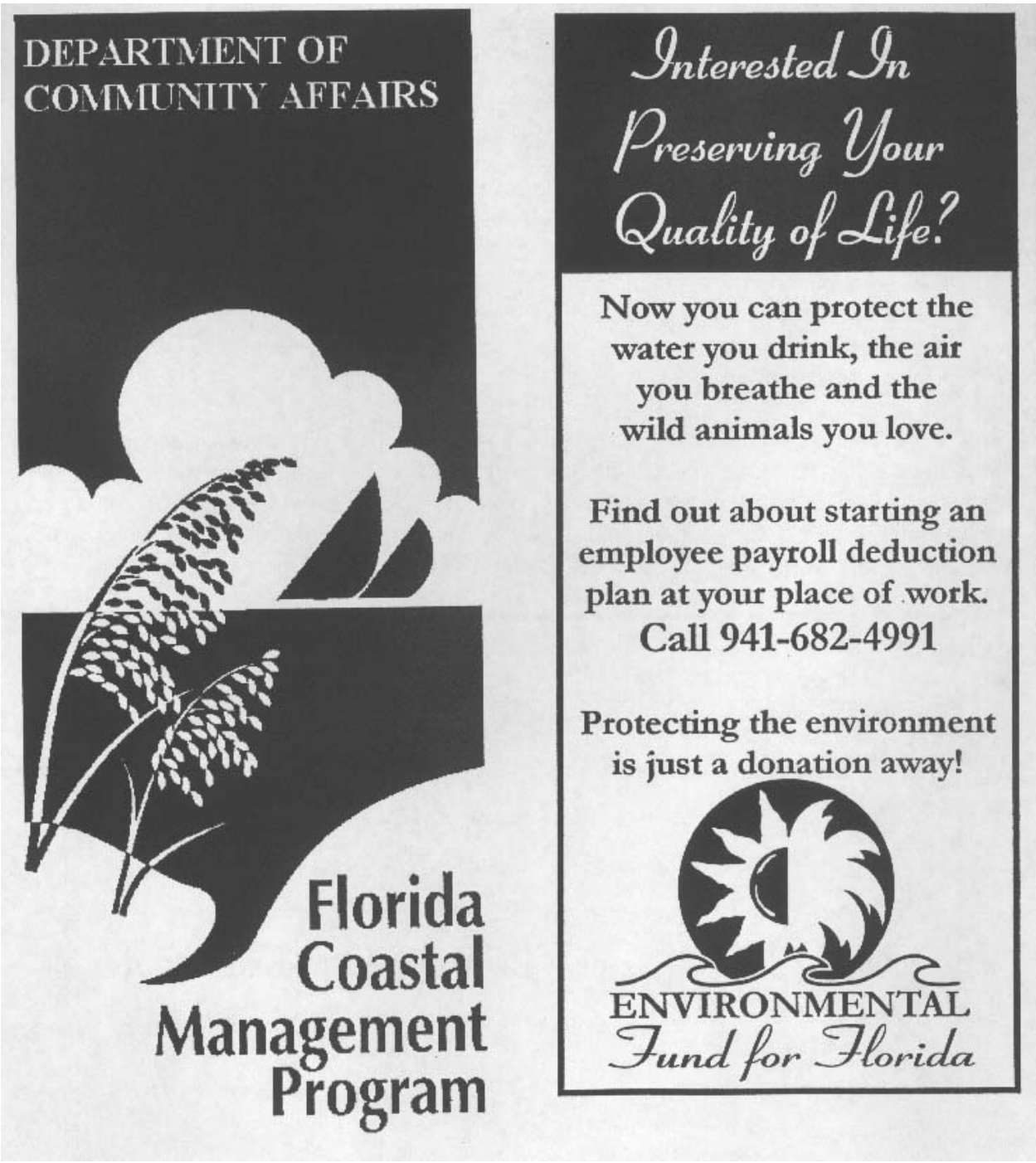
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Florida Lake Management Society - Tenth Annual Conference
May 26-28, 1999
Program of Events

Wednesday, May 26

Registration - 8:00 am to 10:00 am (History Hall)

FLMS Board of Directors Meeting (Open to All Society Members) - 9:00 am to 10:00 am (Cypress Room)

Session 1 - Water Quality Issues in Lake Management (Moderator: Gene Medley, City of Lakeland) - 10:00 am to 11:40 am (All Technical Sessions Held in the Baranoff Ballroom)

1. *Fecal Coliform Contamination Assessment for Lake Fairview* - Kevin McCann, City of Orlando Stormwater Utility Bureau; Damann Anderson and Mark Tyl, Ayres Associates; and Rick Baird and Linda Jennings, Orange County Environmental Protection Department.

2. *Deaths of Fish-Eating Birds on the North Shore Restoration Area at Lake Apopka and Links to Pesticide Residues - an Update* - Roxanne Conrow, Edgar Lowe, Gianfranco Basili, and Julie Hovis, St. Johns River Water Management District.

3. *Recent Improvements in Water Quality in Lake Apopka, the Subject of a Major Lake and Watershed Restoration Program* - Michael Coveney, Lawrence Battoe, Edgar Lowe and David Stites, St. Johns River Water Management District.

4. *Water Chemistry in 320 Lakes in the Southwest Florida Water Management District* - Kenneth Romie, Southwest Florida Water Management District.

5. *Simulating Algal Bloom Conditions with the Lake Okeechobee Water Quality Model* - R. Thomas James, South Florida Water Management District; and Michael Erickson, Victor Bierman, Jr., and Scott Hinz, Limno Tech, Inc.

Lunch On Your Own - 12:00 pm to 1:00 pm

Session 2 - Shallow Lakes Research and Management (Moderator: Karl Havens, South Florida Water Management District) - 1:00 pm to 2:40 pm

1. *Importance of Water Level Changes on Wind Disturbance of Sediments in Shallow Florida Lakes* - Roger Bachmann, Mark Hoyer, and Daniel Canfield, Jr., University of Florida Department of Fisheries and Aquatic Sciences.

2. *Limnological Assessment of Lake Newnan, Florida* - Eric Nagid, Mark Hoyer and Daniel Canfield, Jr., University of Florida Department of Fisheries and Aquatic Sciences.

3. *Limnology of Kissimmee Prairie Ponds* - T.J. Kozusko, J.A. Osborne, and P.N. Gray, Biology Department, University of Central Florida.

4. *Declines in Transparency Related to Mud Sediment Expansion in Lake Okeechobee* - Karl Havens and R. Thomas James, Ecosystem Restoration Department, South Florida Water Management District.

5. *Nutrient-Chlorophyll-Secchi Relationships in Lakes Okeechobee and Apopka* - Karl Havens and Hunter Carrick, South Florida Water Management District; and Edgar Lowe and Michael Coveney, St. Johns River Water Management District.

Refreshment Break - 2:40 pm to 3:00 pm (Palm Lobby and East Room)

Session 3 - Trophic State Dynamics in Florida Lakes (Moderator: Chuck Hanlon, South Florida Water Management District) - 3:00 pm to 4:40 pm

1. *Carbon Flux through the Planktonic Food Web of Lake Okeechobee, Florida* - Kirsten Work, Karl Havens, T. East, and B. Sharfstein, South Florida Water Management District.

2. *Littoral Periphyton Responses to Nitrogen and Phosphorus: an Experimental Study in a Subtropical Lake* - B. Sharfstein, Karl Havens, T. L. East, and A. J. Rodusky, South Florida Water Management District.

3. *Can Periphyton Compete with Phytoplankton for Nutrients, and Indirectly Suppress Phytoplankton Blooms, in Lake Okeechobee?* - A. J. Rodusky, Alan Steinman, T. L. East, B. Sharfstein, and R. H. Meeker, South Florida Water Management District.

4. *Growth and Survival of the Florida Apple Snail (Pomacea paludosa) Fed Three Naturally Occurring Macrophyte Assemblages* - B. Sharfstein and Alan Steinman, South Florida Water Management District.

5. *Seasonal Abundance and Distribution of Daphnia ambigua in Subtropical Central Florida* - John Osborne, Biology Department, University of Central Florida.

FLMS Business Meeting (All Members of the Society are Encouraged to Participate) - 4:45 pm to 5:15 pm (Baranoff Ballroom)

Exhibitors' Social (Cash Bar) - 5:30 pm to 7:00 pm (Palm Lobby and East Room)
Hospitality Suite Open House - 7:00 pm (Four Springs Lounge)

Thursday, May 27

Session 4 - In-Lake Restoration: Case Histories and Emerging Trends (Moderator: Larry Battoe, St. Johns River Water Management District) - 8:00 am to 9:40 am

1. *Why Lake Restoration Projects Fail* - Harvey Harper, Environmental Research & Design, Inc.

2. *Cost Analysis and Management Implications of Real and Perceived Environmental Problems: Berm Formation in Lake Okeechobee as an Example* - Alan Steinman and Karl Havens, South Florida Water Management District.

3. *Automated Bathymetric Mapping of Florida Lakes* - Kyle Campbell, Shawn Landry, Tim Foret, and Nicole Gale, Florida Center For Community Design & Research, University of South Florida; James Griffin, Hillsborough County Department of Public Works; and Kenneth Romie, Southwest Florida Water Management District.

4. *Emerging Technology in Lake Sediment Removal and Dewatering* - Rick Powers, BCI Engineers & Scientists, Inc.

5. *Lake Hancock and the Whole Lake Restoration Controversy* - Michael Perry, Southwest Florida Water Management District.

Refreshment Break - 9:40 to 10:00 am (Palm Lobby and East Room)

Session 5 - Watershed Management: Case Histories and Emerging Trends (Moderator: Harvey Harper, Environmental Research & Design, Inc.) - 10:00 am to 11:40 am

1. *The Everglades Nutrient Removal Project Test Cells: the Use of Experimental Wetlands to Optimize Performance of Stormwater Treatment Areas* - Jana Newman, Martha Nungesser, and Michael Chimney, South Florida Water Management District.

2. *Phosphorus Control Strategies for Lake Okeechobee* - Barry Rosen, South Florida Water Management District.

3. *Periphyton Filtration: The State of the Art* - Kyle Jensen, SAIC, Inc.

4. *Deer Point Reservoir: A Case History of Starting a Watershed Protection Program* - Kathleen McDonald and Steven McLellan, Bay County Utility Services.

5. *Removal of Gross Pollutants from Stormwater Runoff Using Liquid/Solid Separation Structures* - Jeffrey Herr and Harvey Harper, Environmental Research & Design, Inc.

Luncheon and Awards Presentation - 12:00 pm to 1:30 pm (Outside Tented Deck)

Session 6 - Hydrologic Considerations is Lake Management (Moderator: Walt Reigner, BCI Engineers & Scientists, Inc.) - 1:30 pm to 3:10 pm

1. *Ground Water Interaction with Florida Lakes* - Laura Sacks and Terrie Lee, U. S. Geological Survey.

2. *A Two-year Water Budget of Lake Starr – A Flow-through Seepage Lake in Polk County, Florida* - Amy Swancar, U. S. Geological Survey.

3. *Evaluation of the Effects of Pumping Water from Pretty Lake to Lakes Horse, Raleigh, and Rogers in Northwest Hillsborough County, Florida* - Quincy Wylupek, Southwest Florida Water Management District.

4. *El Niño's Effect on Highlands County's Lakes: Was There One?* - Clell Ford, Lakes Manager, Highlands Soil and Water Conservation District.

5. *Managing Water Levels in Closed Basin Systems* - Lake Deeson: A Case History - Walter Reigner, BCI Engineers & Scientists, Inc.

Refreshment Break - 3:10 pm to 3:30 pm (Palm Lobby and East Room)

Session 7 - Fisheries Management in Florida Lakes (Moderator: Tom Champeau, Florida Game and Freshwater Fish Commission) - Thursday 3:30 pm to 5:10 pm

1. *Newburgh Lake Restoration Case Study: Fish Kill I and II* - John O'Meara and Larry Danek, Environmental Consulting & Technology, Inc.

2. *Recruitment Consequences for Early vs. Late - Hatched Black Crappie Pomoxis nigromaculatus in Lake Wauberg, Florida* - William Pine and Mike Allen, Department of Fisheries and Aquatic Sciences, University of Florida.

3. *Lake Talquin: Northwest Florida's TEAM Lake* - Rich Cailteux, Jeff Nordhaus, and Dan Dobbins, Florida Game and Fresh Water Fish Commission.

4. *Lake Istokpoga: South Florida's TEAM Lake* - Furse Beacham and Larry Davis, Florida Game and Fresh Water Fish Commission.

5. *Tussock Removal and Equipment Evaluation on Orange Lake* - Bob Hujik, Florida Game and Freshwater Fish Commission.

Social Hour (Cash Bar) - 6:00 pm to 7:00 pm (Outside Tented Deck)

Dinner Buffet - 7:00 pm to 9:00 pm (Outside Tented Deck)

Hospitality Suite Open House - 9:00 pm (Four Springs Lounge)

Friday, May 28

Session 8 - Aquatic Plant Management in Florida Lakes (Moderator: Ernesto Lasso de la Vega, Lee County Hyacinth Control) 8:00 am to 9:40 pm

1. *Evaluating the Spatial Distribution of Aquatic Plants and the Utilization of Wildlife Habitat in the Littoral Zone of Lake Okeechobee, Florida* - Charles Hanlon, South Florida Water Management District.

2. *Aquatic Habitat Restoration in Lake Griffin, Lake County, Florida* - John Benton, Florida Game and Freshwater Fish Commission.

3. *Submerged Aquatic Vegetation Dynamics in the Lakes of Leon County, Florida* - Sean McGlynn - Florida State University.

4. *Littoral Zone Replanting and Littoral Zone Vegetation Mapping in Lake Apopka* - James Peterson and Roxanne Conrow, St. Johns River Water Management District.

5. *An Integrated Approach to Aquatic Plant Management* - Craig R. LeSchack, Florida Game and Fresh Water Fish Commission.

Refreshment Break - 9:40 am to 10:00 am (Palm Lobby and East Room)

Session 9 - Public Involvement in Aquatic Resource Management (Moderator: Jim Griffin, Hillsborough County Department of Public Works) - 10:00 am to 12:00 am

1. *An Example of Community-Based Volunteer Monitoring - The Hillsborough County Experience* - James Griffin, Hillsborough County Department of Public Works.

2. *Hillsborough Stream Waterwatch* - Pam Stinnette, Hillsborough Community College.

3. *Practical Problems in Managing Storm Water Retention Ponds in South Florida* - Jim Reed, Palm Beach County Florida Yards and Neighborhoods Program.

4. *Public Awareness and Community Involvement in the City of Orlando* - Bruce Fallon, City of Orlando, Stormwater Utility Bureau.

5. *Volunteer Lake Management Programs in Orange County, Florida* - Rick Baird and Linda Jennings, Orange County Environmental Protection Division.

6. *The Nature Conservancy of the Florida Keys: Sea Stewards Program* - Mary Enstrom-Warner, The Nature Conservancy, 2250 Overseas Highway, Marathon, FL 33505.

7. *Oral History: An Important Tool for Understanding Florida's Lakes* - Kyle Campbell, Shawn Landry, and Erin Budde, Florida Center For Community Design & Research, University of South Florida; and James Griffin, Hillsborough County Department of Public Works.

Lake Volunteers Association Luncheon and Organizational Meeting - 12:00 pm to 2:00 pm (Harbor Room)

Adjourn Conference - 2:00

Session 1 - Water Quality Issues in Lake Management (Moderator: Gene Medley, City of Lakeland) - 10:00 am to 11:40 am (All Technical Sessions Held in the Baranoff Ballroom)

Fecal Colifom Contamination Assessment for Lake Fairview

Kevin McCann[1] , Damann Anderson[2] and Mark Tyl[2] , Rick Baird[3] and Linda Jennings[3].

[1] City of Orlando Stormwater Utility Bureau, 400 S. Orange Ave. Orlando Fl. 32806; Phone 407/246-2234, E-mail kmccann@ci.orlando.fl.us ; [2] Ayres Associates, 8875 Hidden River Parkway Suite 200, Tampa Fl. 33607; Phone 813/978-8688, E-mail Andersond@ayres-tpa.com, Tylm@ayres-tpa.com [3] Orange County Environmental Protection Department 2002 East Michigan St. Orlando Fl. 32806; Phone 407/836-7400, E-mail hheplrb1@citizens-first.co.orange.fl.us, hhepllj1@citizens-first.co.orange.fl.us.

Lake Fairview is a 149 hectare lake located in Orlando, Florida. Recreational use of the lake has been limited for the past four years because of lake closures due to elevated fecal coliform concentrations. Fecal coliform concentrations in the lake follow a distinct seasonal pattern with levels exceeding water quality standards during winter months. Summer bacteria concentrations are typically low with the lake open to recreational use from approximately May to November. In order to determine the source of fecal coliform contamination to Lake Fairview, a study was initiated in 1997. Potential sources of bacteria to the lake were ranked and prioritized. Based on the ranking, a monitoring plan was implemented to identify specific sources. Potential sources which were evaluated included shoreline septic systems, stormwater runoff and a migratory bird populations. Even though on-site septic tanks were evaluated to have the highest potential for contamination, data did not indicate significant transport of bacteria to the lakes via groundwater flows. Monitoring results and the correlation between the presence of a large migratory population of Sea Gulls and elevated fecal coliform concentrations, indicated birds were a significant source of fecal contamination.

Deaths of Fish-eating Birds on the North Shore Restoration Area at Lake Apopka and Links to Pesticide Residues – an Update

Roxanne Conrow, Edgar F. Lowe, Gianfranco D. Basili, and Julie A. Hovis, St. Johns River Water Management District, Department of Water Resources, P.O. Box 1429, Palatka, FL 32178-1429

Lake Apopka is a 125 km^2 lake in central Florida about 10 miles northwest of the Orlando metropolitan area. The St. Johns River Water Management District (SJRWMD) in partnership with local, state, and Federal governments developed a five-part restoration and management plan for Lake Apopka that included reduction of phosphorus loading from external sources, primarily agriculture (acquisition and restoration of floodplain farms). With funds appropriated by the Florida legislature and matched up to $26 million by the Federal Wetlands Reserve Program, SJRWMD purchased the 1,200 ha Duda property and the 2,400 ha section of the Zellwood Drainage and Water Control District known as Unit 2. Environmental audits were performed on all of the properties resulting in remediation that included the removal of 20,343 tons of soil and 3,230 gal of ground water. Some 400 soil samples were analyzed for pesticide residues in the environmental assessments and in follow-up sampling. SJRWMD also conducted an environmental risk assessment of the residual pesticide levels expected to remain in the soils after the remediation. The assessment indicated that some concern was warranted about long-term, sublethal effects on growth or reproduction of fish-eating birds, and SJRWMD planned a monitoring program to assess these potential problems. The strategy recommended in the risk assessment to deal with the background levels of pesticides was to shallowly flood the site to promote dense emergent vegetation. This approach combined the beneficial effects of 1) a halt to further application of pesticides, 2) natural attenuation resulting from the accelerated microbial breakdown in a nutrient-rich, anaerobic soil environment, and burial and dilution of the pesticide residues with new organic matter. Individual parcels in ZDWCD Unit 2 were shallowly flooded during summer 1998 as farming activities terminated. This flooding was comparable to the shallow flooding done on these farms on an annual basis to control nematodes and to limit subsidence. However, flooding by the District extended over a greater area and more seasons and was deeper in some areas than earlier agricultural flooding. Birds using the site began to die in large numbers during the fall of 1998 and winter of 1999, apparently due to factors associated with feeding. Most of the species affected were fish-eating birds, and the species most affected was the white pelican. Initial tests indicated that organochlorine pesticide poisoning was likely the cause of the bird deaths. Since the possibility of acute toxicity from field background pesticide levels in the soils was not predicted by the environmental risk assessment, further detailed sediment and soil sampling was indicated. A technical advisory group consisting of university, local, state and federal agency representatives and non-profit organizations agreed on a sampling scheme that would better characterize the background pesticide levels in the fields as well as provide additional data on canals, water and fish tissues. Finally, the risk assessment will be re-examined in light of the observed bird mortality and considering the new data on pesticide levels in soil and tissues. The presentation will provide a status update on this work.

Recent Improvements in Water Quality in Lake Apopka, Florida, the Subject of a Major Lake and Watershed Restoration Program

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Lake Apopka is a large (125 km^2), shallow (z = 1.6 m) lake in central Florida made hypereutrophic by fifty years of agricultural stormwater discharges from farms on 80 km^2 of drained littoral marshes. The lake is characterized by high nutrient levels, high turbidity caused by algae and resuspended sediments, and almost no remaining submersed or emergent macrophytic vegetation. Phosphorus loading to Lake Apopka is being reduced through purchase of the riparian farms and restoration to aquatic habitat. Additional management activities to accelerate recovery of the lake are creation of a treatment wetland to remove nutrients and suspended solids from lake water, removal of gizzard shad (*Dorosoma cepedianum*), and replanting of littoral vegetation. Recent improvements in water chemistry provide strong support that the initial steps in the restoration program for Lake Apopka, reduction in P loading and removal of gizzard shad, have been effective. Starting in summer 1995, trophic-state indicators in Lake Apopka significantly improved compared to previous years in an 11-yr data set. Total P, chlorophyll-a, and total suspended solids averaged about 30% lower after mid-1995, and Secchi depth averaged about 23% greater. Evaluated with a distribution-free resampling technique, mean values for each variable were significantly different before and after mid-1995 ($p < 0.005$). The period after mid-1995 also has seen the spontaneous development of macrophyte (*Vallisneria americana*, *Chara sp*.) beds at more than 20 sites around the lake. Regrowth of submersed macrophytes in response to increased transparency is the response that we predict to occur when the P concentration in Lake Apopka is reduced below the threshold where the macrophyte-dominated system is favored. This modest improvement in water quality apparent since 1995 may not be permanent yet, since P loading from the former farm areas will vary until final discharge targets can be met. However, the improved conditions demonstrated that the concentration of P in Lake Apopka will decline following load reduction. Furthermore, volunteer regrowth of submersed vegetation and success in plantings showed that sediment characteristics will not prevent revegetation of the littoral zone. With lower P levels, beneficial ecological changes such as lowered algal biomass, increased transparency, and increased growth of macrophytes will occur.

Water Chemistry in 320 lakes in the Southwest Florida Water Management District

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Beginning in 1995, the SWFWMD began an ambient monitoring program to collect water chemistry data for 323 lakes throughout the District, many of which had no published water chemistry information. The lakes were sampled over a three year period in three groups of approximately 100 lakes each. Lakes were sampled twice in a year, during the dry and wet seasons. Surface water samples (top 0.5 meter) were analyzed for nutrients and chlorophyll, major ions, color, turbidity, hardness and other standard water chemistry parameters. When compared with Florida lake distributions (Friedemann and Hand 1989), distributions for the 323 lake sample group demonstrated markedly lower concentrations of chlorophyll a, total phosphorus, TDS (specific conductance), total alkalinity, total suspended solids, and turbidity; lower Florida TSIs, and greater transparency as measured by Secchi disc. Water chemistry was compared with land use, soils, and the Florida Lake Regions characterizations. High nitrate concentrations were associated with sandy soils (entisols) and with citrus grove land use. There were general differences in water quality between lakes of the different Florida Lake Regions, however, plots of the distributions by lake region demonstrated considerable overlap of the interquartile ranges.

Simulating Algal Bloom Conditions with the Lake Okeechobee Water Quality Model

R. Thomas James, South Florida Water Management District, West Palm Beach, FL. and Michael J. Erickson, Victor J. Bierman, Jr., Scott C. Hinz, Limno Tech Inc, Ann Arbor, MI.

Algal blooms occur on Lake Okeechobee during calm wind periods. During these periods, sediment resuspension is reduced, increasing available light to the water column. Anoxic conditions at the sediment-water interface also develop during these calm periods. In mud sediments of Lake Okeechobee, the solubility of inorganic phosphorus is determined by iron under oxic conditions and calcium under anoxic conditions. Because the binding property of calcium is weaker than iron, anoxic conditions may result in increased diffusive flux of dissolved inorganic phosphorus (DIP) from the sediment bed to the water column. To determine if the Lake Okeechobee Water Quality Model can simulate algal bloom formation under these calm conditions, a series of three simulations was developed with different timing and duration for anoxic events. These three scenarios simulated anoxic events during a 13-year period: (1) for the month of August, (2) for all May 1 to September 30 periods, and (3) for thirteen randomly selected months from all May to September months within the simulation. The relative importance of reduced sediment resuspension and the elevated sediment phosphorus release under anoxic conditions are assessed by simulating these conditions together and separately for a total of nine simulations. Results from these model simulations suggest that increasing DIP supply to the water column is more important for algal bloom formation than improving light conditions. Because the model treats the water column as a single depth-averaged segment, the impact of improved light conditions may be underestimated. The model simulation results have not been verified by field data, indicating a direction for future research efforts for Lake Okeechobee.

Session 2 - Shallow Lakes Research and Management (Moderator: Karl Havens, South Florida Water Management District) - 1:00 pm to 2:40 pm

Importance of Water Level Changes on Wind Disturbance of Sediments in Shallow Florida Lakes

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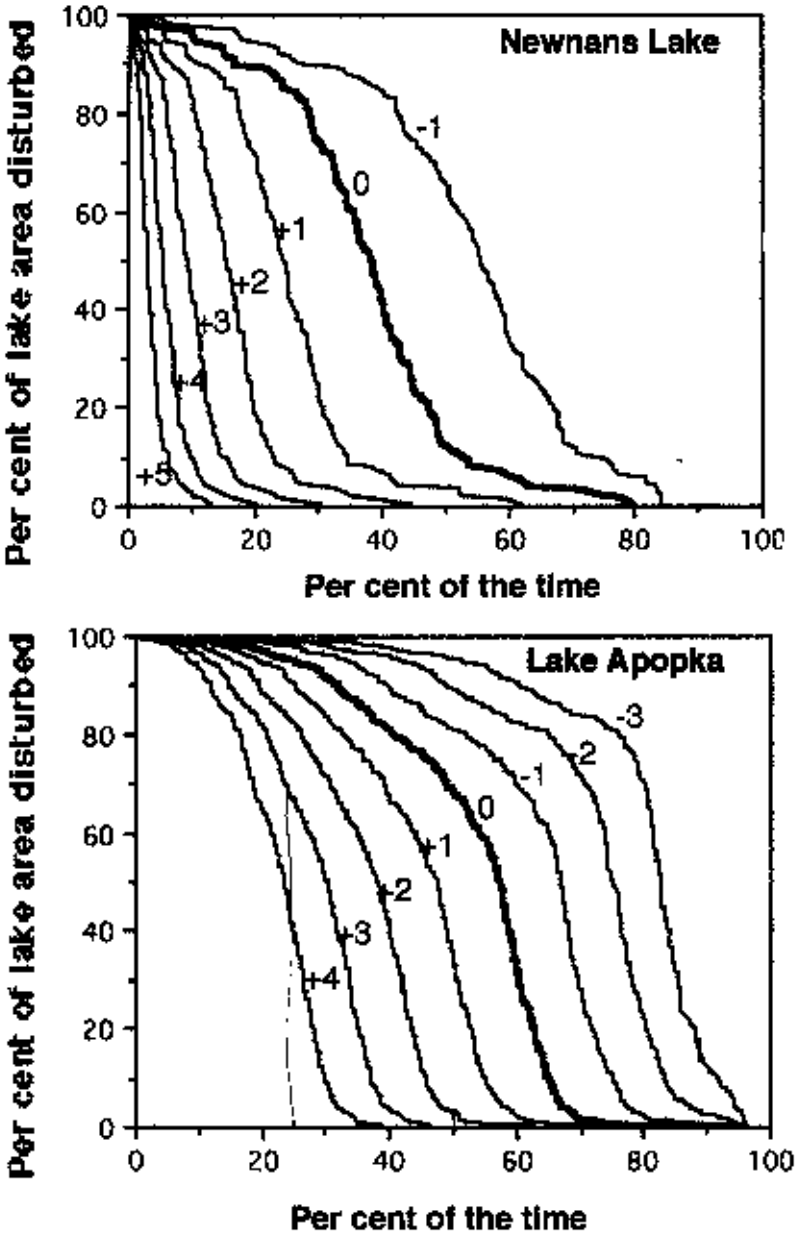
Shallow lakes behave differently from deep ones in part because wind-driven waves can disturb the lakebed and cause the resuspension of fine sediments. This has been well illustrated in Lake Apopka where the basic limnology is dominated by wind disturbances of the sediments (Bachmann et al. in press). Wave action has led to the formation of a thick layer of fluid mud on the lakebed which is easily resuspended and makes an unstable substrate for both benthos and macrophyte establishment. Over 90 % of the suspended material in the waters of Lake Apopka is non-living and presumably comes from the resuspended sediments, so light penetration is less than would be expected on the basis of algal chlorophylls. Carrick et al (1993) showed a correlation between algal chlorophyll in Lake Apopka and wind velocity due to the resuspension of a layer of meroplanktonic algae on the sediment surface. Likewise Hanlon (1999) showed a correlation between total phosphorus concentration and wind velocity in shallow, Lake Okeechobee. This too was due to wind resuspension of phosphorus-rich sediments.

Because water depth is important in determining if wave actions will disturb the sediment surface, it is reasonable to expect that changes in water level in a lake will be important in determining the extent and frequency of sediment disturbance. For example in the early 1950's when a drought produced low water levels in Lake Apopka, massive fish kills were noted during high wind events. These were related to resuspended sediments during storms. It was recognized that deeper water would help to prevent resuspension, and this was one of the reasons a water control structure was placed on the outlet to maintain water levels in dry periods.

Our goal was to quantify the effects of water depth. We used a mathematical model to determine how changes in water levels would influence the extent and frequency that wind-driven waves would disturb the bottom sediments of shallow Florida lakes. For both Lake Apopka and Newnans Lake we found that an increase or decrease in water level of just a few feet can have a significant effect on the per cent of the lake area disturbed by wave action and the frequency with which a given lake area is disturbed. Low water levels lead to increased sediment disturbance, while higher levels tend to offer more protection for the sediments from wind-driven waves. This is a factor that needs to be taken into consideration in the management of shallow lakes. For example it has been reported that the level of Lake Apopka was lowered by about I meter in the 1890s (Delta Canal Company, 1895; Shofner, 1982). Our results

indicate that this action could have made the sediments of this lake more susceptible to wind disturbance than they were with higher water levels. Water level changes may have significant effects in other shallow Florida lakes as well.



Percent of the time

Frequency distributions of lakebed disturbance by waves for Newnans Lake and Lake Apopka when the water levels are raised or lowered by the indicated number of feet.

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Limnological Assessment of Lake Newnan, Florida

Eric J. Nagid, Mark V. Hoyer and Daniel E. Canfield, Jr., University of Florida Department of Fisheries and Aquatic Sciences, 7922 NW 71st Street, Gainesville, FL 32653

Lake Newnan is a large (2700 ha), shallow (1.5 m mean depth) lake located in Alachua County, Florida. Recently private citizens and state professionals have expressed concern over the water chemistry condition of Lake Newnan, describing it as "poor and deteriorating." All available chlorophyll, total phosphorus, and total nitrogen data collected from the late 1950s to present have shown significant increases, while Secchi depth has decreased significantly. Prior to 1993 all parameters appeared to be stable and fluctuating seasonally. After 1993, nutrient and chlorophyll concentrations increased dramatically and Secchi depths decreased. Changes in water chemistry appear to have occurred around 1993, about the time a water control structure was removed and drought conditions decreased water levels in Lake Newnan. Examining these data, lake levels showed inverse relations between nutrients and chlorophyll concentrations, and Secchi depth readings were directly related to lake level. A nutrient budget for Lake Newnan was calculated in 1998 by measuring all inputs and exports to examine the relation between nutrient loading and in lake nutrient concentrations. These data show that Lake Newnan is exporting more nutrients than are being imported suggesting that internal loading of nutrients may be occurring in Lake Newnan. Using a bathymetric map and applying fundamental wave theory, it was determined that above a lake stage of 19.9 m.msl, less than 20% of the lake bottom is potentially disturbed 50% of the time, whereas below a lake stage of 19.9 m.msl, almost 70% of the lake bottom is potentially disturbed 50% of the time. It is concluded that resuspension of flocculent sediments disturbed by wave action during low water periods is responsible for increases in nutrients and chlorophyll and decreases in Secchi depth observed in Lake Newnan.

Limnology of Kissimmee Prairie Ponds

Kozusko, T. J., J. A. Osborne, and P. N. Gray, Biology Dept., University of Central Florida, P. O. Box 25000, Orlando, FL 32816

The physicochemical features of three ponds in the Kissimmee Prairie Sanctuary in Okeechobee County, Florida, were studied between January and August 1997, and between May and August 1998. The data collection included pH, specific conductance, water temperature, water depth, turbidity, water color, alkalinity, concentrations of tannin, chlorophyll-*a*, nitrite, nitrate, ammonium, total Kjeldahl nitrogen, orthophosphate, total phosphate, and dissolved carbon dioxide. Dissolved oxygen was only measured in 1998. Samples were taken in triplicate within pond vegetation zones. The ponds were found to be acidic, poorly buffered, moderate to high in water color, and low in mineralized nitrogen and phosphorus. This study was funded by the Center for Environmental Studies, Florida State University System.

Declines in Transparency Related to Mud Sediment Expansion in Lake Okeechobee

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During the last decade, there have been substantial declines in Secchi depths (SD) measured in the southwestern region of Lake Okeechobee. Locations that previously displayed SD>2.5 m now display SD<1.0 m. Declines in SD occurred abruptly (in a single year at each sampling site), and the recent low values have been very stable. Ratios of SD / total depth suggest that light often reached the lake bottom (ratios>0.5) prior to the new stable state, but seldom reach the bottom today. The relationship between SD and chorophyll *a* (CHLA) also has changed. Previously there were significant inverse relationships between the two variables, similar to what is observed today at near-shore, sand-bottomed sites in the lake. In recent years, there has been no relationship between SD and CHLA, similar to observations in the mud-bottomed central pelagic region, where abiotic turbidity controls light attenuation. One explanation for the relatively sudden changes in SD is migration of mud sediments from mid-lake towards the southwestern shore. A comparison of sediment maps constructed in 1975 and 1988 indicates that the area of lake-bottom covered by mud sediment increased from approximately 30 to 44% over that period. The major direction of expansion was to the southwest, and postulated movement coincided closely with dates when SD declines were observed at water quality monitoring stations. Declines in SD in the southwest region of Lake Okeechobee may have important ecological and societal implications. This region once was a primary foraging and nesting habitat for commercial fish, sport fish, and wading birds. Losses of submerged plant communities due to reduced light penetration may have adversely affected those communities.

Nutrient-Chlorophyll-Secchi Relationships in Lakes Okeechobee and Apopka

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Lakes Okeechobee and Apopka are large Florida lakes that share a number of common features and have large and visible management programs that have benefited from comprehensive monitoring and scientific research. We compared relationships between nutrients, chlorophyll a and Secchi transparencies in the two lakes, to determine whether general models could be found. In the pelagic region of Lake Okeechobee, water quality is strongly controlled by wind resuspension of mud sediments. There is low underwater irradiance and conditions that are not sufficient for net positive growth of phytoplankton. As a result, there are no significant relationships between nutrients, chlorophyll a, and Secchi transparency. In the near-shore region of Lake Okeechobee, the water column is shallower and sediments are comprised of sand and peat. Underwater irradiance is more favorable for algal growth, and there is a positive relationship between nutrients and chlorophyll a. In Lake Apopka, strong positive relationships are found between nutrients and chlorophyll a, and a negative relationship occurs between chlorophyll a and transparency. These results and others to date suggest that due to complex and variable interactions between the benthos and water column, these shallow lakes do not lend themselves to generic models relating nutrients, chlorophyll a and transparency. At a minimum, shallow lake models may need to include the following distinct classes: (1) macrophyte-dominated lakes; (b) phytoplankton-dominated lakes, such as Apopka; and (c) abiotic seston-dominated lakes, such as the pelagic region of Okeechobee. The important role of wind-driven mixing and benthic-pelagic interactions also suggests that a solid understanding of ecosystem dynamics may require sampling at shorter time scales than normally occurs in lake monitoring programs.

Session 3 - Trophic State Dynamics in Florida Lakes (Moderator: Chuck Hanlon, South Florida Water Management District) - 3:00 pm to 4:40 pm

Carbon Flux Through the Planktonic Food Web of Lake Okeechobee, Florida

Work, K.A., Havens, K.E., East, T., Sharfstein, B., South Florida Water Management District, West Palm Beach, FL 33416

Carbon flux is often used to approximate energy flow in aquatic ecosystems. However, most of the carbon flux models that have been published were developed for north temperate lakes or for marine systems. The total productivity and the biological composition of subtropical lakes often differs from north temperate lakes, so models developed for northern lakes are not likely to represent fluxes in subtropical lakes adequately. In particular, carbon flux in Lake Okeechobee, with its high suspended sediment load and low light transmission, is likely to differ from relatively clear, cool northern lakes. High temperature, high suspended sediment load, and low light are often associated with high bacterial biomass and productivity and a predominance of large cyanobacteria. Zooplankton may have difficulty consuming large cyanobacteria, particularly if the zooplankton assemblage is dominated by small species, as it is in Lake Okeechobee. Therefore, we are testing the hypothesis that bacterial carbon constitutes a higher proportion of total carbon flux to zooplankton in Lake Okeechobee than in many temperate lakes and that this pattern is most pronounced in the turbid, eutrophic pelagic region. We are measuring in situ uptake of radiolabeled and fluorescently labeled bacteria and radiolabeled phytoplankton by zooplankton and protozoa both in the pelagic and near-littoral zones. At the midpoint of the study, the data indicate that bacterial carbon flux to protozoa and zooplankton is higher than algal carbon flux and that carbon uptake is more skewed toward bacterial carbon in the pelagic than in the near-littoral zone of the lake.

Littoral Periphyton Responses to Nitrogen and Phosphorus: an Experimental Study in a Subtropical Lake

Theresa East, Sharfstein, B., Havens, K.,., and Rodusky, A., South Florida Water Management District, West Palm Beach, Florida.

Portions of the natural littoral community in a subtropical lake were enclosed in 1.2 m. diameter mesocosms and subjected to high rates of nitrogen and/or phosphorus loading for 28 days. Changes in periphyton structure and function were compared with untreated controls to evaluate limiting resource effects. Mesocosms that received phosphorus additions displayed minor increases in whole-community metabolism measured by in-situ oxygen evolution during mid-day, and small increases in the chlorophyll a (CHLA) content of surface algal mats. Mesocosms that received nitrogen doses displayed significant increases in the CHLA content of epiphyton growing on submerged stems of *Eleocharis*. Striking treatment effects were observed when phosphorus and nitrogen were added together. In that case, there were highly significant increases in phytoplankton productivity, whole-community metabolism, CHLA content of surface mats, and CHLA content of epiphyton growing on artificial substrata and on submerged *Utricularia*. These results suggest that the community may have been co-limited by Phosphorus and Nitrogen, in contrast to previous findings of strong P limitation in more pristine regions of this marsh, and in the nearby Florida Everglades. The observed community responses may reflect early eutrophication effects, because the study site was located in close proximity to the lake's eutrophic pelagic region.

Can Periphyton Compete with Phytoplankton for Nutrients, and Indirectly Suppress Phytoplankton Blooms, in Lake Okeechobee?

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South Florida Water Management District, West Palm Beach, FL 33406.

Periphyton communities sometimes are very abundant in the littoral and littoral/pelagic interface regions of Lake Okeechobee, and they may be able to suppress phytoplankton blooms in these regions of the lake by removing nutrients from the water column. Nutrient limitation of periphyton growth was examined using nutrient-diffusing substrates spiked with nitrogen, phosphorus, both, or neither, at four stations in these two regions of the lake. Physical and chemical variables that affect both periphyton and phytoplankton also were measured. Periphyton biomass was highest at the western littoral station, and nitrogen was almost always the limiting growth factor. However, even the largest biomass differences between treatments (3 Tg/cm^2 - as chl *a*) did not appear to be ecologically significant. Light limitation due to high water levels appears to have limited growth at the remaining stations, while nitrogen limited growth in a few instances. These results suggest that light can have a significant effect on periphyton nutrient dynamics. High water levels and reduced light penetration may reduce the ability of periphyton to compete with phytoplankton for nutrients, resulting in an increase in the frequency and intensity of phytoplankton blooms in the littoral and littoral/pelagic interface regions of Lake Okeechobee.

Growth and Survival of The Florida Apple Snail Pomacea paludos Fed Three Naturally Occurring Macrophyte Assemblages

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Populations of young Pomace paludosa (Florida Apple Snails) were reared for 32 days in 4 screened enclosures in the littoral zone of Lake Okeechobee and in 12 laboratory tanks with a common supply of recirculated, biofiltered water. Snails in tanks were provided with either Utricularia §p., Eleocharis sp., or metaphyton, collected from the field at the start of the experiment, as food sources (n--4). Snails in enclosures were supplied with equal volumes of all three substrates. There were no significant differences in snail growth or survival between the enclosures and the laboratory tanks suggesting that laboratory conditions were good mimics of field conditions. Growth and survival were significantly higher in the Utricularia tank treatment than in the metaphyton tank treatment, but no significant differences in growth were noted between either the ' Utricularia and Eleochris or Eleochris and metaphyton treatments (Figures 1 a,b,c). Feed substrates were analyzed for chlorophyll, ash, nitrogen, carbon, and phosphorus content at the beginning and end of the experiment. Multiple comparison tests distinguished significant differences in initial feed substrate chlorophyll content and final tissue phosphorus content between all the substrates, but otherwise segregated the substrates into a Utricularia-metaphyton group and an Eleochris group.

Changes in snail biomass were positively correlated with substrate chlorophyll content unit mass , total substrate phosphorus content, and substrate carbon content. Changes in snail length and survival were positively correlated with substrate chlorophyll content unit mass- , while survival and biomass were inversely correlated with substrate ash content (Table 1). Snail fecal material, collected at the end of the experiment, showed significant differences in nitrogen content between all treatments, with the fecal nitrogen content of metaphyton reared snails being twice that of the other two treatments (Figure 2). Changes in snail biomass were inversely correlated with snail fecal nitrogen content.

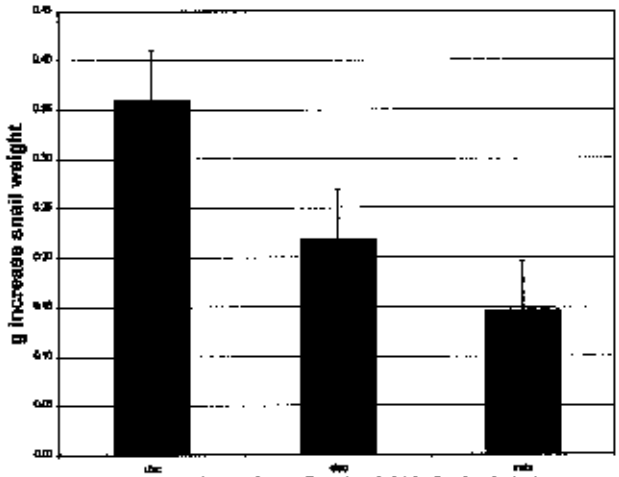

Figure 1a: change in snail wet weight in feed substrate treatments on Day 32

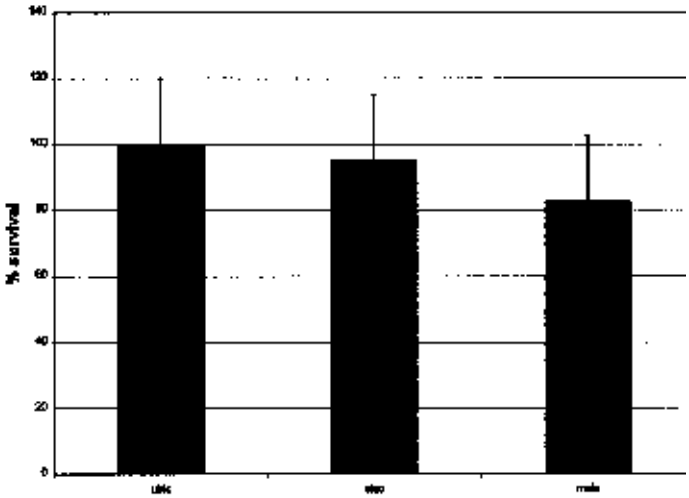

Figure 1b: Survival of snails in feed substrate treatments on Day 32

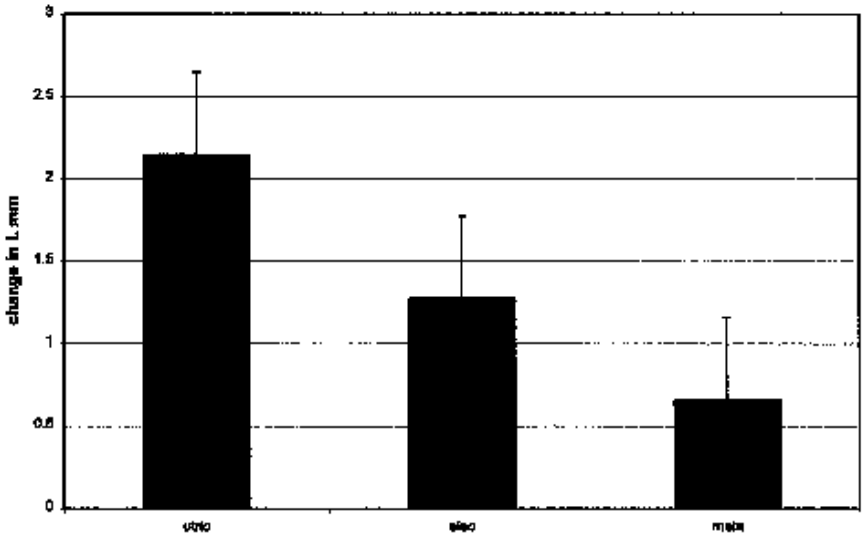

Figure 1c: Change in snail length in feed substrate treatements on Day 32

Parameter	change in snail biomass	change in snail length	survival	snail tissue carbon
change in snail biomass		+		
initial chla content feed substrates	+	+	+	
initial ash content feed substrates	-		-	
initial phosphorus content feed substrates	+			
initial carbon content feed substrates	+			+
final carbon content feed substrates				+
final snail tissue carbon content	+			+
final snail fecal nitrogen content	-			

Table 1: Results of linear regression analysis of snail growth, snail tissue composition, and feed substrate composition parameters.

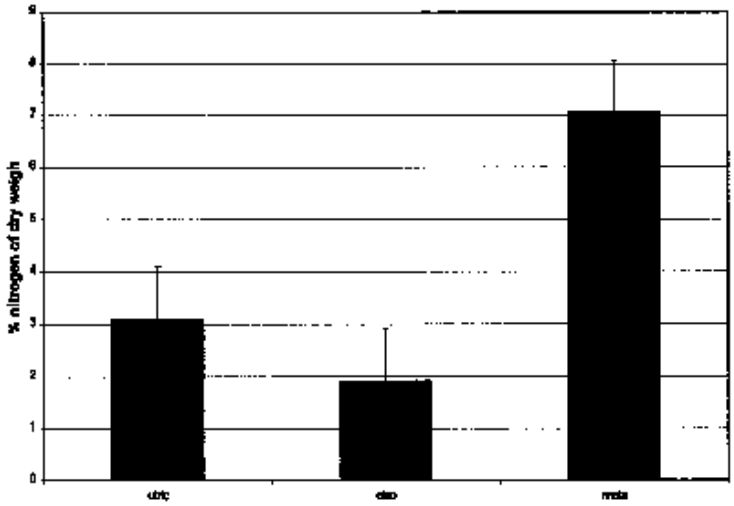

Figure 2: Snail fecal nitrogen content in Feed Substrate Treatments on Day 32

Seasonal Abundance and Distribution of Daphnia Ambigua in Subtropical Central Florida

J.A. Osborne, Biology Department, University of Central Florida, P.O. Box 25000, Orlando, FL 32816, Phone: 407/823-2980

Daphnia ambigua is a small daphniid that is the sole species found in central Florida's lakes, ponds, and canals; the only exception being a report of Daphnia laevis in Bay Lake, Daphnia lumholtzi in Lake Okeechobee, Lake Kissimmee and lakes in Polk Co., and Daphnia magna in some fish hatchery ponds. Most cladocerans and Daphnia, in particular, in temperate lakes are most abundant in spring and summer, then undergo a midsummer decline that results in low autumn and winter densities. Water temperature, predation, anoxic hypolimnetic conditions, and low algae growth are generally cited as casual agents. This study was conducted to determine if Daphnia in central Florida's subtropical, warm monomictic lakes undergo this same seasonal trend. Lakes in central Florida are typically warm (10-15 C), isothermal and holomictic during winter (December – March). Pickett Downs Pond is a small, natural, solution basin (0.4 ha; Zmax = 4.5m) located between Orlando and Titusville, Florida (N28 38.5 W81 6.4). It was sampled for Daphnia ambigua monthly from August, 1997 – December, 1998; and then weekly until August, 1998 using an oblique tow from the center of the pond to the shore with a 0.73 micron net. When the population dynamics of Daphnia ambigua in the Pickett Downs Pond was compared to that for Daphnia ambigua in other central Florida lakes (reported in the literature), the seasonal trend of high winter/spring and low summer/autumn population densities was found to be similar. Daphnia ambigua acts like a cold stenothermal organism, even in Florida's moderate winter climate.

Session 4 - In-Lake Restoration: Case Histories and Emerging Trends (Moderator: Larry Battoe, St. Johns River Water Management District) - 8:00 am to 9:40 am

Why Lake Restoration Projects Fail

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All too often, lake water quality improvement projects are perceived to be unsuccessful by the funding client. This perception is primarily caused by technical errors on the part of the consultant, along with a lack of communication between the consultant and the client. One of the foremost causes of successful lake restoration projects is a failure to develop initial target water quality goals. Development of water quality goals is essential so that the consultant can properly select the type and size of treatment facility necessary to achieve the water quality goals. Development of target water quality goals also provides the client with a yardstick for measuring the success of the water quality improvement project. Failure to adequately identify pollutant sources affecting water quality is another significant factor. All pollutant sources must be carefully evaluated, including external inputs such as stormwater, baseflow, bulk precipitation, groundwater seepage and water fowl, as internal inputs from sediment recycling, vegetative recycling, and alternate phosphorus pathways. Once the pollutant source has been identified, consultants often fail to properly consider or identify the limiting nutrient status of the lake. Evaluation of the limiting nutrient is necessary to select an appropriate treatment option which maximizes removal of the nutrient of concern.

One of the largest sources of error in lake evaluation studies involves the development and use of models for prediction of water quality improvements. Violation of model restrictions and limitations is common, and consultants often fail to evaluate the impact of restoration options on model rate constants under post-treatment conditions. Finally, selection of treatment options often fails to consider the ability of the treatment process to remove the nutrient of concern and fails to properly evaluate the anticipated efficiency of the proposed system.

Cost Analysis and Management Implications of Real and Perceived Environmental Problems: Berm Formation in Lake Okeechobee as an Example

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One of the challenges that research scientists working in public agencies face is how much credence should be given, and how many resources dedicated, to address potential problems brought to their attention by people outside their agency (so-called "brushfires"). The agency must be accountable to the tax-paying population that they serve, so these problems cannot be dismissed arbitrarily. However, often the problem is publicized in local media and may be championed by advocates before its real threat can be assessed scientifically. Under such circumstances, agency resources are often redirected from existing projects toward the new problem; the driving force behind the research program then becomes advocacy and politics instead of science. The formation of a berm (a several meter wide "wall" of coarse organic material and plant matter at the pelagic-littoral interface) in Lake Okeechobee, the circumstances surrounding its publicity, and the redirection of resources and research effort at the South Florida Water Management District, present an excellent example of the effects of one brushfire. In this presentation, we quantify the costs associated with resource redirection and offer suggestions how public agencies can better deal with brushfires, while still maintaining accountability and credibility to taxpayers.

Automated Bathymetric Mapping of Florida Lakes

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Traditional methods for accurately measuring bottom contouring in lakes are typically Costly, labor intensive, and are subject to operator error. Because of this, bathymetric data do not exist for many Florida lakes. This work describes a specific procedure used to automate bathymetric mapping, thereby reducing the time and cost of surveys and increasing the accuracy of contour maps. This process has been used to map over 50 lakes in Hillsborough County, Florida in less than one year.

Our automated bathymetric mapping procedure has been developed through an effort to create an online, multimedia lake atlas (www.lakeatlas.usf.edu) that is useful for citizens and scientists. The Atlas is produced in conjunction with the Florida Center for Community Design and Research at the University of South Florida, the Hillsborough County Public Works Department, and the Southwest Florida Water Management District.

Central to the methodology is the use of a Trimble Differential Global Positioning System (DGPS) interfaced to a Lowrance fathometer. The fathometer and GPS are used to collect water depths with accompanying latitude/longitude coordinates within one-meter of horizontal accuracy. Pre-trip planning for bathymetric mapping is necessary to assure optimal DGPS satellite views during the time period that field data is obtained, and to determine the sampling effort necessary to completely cover the size and shape of the lake. The distance required between transects is judged by the size of the lake, while the vector direction is primarily based on the overall morphology of the lake.

Field data are then transferred to Pathfinder Office software for quality control procedures, and subsequently exported for post-processing using ESRI's Arc/Info Triangulated Irregular Network module (TIN), part of the Arc/Info Geographic Information Systems software package. Shoreline data may be obtained by digitization of the shoreline from existing I foot interval topographic maps; or in the field by circumnavigating the lake and using a laser rangefinder to offset the perimeter. Depth data are combined with shoreline data and processed in the Arc/Info TIN module to create a 3-dimensional model of the lake. From this model, various interpolation

algorithms can be employed through an iterative process to generate a "best fit" contour map.

Bathymetric data can be integrated with digital orthophotography and other spatial data sets to model the effects of lake level change including: impacts of flooding on property during periods of high water, and reduction of aquatic habitat during extreme low water levels. Such results may be incorporated into future best management practice scenarios.

Limitations on the procurement of bathymetric maps include the obstruction of consistent perimeter circumnavigation, inaccessibility due to extremely dense aquatic vegetation, the failure to receive GPS satellite views either by negligent planning or by a hindering tree canopy, and maintaining a consistent distance between transects. It is anticipated that the results of such rapid assessment methodologies will broaden the current knowledge of water resources and assist citizens, scientists, and planning agencies to improve the management and development practices in local watersheds and basins.

Emerging Sediment Removal and Dewatering Technology

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Hydraulic dredging has become the method of choice for many sediment removal projects due primarily to its simplicity, relative low cost and effectiveness. The primary technical/management challenges of utilizing hydraulic dredging focus on sediment disposal and water quality issues. Over the last five years several projects and tests have been completed utilizing advanced techniques to minimize sediment volume (required disposal area) and water quality problems. Elements of these advanced techniques consist of: polymer flocculation for dewatering and water clarification; screening and cycloning of sediments for particle separation and dewatering; "progressive cavity" pumping to move thickened sediment; belt filters to achieve high dewatered solids; long distance pumping systems – up to five miles. This paper will discuss the new techniques and their application to lake sediment removal.

Lake Hancock and the Whole Lake Restoration Controversy

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Lake Hancock is a meandered lake located southeast of the City of Lakeland and north of the City of Bartow in Polk County, Florida. The lake was surveyed for the State in 1850 and is still publicly-owned. At 4,553 acres, Lake Hancock is the largest lake associated with the Peace River, the third largest lake in Polk County, and the fourth largest in Florida. Lake Hancock has been recognized as having some of the poorest water quality in the State. The lake is considered to be eutrophic to hypereutrophic, characterized by persistent blue-green algae blooms, high nutrient concentrations and low dissolved oxygen levels in the water column, nearly 12,000 acre-feet (18 million cyds.) of nutrient rich bottom sediments, and vegetation, fish, and wildlife populations indicative of eutrophic to hypereutrophic conditions. There has been a substantial amount of work done to assess the condition of Lake Hancock and to identify the issues that need attention. The most prominent work was the Florida Institute of Phosphate Research (FIPR)/Zellars-Williams 1986 contract to secure data, prepare a mining and reclamation program, and secure supporting documentation for permits. Their conclusions and recommendations are summarized below:

Drawdown and Desiccation

Drawdown with desiccation has the quickest effect on the lake nutrient concentrations. Post-desiccation nutrient release from the sediment is predicted to be about 25% of existing conditions and would significantly improve water quality. The effect on aquatic life is, of course, profound during the drawdown and desiccation process, but the water quality improvement is the most rapid of any of the alternatives considered, with the results being achieved immediately on lake re-flooding.

Even if relatively effective desiccation could be brought about by drawdown of the lake, there is no evidence that this approach represents a means of permanently restoring Lake Hancock water quality. A strictly gravity driven drawdown would expose only 37% of the lake bottom. The topography of the downstream channel blocks further gravity discharge, and the rest of the water would have to be pumped out. Pumping the water would be a considerable additional expense (estimated at $5 to 6 million in 1987). If a low-cost means of exposing large expanses of bottom sediment were available, drawdown might have merit as a means of gaining at least short-term improvement. Pumpdown, however, would be costly, and the expense did not seem to be justified. Therefore, drawdown was not recommended for Lake Hancock restoration.

Mining and Reclamation

Mining and reclamation represented the only approach that offered the potential for performing restoration without expense to the State, and in that respect it is the most appealing of the

alternatives. It should be noted that only 2,100 acres of the 4500 acre lake would be mined and cleared of sediment with an average depth of 15 to 16 feet. The remainder of the lake would be unrestored and in the same condition as in the no-action case -- very shallow, with a significant sediment layer. During the mining operation the nutrient concentrations would rise above the no-action case and more than half of the lake would remain in its present very shallow form, with a likelihood that this area could degenerated into a bog or marsh. The depressed conditions of the worldwide phosphate market in 1987 would not allow sufficient revenues to justify the operation. If a rise in the price of phosphate rock were to make it economically viable, mining could be an alternative. At the time of the report, however, mining and reclamation could not be recommended.

Sediment Dredging

Removal of the sediment from the lake bottom and deposition of this sediment at the south end of the lake was the most attractive alternative from an environmental perspective. A large reservoir of nutrient reserves would be removed from the lake, and the best possible water quality is established immediately after dredging is complete. The majority of the lake is restored to a depth of 5 and 6 feet, which is an ideal habitat for fish. The provision of sediment traps and the resulting islands and littoral shelf increases the available shoreline and the suitability of the lake for recreation. Sediment dredging results in a minimum of disturbance to the flora and fauna within the lake during the dredging operation. The estimated cost of the dredging program was $18-24 million depending on the extent that desirable features (islands, sediment sumps, etc.) were incorporated into the design. The expense could be reduced using a combination of drawdown and dredging.

Removal of lake bottom sediments was projected in the Zellars-Williams study to result in the greatest degree of water quality improvement of any option considered. Mining and reclamation offered the prospect of improvement over the area mined, and if unmined areas were dredged, then the ultimate water quality results were predicted to be similar to those for dredge-removal of sediment. Drawdown with desiccation was projected to show a lesser degree of improvement.

Lake Hancock restoration was recommended to be accomplished by sediment dredging. For various reasons a restoration approach was never implemented.

Session 5 - Watershed Management: Case Histories and Emerging Trends (Moderator: Harvey Harper, Environmental Research & Design, Inc.) - 10:00 am to 11:40 am

The Everglades Nutrient Removal Project Test Cells: the Use of Experimental Wetlands to Optimize Performance of Stormwater Treatment Areas

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The Everglades is an oligotrophic wetland that is being impacted by nutrient-rich runoff generated from urban and agricultural sources. The Everglades Forever Act (EFA) requires the South Florida Water Management District (District) to construct a series of large treatment wetlands (ca. 16,000 ha) called Stormwater Treatment Areas (STAs) to reduce nutrient levels in runoff before it reaches the Everglades. The EFA also requires the District to conduct research to optimize nutrient removal performance by the STAs. One part of the District's STA Optimization Research and Monitoring Program involves conducting research in the Everglades Nutrient Removal Project (ENRP) test cells. The test cells are small, shallow, fully lined wetlands, about 0.2 ha in size, located within the boundaries of the ENRP, a prototype STA built and operated by the District. Thirty test cells are arranged into two groups of 15 cells each; one group is located at the northern end of the ENRP and the other at the southern end. Inflows to each set of test cells come from within the ENRP itself. Based on historical ENRP water quality data, the range of influent nutrient concentrations at the northern test cells is expected to be higher (ca. 60 to 120 µg TP/L) than at the southern set of cells (ca. 30 to 50 µg TP/L).

Experiments planned for the test cells will focus on wetland performance response to extremes in operating conditions. One experiment will compare the effect of maintaining cells at the STA design maximum depth (140 cm) for long periods of time relative to controls kept at the design average depth (60 cm). Another experiment will determine the maximum efficiency that the test cells can achieve by sequentially decreasing the hydraulic loading rate (HLR) keeping depth constant and thereby increasing the hydraulic retention time (HRT). Conversely, a third experiment will identify the point at which nutrient removal in the test cells fails by sequentially increasing HLR to decrease the HRT.

Modifications to the test cells as originally constructed were required prior to initiating these experiments. The cells were lined and filled to a 65 cm depth with peat collected from the ENRP or adjacent farmland. All work was completed by March 1998 at the north cells and by September 1998 at the south cells. The test cells were then flooded to a shallow depth (30 cm) and the outflow weirs were adjusted to permit continuous discharge. Wetland vegetation has become reestablished in each cell from the native seed bank in the peat soils. Plant colonization rates are being documented to provide plant grow-in estimates for the STAs. Preliminary water quality sampling was conducted to characterize each test cell before initiating experiments. Analyses of data from the north set of test detected no significant differences ($p = 0.05$) in any of the measured parameters (TSS, total P, SRP, total N, TKN, and NO_x) among the inflows to each cell. Characterization of the southern test cells is still underway.

Phosphorus Control Strategies for Lake Okeechobee

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Lake Okeechobee, with an area of 730 square miles and a drainage basin of 5000 square miles, is the center of the Kissimmee-Okeechobee-Everglades ecosystem. The existing conditions within the lake are attributed to three major issues. 1) Phosphorus loading rates to the lake exceed the legally-mandated SWIM target by over 100 tons/year. Sources of phosphorus pollution in the watershed have been heavily regulated, and progress has been made in load reduction; however, the last decade of data indicates that additional measures are needed to reach the SWIM target. 2) In-lake phosphorus concentrations are over two-fold higher than in the early 1970s and large quantities of phosphorus have accumulated in the lake's mud sediments. These sediments provide a high rate of internal phosphorus loading, and this process is expected to delay responses of the lake to external load reductions (by decades or longer). 3) The lake's marsh zone, which provides critical habitat for fish and wildlife (including federally endangered species), has seen a rapid expansion of cattails since the early 1970's and is being invaded by exotics that are displacing native vegetation at intolerable rates. The littoral zone also is threatened by high lake stage due to (a) erosion and loss of important emergent plant communities by wind and waves, (b) increased horizontal transport of phosphorus from mid-lake to near-shore regions that are heavily utilized by humans and wildlife, and (c) nutrient transport into the pristine interior marsh.

The Lake Okeechobee Issue Team was formed by the South Florida Ecosystem Restoration Working Group in May, 1998. Its purpose is to develop federal, state, and local ~~stakeholder~~ consensus on an action plan to achieve the Lake Okeechobee phosphorus in-lake concentration and load reduction goals stated in the SWIM Act and the Lake Okeechobee SWIM Plan (1997). The Issue Team has developed the following strategies for the issues described above. For watershed loading, several approaches are being used: on-site water retention and treatment, regional storage and treatment, tributary dredging, and implementation of additional agricultural Best Management Practices throughout the watershed. For in-lake phosphorus issues, implement, if deemed feasible, measures for reducing or eliminating the internal phosphorus loading, including the possibility of sediment dredging. For the lake's marsh zone, efforts to control exotic plants should be expanded. In addition, with multiple benefits for the lake, high lake stage events must be reduced both in frequency and duration. Treatment and storage of stormwater runoff is a critical and costly approach that is being developed for improving the lake. This will be accomplished by individual landowners through on-site wetland restoration and water retention, as well as reservoirs and stormwater treatment areas (STAs) on a basin-scale. Current estimates range from 30-35,000 acres of reservoirs and STAs in the northern watershed needed for load reduction. These regional facilities will also benefit the marsh and estuaries. By retaining more water in the watershed, the rise in lake stages will be smaller, and large freshwater releases to the estuaries will be reduced. In addition, lower lake stages reduce nutrient enrichment and other detrimental impacts on the marsh zone.

Periphyton Filtration: The Current State of the Art

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Periphyton Filtration is a type of wetland water polishing system specifically limited to attached algae. It has been shown to achieve high phosphorus and nitrogen yields through regular harvesting. Measured P yields of 400 to 1,875 Kg/H/ year have been observed. Periphyton Water Gardens have been deployed successfully in an urban setting in Orlando. Photos and data will be presented. Linking periphyton filtration with a packaging manufacturing technology has enabled the jump to commercial sector viability. Details of the 20 ton per day manufacturing plant at Lake Apopka utilizing harvest from a 2 acre periphyton filter currently under construction will be discussed.

Deer Point Reservoir: A Case History of Starting a Watershed Protection Program

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Bay County's 5,000 acre Deer Point Reservoir was created in 1961 by constructing a low-level dam across North Bay, an arm of the St. Andrew Bay estuary. It's major purpose was to provide an abundant and reliable fresh water source for industry and citizens who were experiencing salt water intrusion due to many years of high volume groundwater withdrawls. Bay County was given full control of and permission to build the reservoir by a Special Act of the Legislature in 1957.

The Deer Point Reservoir watershed covers approximately 435 square miles. On average, 600 million gallons per day enter the reservoir from four tributaries. The primary tributary, Econfina Creek, supplies an average of 60% of the water to the reservoir, with the relative amount increasing to 80% during extremely dry conditions. Bear Creek, the second major tributary, supplies an average of 35% of the water to the reservoir, decreasing to 15% during dry conditions. The County Utility Services Department currently withdraws approximately 50 million gallons per day from the reservoir for industrial and potable water use. The remaining 550 million gallons per day overflows the dam and enters North Bay.

The uniqueness and value of the reservoir was officially recognized in 1967 when a State law was passed which both defined the "Watershed" and prohibited certain activities (e.g. sewage and other waste disposal, septic tank setbacks) within the watershed. This law defined the "Deer Point Lake Watershed" as primarily an area immediately around the reservoir and the lower reaches of the major tributaries. The law did not define the actual hydrologic watershed.

In the late 1980's, the County Commission formed the Deer Point Reservoir Advisory Committee. The purpose of this Committee is to consider reservoir management issues and make recommendations to the County Commissioners regarding actions to help protect the quality of the water in the reservoir. A recurring issue addressed by the Committee at the insistence of the waterfront property owners has been aquatic weeds. The Committee's 1991 annual report to the County Commissioners recommended the creation of a Watershed Management Specialist position within the County's Utilities Department to provide for monitoring of the water quality and quantity within the watershed, especially in response to development pressure.

The Northwest Florida Water Management District performed a Surface Water Improvement and Management (SWIM) Program Study of the watershed from 1991 through 1994. This study carefully defined the Deer Point hydrologic watershed and determined that approximately 53 %

of the watershed land area is silviculture, with an additional 21 % of the watershed being wetlands. The major conclusions were: 1) Deer Point Reservoir and its tributaries currently have excellent water quality, and; the biggest threat to water quality within the watershed is non-point source pollution due to increased development. Comprehensive land use planning and watershed management were strongly recommended.

Also in the early 1990's, several large silviculture land owners began a program to rezone tracts of their land to "residential" for the purpose of development. In order to help prevent water quality degradation, Bay County enacted the Deer Point Lake Protection Zone Ordinance in 1994 to add more stringent development requirements for any rezoned tracts of land within the Protection Zone area. The Protection Zone area encompasses an area larger than the "Deer Point Watershed" described by the 1967 Florida law, but does not include the entire hydrologic watershed. The primary features of this ordinance are a requirement for low density development (1 dwelling per five acres or ten acres, depending on location), a 75 feet natural vegetative setback, storm water runoff must be treated to twice the level normally required, and prohibited certain types of land use (i.e industrial, commercial) within the Protection Zone.

In 1995, Bay County began a watershed water quality monitoring program. Baseline data was needed to assess the quality of the surface water and monitor the effects of development within the watershed. Since June 1995, samples have been collected monthly at thirteen locations. The three primary factors considered in site selection were: 1) the quantity of water passing the location; 2) ease of access for sample collection, and; 3) location relative to ability to detect changes due to significant development. Currently, we measure pH, dissolved oxygen, conductivity, and temperature in the field. Monthly analyses include total coliform, Escheria coli, total dissolved solids, total suspended solids, total organic carbon, turbidity, color, UV254, and SUVA. Quarterly analyses include alkalinity, chloride, ammonia, nitrate-nitrite, total Kjeldahl nitrogen, total nitrogen, total phosphorous, and chlorophyll A.

Seven continuous data collection systems were installed throughout the watershed in 1998 to begin monitoring the quantity of water entering and leaving the reservoir under different climatic conditions. Three of these stations include rainfall intensity and volume measurement equipment. This data is being used to better define the hydrologic conditions within the watershed and will further help identify changes within the watershed due to development.

Comprehensive watershed management is an on-going commitment for Bay County. The County has been blessed with an abundant supply of fresh water, an unusual condition for a coastal community. Properly managed, this resource will provide an adequate water supply to the area for many generations to come. Bay County continues to evaluate what other steps are necessary to protect this special resource.

Removal of Gross Pollutants from Stormwater Runoff Using Liquid/Solid Separation Structures

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Gross pollutants in stormwater runoff generally consist of litter, debris and coarse sediments. Litter is typically defined as human-derived material, including paper, plastic, metal, glass and cloth. Debris is typically defined as any organic material transported by stormwater runoff, such as leaves, twigs and grass clippings. Coarse sediments are defined as inorganic particulates. The discharge of gross pollutants to surface waters can threaten wildlife and aquatic habitats, can produce unpleasant odors and attract vermin, and can be aesthetically unpleasing. Many gross pollutants cannot be sampled by traditional automatic samplers and, as a result, gross pollutants are often overlooked when evaluating the impact of stormwater runoff on receiving waters. During 1998-1999, evaluations were conducted for the City of Orlando, the City of Winter Haven, and the City of Atlantic Beach related to the removal of gross pollutants from stormwater runoff using liquid/solid separator technologies. Based on information found in the literature and information obtained from technology manufacturers, removal efficiencies were compared for four separate liquid/solid separator technologies, including Vortechnics, Stormceptor, CDS Technologies, and traditional baffle boxes. The evaluation considered removal efficiencies for litter, debris, and coarse sediments; estimated installed cost; and operation and maintenance requirements. Based on removal efficiencies for coarse sediments, removal efficiencies were estimated for common stormwater constituents, including total nitrogen, total phosphorus, total suspended solids, BOD, and heavy metals. Based on typical fractions of particulate matter in runoff, liquid/solid separators are capable of removing approximately 20-50% of nutrients and heavy metals under ideal conditions. Limitations of liquid/solid separators must be understood when considering these systems for retrofit applications.

Session 6 - Hydrologic Considerations is Lake Management (Moderator: Walt Reigner, BCI Engineers & Scientists, Inc.) - 1:30 pm to 3:10 pm

Ground-Water Interactions With Florida Lakes: A Watershed Perspective

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The U.S. Geological Survey, in cooperation with local water management districts and state agencies, has conducted studies on the interaction of ground water with Florida lakes for more than a decade. Most of the lakes studied have been in the mantled karst of Florida's ridge areas, where rainfall quickly infiltrates through sandy soils to recharge the shallow surficial aquifer system. A fraction of this ground water discharges to lakes, which are directly connected to the surficial aquifer. The remainder of the shallow ground water leaks across a clayey confining unit to the deeper carbonate aquifer. Factors such as recharge, local hydrogeology, and pumping from the deeper aquifer influence the rate of downward flow. The majority of lakes in this setting are seepage lakes, with no surface-water drainage. Thus, a lake's watershed is equivalent to the area of the lake basin contributing ground water to the lake.

Because of the tendency for downward flow to the deeper aquifer and differences in confining-unit properties, the water table does not always reflect topography. In some areas of a lake basin, the water table may slope away from the lake, resulting in lateral ground-water outflow. Thus, the area contributing ground water to a lake can be much smaller than the topographically defined lake basin, and does not necessarily extend to the topographic divide (fig. 1). Of 10 lakes studied in ridge areas of central Florida, all were ground-water flow-through lakes during part of the year (Sacks and others, 1998).

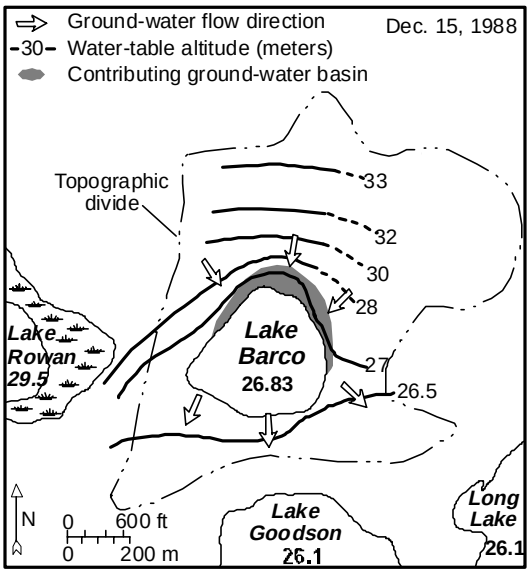

Figure 1 -- Water table configuration and area contributing ground-water inflow to Lake Barco; contributing areas defined by numerical modeling (Lee, 1996)

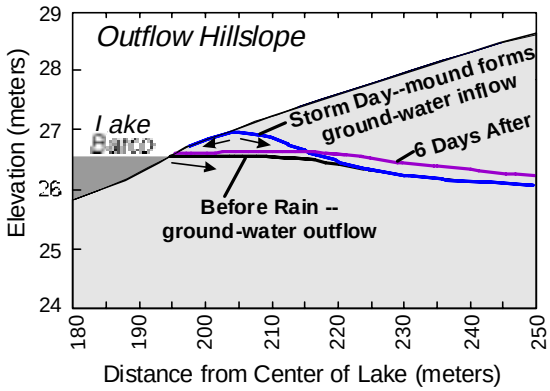

Figure 2 -- Development of water-table mound on side of lake that typically experiences ground-water outflow (Lee, in press)

Recharge from large rainfall events can temporarily increase the size of the contributing ground-water basin for flow-through lakes. Temporary mounding of the water table on the "outflow" side of a lake can reverse the slope in the water table, causing ground-water inflow to occur (fig. 2). Transient water-table mounds also can increase the amount of ground-water inflow

to the "inflow" side of the lake. Mounding is most often observed in areas where the water table is within 6 feet of the land surface.

The amount of ground-water inflow can vary significantly between lakes. For example, at 10 lakes recently studied in central Florida, ground-water inflow ranged from less than 10 to more than 150 inches/year (equivalent to 10 to 80% of total inflows). These inflow differences underscore the dramatic variability in the amount of interaction between ground water and Florida lakes.

Differences in the amount of ground-water inflow to lakes and the land use in the ground-water basin have important implications on solute loading to lakes. The influence of ground water on lake-water quality is readily apparent when comparing major ion concentrations in ground water and lake water in undeveloped lake basins to those in basins dominated by citrus agriculture. In undeveloped basins, ground water and lake water are dilute and dominated by sodium and chloride (fig. 3). In contrast, land applications of fertilizers and irrigation water in areas of citrus agriculture result in increased concentrations of major ions and nitrate in shallow ground water; many of the more conservative ions can subsequently be seen in the lake water (fig. 3).

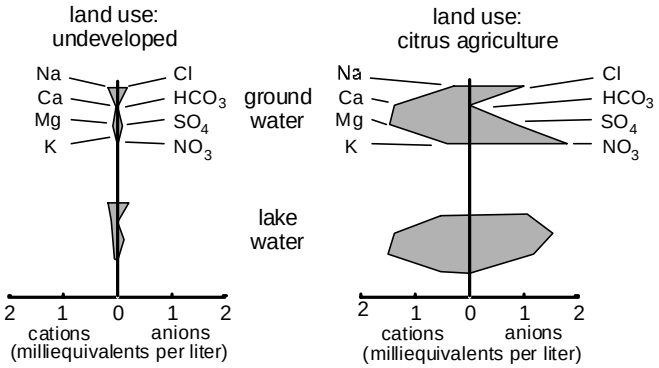

Figure 3 -- Comparison of major ion concentrations in ground water and lake water in lake basins with different land uses (Sacks and others, 1998)

Nitrate loading from ground water was estimated for 10 lakes. Loading was highest for lake basins dominated by citrus agriculture with high amounts of ground-water inflow, and lowest for lakes with undeveloped basins or with no development in the area near the lake, regardless of the amount of ground-water inflow. Nitrate is depleted in the lakes, most likely from increased biological productivity, but occasionally loading is sufficient to cause elevated nitrate concentrations (greater than 2 mg/L as N) in the lake water. Productivity in these lakes may be limited by another nutrient such as phosphorus.

A better understanding of the interaction between ground water and lakes is useful to those managing both water levels and water quality in lakes. For example, defining the ground-water contributing area of a lake is fundamental if best management practices in the basin are implemented to improve lake-water quality. Understanding the magnitude and timing of ground-water inflow to a lake helps not only to define the water budget, but also is important in understanding the potential for chemical loading from the ground-water basin. Florida lakes are directly connected to the ground-water system, and as such, an integrated approach is necessary to best manage this valuable resource.

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A Two-year Water Budget of Lake Starr – A Flow-through Seepage Lake in Polk County, Florida

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Lake Starr, a seepage lake in Polk County, Florida, is the subject of a water-budget study by the U.S. Geological Survey and the Southwest Florida Water Management District. Data collection was most intensive for the two-year period from August 1996 through July 1998, when the hydrogeologic framework of the lake basin was described, lake and ground-water levels were measured, and climate data were gathered to calculate a lake water budget. A preliminary analysis of lake/ground-water interactions was also done, providing a basis for a future modeling study of Lake Starr. This study also provides a foundation for a long-term study to monitor the effects of annual changes in climate and ground-water withdrawals on lake water-budget components.

Lake Starr is a 134-acre sinkhole lake in a karst setting on the Lake Wales Ridge, an upland area of central Florida where recharge from the surface to the Upper Floridan aquifer is high. Ground-water levels in a network of wells around the lake show a flow-through pattern in the water table. Ground water flows from the surficial aquifer system to the lake on the west and north sides of the lake, and lake water flows out to the surficial aquifer system on the southeast side. The shape of the water table reflects the head distribution in the underlying Upper Floridan aquifer rather than land surface topography. In fact, the lowest water table elevations occur in the southern half of the basin, under the highest land-surface elevations. The southern half of the basin also has conspicuous sinkholes caused by collapse of overlying sediments into solution cavities in the carbonate rocks of the Upper Floridan aquifer.

Rainfall and evaporation were the largest components of the lake water budget. Annual rainfall for the two years was 50.68 and 54.04 inches, respectively, differing slightly during the two years of the study. Short-term evaporation was accurately quantified using the energy budget method, allowing weekly water budgets to be calculated and overall water-budget error to be reduced. Evaporation was 57.08 and 55.88 inches per year, respectively. Lake stage dropped 4.9 inches during the first year, and rose 12.7 inches during the second year. The much larger increase in lake stage during the second year was due to the timing and intensity of the winter rains during that year. Rainfall was higher than normal from December 1997 through March 1998 (27.89 inches) because of a strong El Niño weather pattern. The resulting high net precipitation (rainfall–evaporation) caused increased recharge and greater net ground-water inflow in the second year.

Net ground-water flow (ground-water inflow minus outflow) was calculated as the residual term to the water budget (fig. 1). Analysis of the net ground-water flow component of the water budget can give insight into the relative magnitude of ground-water inflows and outflows to the lake water budget. One way to estimate ground-water inflow to the lake is to assume a constant ground-water outflow rate that is equivalent to the median net ground-water flow of all months with negative net ground-water flow. Using this technique, ground-water outflow accounted for between 20 and 23 percent of the total losses from the lake water budget. Assuming that ground-water inflow is equal to the median outflow plus net ground-water flow during months with positive net ground water, ground-water inflow accounted for between 26 and 40 percent of

inflows to the lake. Ongoing numerical modeling of the basin will provide independent estimates of ground-water inflow and outflow.

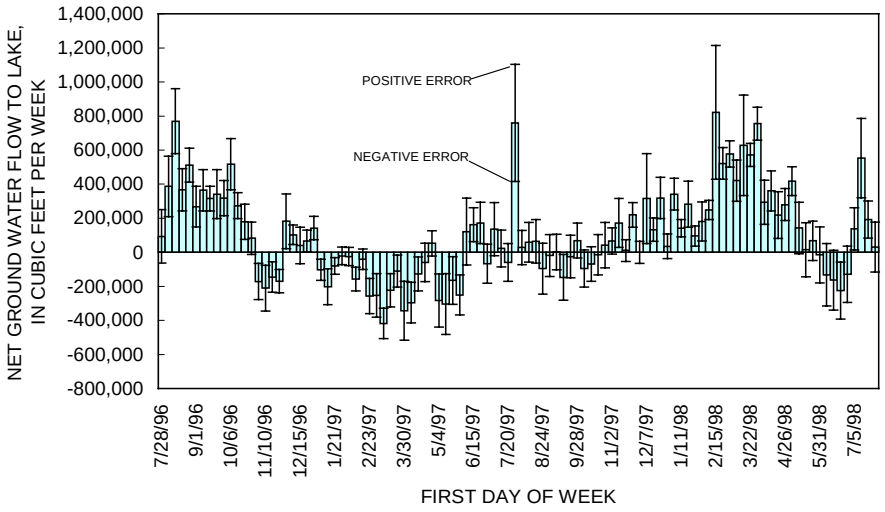


Figure 1.--Weekly net ground-water flow to Lake Starr for July 28, 1996 to August 1, 1998

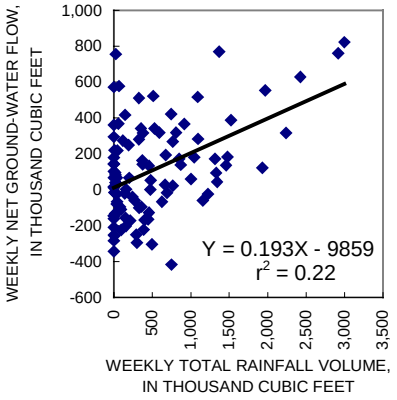


Figure 2.-Relation of weekly net ground-water flow to and from Lake Starr to weekly rainfall on the lake

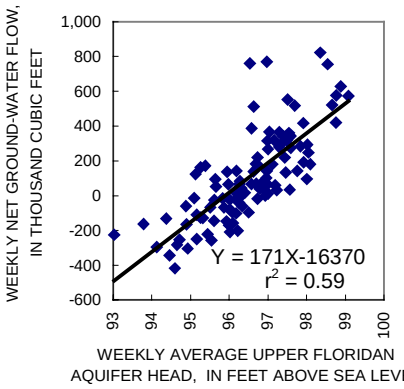


Figure 3.-Relation of weekly net ground-water flow to and from Lake Starr to weekly average head in the Upper Floridan aquifer

Weekly net ground-water flow shows a seasonal pattern with net ground-water inflow occurring during the wet season and outflow occurring during the dry season. For the entire study period, however, weekly net ground-water flow was poorly correlated to weekly rainfall (r^2 = 0.22, fig. 2). This relation is partly due to the size of the basin and the depth to the water table. Depth to the water table is greater than 100 feet in upper parts of the basin, creating a one- to two-month lag in recharge to the water table and ground-water inflow to the lake. In contrast, weekly net ground-water flow is more highly correlated to weekly average head in the Upper Floridan aquifer[1] (r^2 = 0.59, fig. 3). This indicates that the head in the Upper Floridan aquifer affects weekly net ground-water flow more than does rainfall. Short-term head changes in the Upper Floridan aquifer are due to ground-water pumping. This illustrates that the head in the Upper Floridan aquifer can affect the lake water budget over time periods as short as a week.

[1]Weekly predicted head in the Upper Floridan aquifer is estimated from a relation between point measurements of water level in a well in the lake basin and hourly recorded water level in a well about 4 miles away (ROMP 57A).

Evaluation of the Effects of Pumping Water from Pretty Lake to Lakes Horse, Raleigh, and Rogers in Northwest Hillsborough County, Florida

Quincy D. Wylupek, Environmental Scientist, Southwest Florida Water Management District
2379 Broad Street, Brooksville Florida, 34609-6899

El Nino drenched northwest Hillsborough County with 42 inches of rain during the 1998-1999 Winter season. In December alone, 15.97 inches of rain fell in the Rocky Creek basin producing localized flooding. This flooding provided an opportunity to restore water levels of three lakes in the area that have been impacted by potable water supply well pumping and drought. Lakes Raleigh and Rogers are within the Cosme Odessa well field and Horse Lake is in close proximity to the well field. To alleviate flooding, the Southwest Florida Water Management District (the District) began pumping water from Pretty Lake (which is fed by Rocky Creek) to Horse Lake on January 8, 1998, and then from Horse Lake to Lake Raleigh on January 15, 1998. Tampa Bay Water (formerly West Coast Regional Water Supply) began pumping water from Lake Raleigh to Lake Rogers on January 23, 1998. All pumping stopped on March 30, 1998. The purpose of this study was to document the water quality effects of augmenting a lake with water from another lake. The fact that Pretty Lake is a tannic lake and the other three lakes are not, added further consideration to this project. Water quality sampling occurred bi-weekly from just before pumping began until April 5, 1999. Analysis of the data from the sampling event just before pumping began until pumping stopped revealed the lakes were becoming more similar in their water chemistries. A preliminary review of the full data set suggests the lakes have returned to pre-pumping conditions. Further analysis of the data collected and analysis of historic data will be presented.

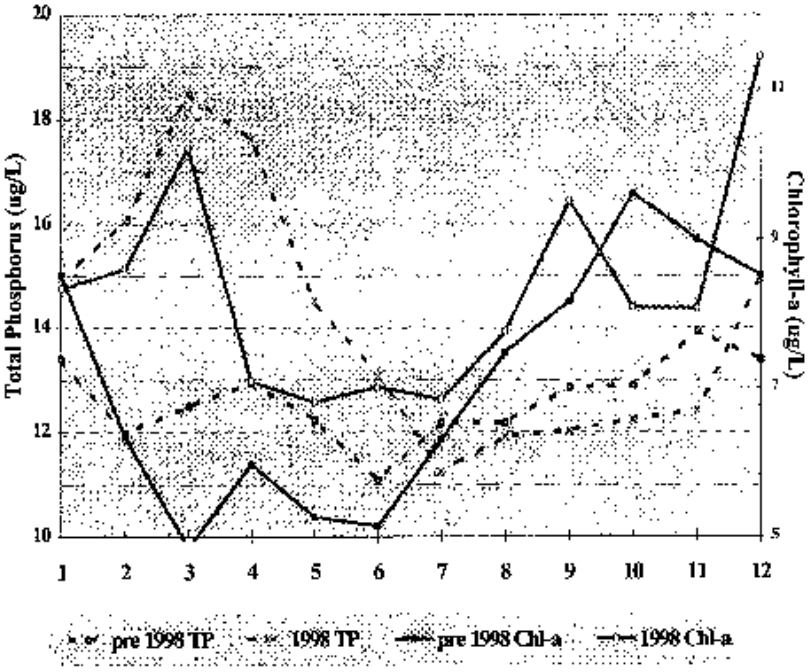
El Niño's Effect on Highlands County's Lakes: Was there one?

Clell J. Ford, Lakes Manager, Highlands Soil and Water Conservation District, 4505 George Blvd, Sebring, Florida 33872-5837

Highlands County's 90 lakes, on the southern end of the Lake Wales Ridge and in the Kissimmee Valley lowlands, were the main beneficiaries of the unusual winter 1998 weather. The 1997-1998 El Niño event brought extremely heavy rains to the lakes of Highlands County, many of which experienced record-high dry season water levels. Water levels were well above average for the time period, with most lakes reaching their 10 year flood warning level. The winter - spring decline in nutrients, typical of normal rainfall years, were also dramatically reversed.

Water Quality Total phosphorus concentrations in the 33 public access lakes monitored by Florida LAKEWATCH, representing 46,000 of the County's 48,000 acres of surface water, were well over the winter spring average. Broken out by Florida Lake Region, total phosphorus levels for the 16 Southern Lake Wales Ridge Region lakes were 2 to 6 µg/L above the pre-1998 winter-spring average (figure 1). This difference had disappeared by July, when pre-1998 levels were slightly higher (12.2 µg/L) than those for 1998 (11.3 µg/L). Chlorophyll-a values showed a similar winter trend, with from 1 to 5.5 µg/L higher chlorophyll-a values in winter 1998 as compared with historic values. As with total phosphorus, the differences in chlorophyll values between El Niño and non-El Niño years disappeared with the onset of the summer dry season (figure 1). Total nitrogen values, averaged over the 16 Ridge lakes were also elevated during the 1998 El Niño rains by between 150 and 200 µg/L. However, following the extremely dry spring and return of wet season rains in July, trends in total nitrogen returned more to normal. Secchi transparency in these lakes was as much as 0.4 m lower during the El Niño rains, but as with other parameters, values were indistinguishable from pre 1998 levels once the rainy season returned.

Figure 1. Comparison of water quality in Southern Lake Wales Ridge Lakes, pre 1998 vs. 1998.



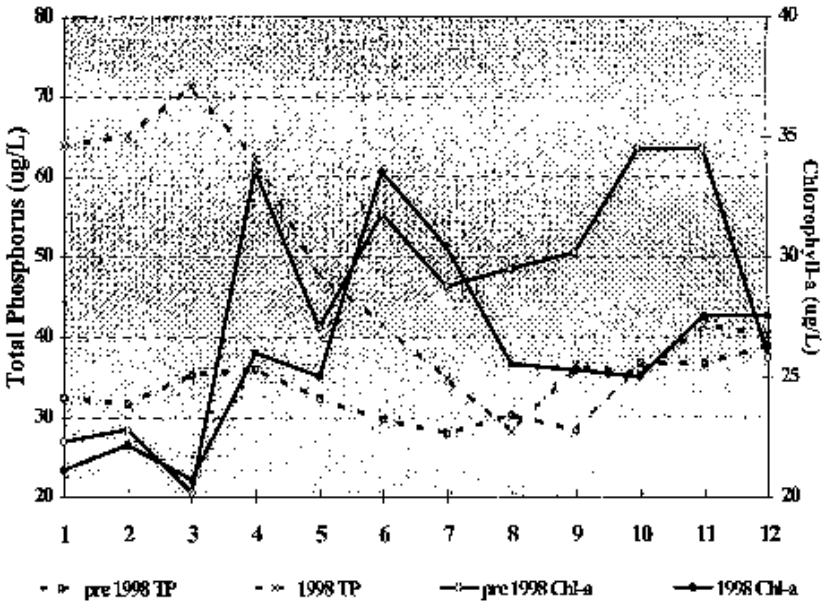
The total phosphorus increase was even more dramatic for the 16 Lake Wales Ridge Transition Region lakes, with 1998 winter-spring average values from 11 to 36 µg/L above the pre-1998 average (figure 2). However, as in the Ridge Lakes, the difference had largely disappeared by

July. The chlorophyll-a "signal" was not evident at all in Transition lakes, as chlorophyll-a values were generally *lower* in 1998 than in previous years. However, chlorophyll-a was still healthy in these transition lakes, with values ranging from 20 to 33 µg/L during 1998 (figure 2).

Average total nitrogen values also did not appear to be significantly different in 1998 as compared with earlier years. Secchi transparency, which averages a little more than 1 m in these lakes was not substantially different during 1998.

The difference in response to nutrient flux between these two very different types of lakes is likely related to their inherent differences in watershed type, with such parameters as soil type, land use and watershed size playing key roles. Algal growth in Ridge lakes is phosphorus limited. It therefore responded much more decisively to additional phosphorus being washed into these generally low nutrient systems, than did the algae in the naturally more eutrophic Transition lakes.

Figure 2. Comparison of water quality in Lake Wales Ridge Transition Region lakes, pre 1998 vs. 1998.



El Niño may have signaled the beginning of several years of above-average water. This, combined with changes in groundwater use practices and water conservation in general, may serve to keep levels healthier for longer.

The "long term" effects on water quality from the winter 1998 El Niño appears to have lasted only until the next rainy season. Nutrient levels for the second ½ of 1998 were very comparable with historic values. But the difference in response between lake types is instructive. Ridge lakes are susceptible to short-term perturbation, but seem to be able to recover quickly. Transition lakes appear less influenced by such events, though this may be due to the naturally high nutrient levels in their watershed soils. Of concern is the continual impact of nutrient inputs from fertilizer applications, stormwater runoff and other sources. This nutrient legacy may have left the water column, but it provided valuable insight into the response of lakes to the impact of cultural eutrophication that is raising nutrient levels for all lakes in Highlands County.

There was an effect of El Niño on Highlands County lakes, but it was not uniform, and, at least in terms of nutrient levels, not long lasting.

Managing Water Levels in Closed Basin Systems - Lake Deeson: A Case History

Walter R. Reigner, P.E., BCI Engineers & Scientists, Inc., 2000 E. Edgewood Drive, Suite 215, Lakeland Fl. 33803, USA; phone: 941-667-2345; fax: 941-667-2662; wreigner@bcieng.com

In response to increased rainfall over the last several years many lakes in the Central Florida region have experienced higher than normal water levels. This observation applies most prominently to the closed basin systems, such as Lake Deeson, that comprise a large number of lakes along the ridge areas of interior Florida. Closed basin systems have no surface discharge mechanism and generally experience large lake level fluctuations (up to 20 feet) that are highly dependent on rainfall depth and distribution, and aquifer levels. As a result of mild rainfall occurring over the last 30 years and corresponding low water levels in the lake systems, development has encroached into once inundated areas of many closed system depressions. Unfortunately, with the cessation of many groundwater withdrawals coupled with wet antecedent conditions and a wet rainfall year, water levels over the last several years (particularly 1995 and 1996) have been higher than they have been in nearly 30 years. As a result of high water conditions coupled with the threat of reoccurring problems and potential inundation of numerous residential dwellings, impacted property owners have requested that Polk County investigate options for providing flood protection. As part of this investigation a variety of options were evaluated including: mechanical diversion; gravity diversion (open channel, siphon); drainage well; dike and levee systems; upstream contributing area diversion; and relocation. The findings and conclusions of this evaluation will be discussed.

Session 7 - Fisheries Management in Florida Lakes (Moderator: Tom Champeau, Florida Game and Freshwater Fish Commission) - Thursday 3:30 pm to 5:10 pm

Newburgh Lake Restoration Case Study: Fish Kill I and II

John O'Meara and Larry Danek, Environmental Consulting & Technology, Inc., 3701 Northwest 98th Street, Gainesville, Florida 32606

Fishing on Newburgh Lake had been nonexistent due to a fish consumption advisory against eating any fish caught from the lake. The advisory stemmed from polychlorinated biphenyls (PCBs) in the sediment eventually bioaccumulating in the fish. To make a viable fishery in the lake again, the Newburgh Lake Restoration Project conducted two fish kills to remove fish contaminated with PCBs. Additional work to prevent future contamination was also conducted as part of the restoration. This paper presents the design, implementation, results, modifications from the first fish kill to the second, and recommendations. The basic fundamental process for the project was to use rotenone to kill the fish, use potassium permanganate to detoxify the rotenone, and collect the fish and deliver them to a landfill for disposal. Though this was the basic idea, this project was completed on an open system. Because the lake was really an impoundment in a flowing river system, killing the fish and containing the toxicant led to some challenges. The rotenone had to be injected upstream at a dam located 3 miles away, the leading edge had to be identifiable at all times, the strength of the rotenone had to be sufficient to accomplish the kill, and the rotenone had to be properly detoxified to prevent accidental downstream kills. The public and media also had to be informed and involved since the project was conducted in an urban area. In both fish kills, work to complete the job took at least 6 days and resulted in the removal of more than 35,000 pounds of contaminated fish.

Recruitment consequences for early vs. late - hatched black crappie Pomoxis igromaculatus in Lake Wauberg, FL

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Mike S. Allen (Department of Fisheries and Aquatic Sciences, University of Florida, Gainesville, FL 32653-3071; 352-392-9617; FAX 352-846-1088; msal@gnv.ifas.ufl.edu)

Black crappie Pomoxis nigromaculatus, like many fishes, exhibit highly variable recruitment due to varying larval and juvenile abundance, growth, and survival during early life. To evaluate factors related to recruitment, we examined how hatch date, growth rate, and survival varied among 7-day cohorts of juvenile black crappie at Lake Wauberg, Florida (100-ha hypereutrophic natural lake). Fish were collected weekly in spring 1998 and then twice per month during summer 1998 using an otter trawl (3.7-m mouth, 4.6-m body, 8.4-mm bar mesh body, 6.4 mm bar mesh bag). Black crappie recruited to the trawl at approximately 20-mm and were first collected on April 16. Collections continued until all fish exceeded 100 days old (August 25). Based on daily otolith increments, the majority (>90%) of hatching occurred over a two-month period (March 4-May 5). Survival rates were highly variable among 7-day cohorts and instantaneous mortality ranged from 0.04 to 0.42 (4% to 34% daily mortality). However, late-hatched fish (e.g., May 14) experienced more rapid growth rates (0.98 mm/day) than did early-hatched fish (e.g., March 4, 0.68 mm/day, one - way analysis of variance, $P<0.05$). Rapid growth of late - hatched fish relative to early - hatched fish could be advantageous for survival to adulthood. Thus late-hatched black crappie may have exhibited higher recruitment to adulthood than early-hatched fish in this study.

Lake Talquin: Northwest Florida's TEAM Lake

Rich Cailteux, Jeff Nordhaus, and Dan Dobbins, Florida Game and Fresh Water Fish Commission, Route 7 Box 3055, Quincy, FL 32351, e-mail: cailter@gfc.state.fl.us.

Lake Talquin is an 8,200 acre reservoir located just west of Tallahassee. It is northwest Florida's representative to the TEAM (Team Effort Accomplishing Management) concept. Unlike most Florida lakes, it is devoid of aquatic vegetation and is riddled with tree stumps. Periodic extreme dewaterings need to be accomplished to produce vegetative habitat that can sustain large year classes of sportfish. The most recent dewatering was started in December 1997 and refilled in August 1998. Approximately $250,000 from the lake Enhancement Section of GFC was used to enhance the lake by creating new habitat and angler access. Sport fishing was closed from December 1, 1997 through March 31, 1998 in an attempt to protect fish from being harvested during the extreme drawdown. Winter rye grass was aerially seeded on moist lake bottom to serve as short term nursery habitat once the lake was refilled. Two hundred cypress trees were planted in an attempt to create future nesting sites for birds and habitat for fish. Seven limerock (#5) beds were created in proximity to public fishing piers to attract bedding fish. Three rock (DOT donated) attractors were placed at two locations in an attempt to attract catfish and other sportfish. A 2000 square foot fishing pier was constructed with handicap access. Repair to a GFC boat ramp was also accomplished. A lake cleanup was done in conjunction with Super Clean Sweep and Keep Tallahassee/Leon County Beautiful in which over a ton of trash was picked up on and around the lake bottom. American cupscale and giant bullrush (194,000 plants) were planted in an attempt to create long-term aquatic habitat. A local newsletter was sent out to lake residents, other interested persons as well as local officials in an attempt to keep people apprised of various activities going on before and during the drawdown. In all, many agencies, business owners and lay persons acted as a TEAM to get this job accomplished. Preliminary results will be discussed.

Lake Istokpoga: South Florida's TEAM Lake

Furse, J. Beacham (Florida Game and Fresh Water Fish Commission, 3991 SE 27th Court, Okeechobee, FL 34974; 941/462-5190); and Larry J. Davis (Florida Game and Fresh Water Fish Commission, 3991 SE 27th Court, Okeechobee, FL 34974; 941/462-5190)

Lake Istokpoga, a 11,200-hectare lake, is the fifth largest natural lake in Florida. Located in south-central Florida, the lake supports a strong recreational fishery for largemouth bass (Micropertus salmoides) and black crappie (Pornoxis nigromaculatus). With the designation of the lake as a Fish Management Area/TEAM lake by the Florida Game and Fresh Water Fish Commission's (FGFWFC) Division of Fisheries in 1997, the FGFWFC lake management team was directed to identify and attempt to solve Istokpoga's problems, so the lake could be managed for quality fisheries. Stabilization of water levels, inadequate control of invasive plants, and increases in nutrient loads from watershed development have led to a decline in both openwater and littoral habitats. Hydrilla (Hydrilla verticillata), which became problematic in the late 1980s, has fluctuated between 2,000 and 26,000 acres with periodic whole-lake fluoride treatments by the Florida Department of Environmental Protection (FDEP). Tussock development and expansion, spurred by further reduction in water level fluctuation in 1990, has negatively impacted littoral habitat. The FGFWFC, along with DEP, Highlands County, the South Florida Water Management District, and the public, are developing a management plan, including aquatic habitat enhancement and recreational fishery regulation, that ensures Istokpoga's future health. The purpose of this presentation is to discuss the problems and possible solutions for Istokpoga's management and FGFWFC's role in that process.

Tussock Removal and Equipment Evaluation on Orange Lake

Bob Hujik, Florida Game and Fresh Water Fish Commission, 7922 NW 71st Street, Gainesville, FL 32606, 352/392-9617 ext. 266

Tussocks are common in many Florida lakes. Problems resulting from tussocks include blocking shorelines, impeding water flow and navigation, shading desirable aquatic plants contributing to poor water quality in terms of fisheries habitat (low dissolved oxygen levels and accumulation of organic matter below tussocks) and interfering with recreational activities. As a result of these problems and widespread distribution of tussocks across Florida, the Florida Game and Fresh Water Fish Commission is exploring ways to manage tussocks. The primary objective of this project was to evaluate a new mechanical control technique, using a trackhoe on a floating barge. Approximately 63 acres of tussocks were removed from two areas on Orange Lake. Cost ranged from $1,500/acre to remove Cuban bulrush/frog's-bit tussocks to $3,600/acre for mud tussock removal. The tussock material was used to construct three in-lake spoil islands, totaling one acre. Tussock removal areas and spoil islands will be monitored for three years. Preliminary results show the height of the spoil island created with mud tussocks decreased 1.9 feet, while two spoil islands constructed with Cuban bulrush/frog's-bit tussocks decreased an average of 1.1 foot one year following completion. Area of the spoil islands has remained constant since project completion. Transect lines across spoil islands indicated alligatorweed (20%), smartweed (6%) and pigweed (6%) are most abundant species while tussock removal areas were dominated by submersed plants (coontail - 92% and hydrilla - 81%). Electrofishing transects show sport and forage fish species made up approximately 85% of all fish sampled, by number, within the tussock removal areas.

Session 8 - Aquatic Plant Management in Florida Lakes (Moderator: Ernesto Lasso de la Vega, Lee County Hyacinth Control) 8:00 am to 9:40 pm

Beneficial Uses of Dredged Sediments: Lets Recycle the Soil!

Shailesh K. Patel and Joel S. Steward
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2000 E. Edgewood Drive, Suite 215,
Lakeland, FL 33803

Restoration of the Indian River Lagoon (IRL) includes the removal and management of organic muck sediments. These sediments, once dredged, are often labeled as "spoil", which is unfortunate. This connotation has resulted in the public perception that it is bad or contaminated to the point it cannot be used in any beneficial way. Besides natural causes, it is generally agreed that much of the IRL muck sediment is upland topsoil being washed away from yards, roadways and other watershed areas. Furthermore these dredged muck sediments are not toxic or hazardous. Placement of the dredged sediments in upland disposal areas is the typical strategy for their containment. However, land is generally unavailable around water bodies, or if available, quite expensive. Therefore, it is imperative that minimal land be allocated for the placement of these sediments and that options be sought for their use or recycling. Demonstrated uses such as potting media, wetland creation, beach renourishment, topsoil augmentation, and construction fill material show the potential benefits of IRL muck sediment.

Evaluating the Spatial Distribution of Aquatic Plants and the Utilization of Wildlife Habitat in the Littoral Zone of Lake Okeechobee, Florida

Charles Hanlon, Okeechobee Systems Research Division, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, Florida 33416-4680.

More than 60 species of aquatic plants are found in Lake Okeechobee's 40,000 ha littoral zone. During the past 25 years, exotic vegetation has invaded many areas of the littoral zone replacing thousands of hectares of native plants. In order to document and monitor changes in the plant community, a vegetation distribution map was created using GIS. This valuable tool can be used by lake managers to evaluate the spatial distribution and areal coverage of the lake's plant communities and determine how the distribution of aquatic plants is correlated with hydroperiod and water depth. In addition, the map will serve as a benchmark against which other vegetation maps can be compared. Because many of the plant communities in the littoral zone provide habitat for animals, it is important to identify which plant communities are most valuable and whether they may be threatened by the expansion of exotic vegetation or changes in hydroperiod.

Relationships between aquatic vegetation and wildlife were evaluated by field surveys during a two year period (1997-98). More than 60 species of birds and 16 species of amphibians and reptiles were observed utilizing various habitats. However, because of the short duration of sampling (< 2 years) and the limitations of sampling devices under high water conditions, it has not yet been possible to establish robust relationships between wildlife, plants, and hydroperiod. Additional research at a larger spatial scale and of longer duration is needed to resolve these issues.

Submerged Aquatic Vegetation Dynamics in the Lakes of Leon County, Florida

Sean McGlynn - Department of Biological Sciences, Florida State University, Tallahassee, FL 32306-2043; ph: (850) 570-1476, email: mcglynn@bio.fsu.edu.

Some results of a survey of the aquatic plants communities of seven shallow subtropical North Florida lakes. Macrophyte communities compete with one another for resources, mainly light and nutrients. In an oligotrophic lake, these plant communities will be rather stable, but as the trophic status of the lake increases to mesoptrophic and eutrophic states, dynamic successional changes occur. The angiosperms in unproductive oligotrophic lakes exhibit a 'rosette' form Growth occurs near the sediment in close proximity to the proportionately large root systems. These plants are adept at extracting nutrients from the sediments (*Isoetes macrospora*, *Sagittaria stagnorum*, *Vallisneria americana*).In mesotrophic and eutrophic lakes, 'vittate' species become dominant. They have a large stand size and a small root system relative to their total biomass (*Cabomba caroliniana*, *Bacopa caroliniana*, *Myriophyllum heterophyllum*, *Myriophyllum spicatum*). As lakes approach hypereutrophic and distrophic stages, the macrophyte communities decline and are replaced by rootless vegetation (*Ceratophyllum demersum*, *Salvinia rotundiflolia*, *Lyngbya spp*.). Introduced exotics (*Hydrilla verticillata*, *Eichhornia crassipes*, *Salvinia molesta*) often become dominant in lakes. External environmental changes, like nutrient availability, do not seem to cause this phenomenon. Introductions usually have a 'boom and bust' life cycle, where the exotic will greatly increase in biomass, replacing native plants, and then disappear without explanation.

Littoral Zone Replanting and Littoral Zone Vegetation Mapping in Lake Apopka

James Peterson and Roxanne Conrow, St. Johns River Water Management District, Department of Water Resources, P.O. Box 1429, Palatka, FL 32178-1429

Lake Apopka is the most polluted large lake in Florida. A restoration plan currently being implemented by the St. Johns River Water Management District (SJRWMD) includes the purchase and restoration of former farm lands to decrease phosphorus discharges to the lake, operation of a marsh flow-way to filter lake water, removal of rough fish from the lake, and replanting native littoral zone vegetation. Littoral zone replanting began with a contractual effort in 1992, and has continued since then by SJRWMD staff. To date there are approximately 35 replanted sites in Lake Apopka. SJRWMD has monitored plant density and height measurements and has described sediment core profiles at a limited number of sites. A project to map all of the littoral zone plant areas (both replanted areas and natural growth) in Lake Apopka began in 1997. This project was begun in order to have a base map for comparison with future changes in the lake's vegetation coverage. A real-time corrected GPS unit was used and all littoral zone vegetation found in the approximately 39 miles of shoreline was mapped based on primary and secondary dominant species. Other data collected, using a custom-made data dictionary, included plant density and water depth. These data were then converted to GIS format and a Panel Atlas was created in ARC/INFO GIS.

An Integrated Approach to Aquatic Plant Management

Craig R. LeSchack, Division of Wildlife, Florida Game and Fresh Water Fish Commission, Guana River Field Office, 2690-E South Ponte Vedra Blvd., Ponte Vedra Beach, FL 32082, (904) 825-6877, Fax: 825-6878, e-mail: leschac@gfc.state.fl.us

The Guana Lake impoundment was created in the 1960s to provide brackish marsh habitat for wintering waterfowl. The lake is presently operated within broad, multipurpose objectives of biological productivity, public recreational use, flood control, and mosquito control. Between 1980 and 1990, the lake was not managed due to failure of the original water control structure. At this time, the structure functioned as a fixed-crest weir, which stabilized water levels between 2.5 and 3.0 feet above mean sea level. By 1988, cattails (*Typha latifolia*, *T. angustifolia*, and *T. domingensis*) covered approximately 33% of the impoundment. An integrated approach for managing the Guana Lake impoundment was developed to meet resource management objectives. Aquatic plant control will be achieved using a combination of the following techniques: water level manipulation, salinity, herbicide, control burning, and mechanical harvesting. A preliminary investigation was conducted to look at the effectiveness of this management strategy. Results indicate that an integrated approach is the best strategy for controlling nuisance vegetation on Guana Lake. For example, preferred vegetation, such as saltmarsh bulrush (*Scirpus robustus*) and bearded sprangletop (*Leptochloa fascicularis*), was successful in colonizing sites previously dominated by cattails. This management approach will continue to be evaluated and refined as necessary to control nuisance vegetation.

Session 9 - Public Involvement in Aquatic Resource Management (Moderator: Jim Griffin, Hillsborough County Department of Public Works) - 10:00 am to 12:00 am

An Example of Community-Based Volunteer Monitoring – The Hillsborough County Experience

Jim Griffin, Hillsborough County, Public Works/Stormwater Section, P.O. Box 1110, Tampa FL, 33601

Hillsborough County like many counties in Florida has a history closely tied to its water resources and a future dependant on the preservation of these resources. The County has 17 distinct watersheds. Some are lake-centered and major streams dominate others. The County's northwestern section contains primarily lake-centered watersheds where the primary surface water resources are lakes and where conveyances are creeks that connect these lakes to the bay.

Streams are the major water resource in the northeast and southeastern watersheds. To the northeast is the Hillsborough River that has its origin at Green Swamp (Pasco and Polk Counties) and is a primary drinking water resource for the City of Tampa. To the east is the Alafia River that finds its origin in a series of creeks that flow westward into Hillsborough County from Polk County (North Prong) and from the southeastern part of the county (South Prong). And to the southeast is the Little Manatee River, which begins as a series of small creeks in the southeast county and flows into Tampa Bay. In addition to these major streams, the county has a number of large creek systems such as Bull Frog Creek, Rice Creek, Baker Creek, Rocky Creek, Brushy Creek and Pemberton Creek.

With all these water resources, the County has a great need for water resources management, which includes the need to assess and evaluate the quality of surface waters. The County has one agency, the Environmental Protection Commission (EPC) which is dedicated to the monitoring and regulation of surface waters. Federal and State agencies such as the United States Geological Survey (USGS), Florida Department of Environmental Protection (FDEP) and the Southwest Florida Water Management District (SWFWMD) also are active in surface water monitoring and in regulations. However, even with the wealth of resources the County finds that there still is a need for additional monitoring. Community-Based Volunteer Monitoring was the County's approach to meeting this need.

In the last three years the County has shifted the focus of its surface water data needs leading from one that concentrated on Tampa Bay and its tributaries to an increased requirement for monitoring activities on it lakes and streams. Two requirements lead to this shift. The first was the Federal National Pollutant Discharge Elimination System (NPDES) guidelines which required monitoring of the Municipal Separate Storm Sewer System (MS4) as well as water of the state that the MS4 discharged into. Second was the Board of County Commissioners direction to complete watershed plans for each of the County's 17 watersheds. Each watershed plan required an environmental assessment that also required extensive surface water quality

data. Because the County did not have the available field technicians to carryout the monitoring activities, several Community- Based Volunteer Monitoring activities were initiated.

The first activity was the Hillsborough Lake Management Program which supports Florida LAKEWATCH activities in the county in addition to a comprehensive lake property owner training and support program. Hillsborough LaMP was initiated in January 1997 with the goal of reaching all the lakes in Hillsborough County by 2002. Presently there are 120 lakes in the program.

The second involved the training of Hillsborough Adopt-A-Pond volunteers to measure nutrients, dissolved oxygen and turbidity in ponds and the pond inflow and outflow. The goal of this program is to reach all current and future Adopt-A-Pond Pond groups. The program is a partnership of citizen volunteers, the County and the SWFWMD.

The last community based monitoring activity is the Hillsborough STREAM WATEREWATCH program initiated to increase citizen awareness of the changing habitat and water quality of County streams, and to involve citizens in the management of those streams. The program includes monitor training, stream monitoring and stream clean-up and restoration. The program was initially funded by a Florida Game and Freshwater Fish Commission Environmental Education Grant. Future funding will come from cooperative funding by the County and Southwest Florida Water Management District (SWFWMD). The program has just completed its initial proof of concept phase and has 30 adopted stream segments covering the majority of County streams.

With all these new data sources, a need was created for a database system, which would allow the cataloging of County lake and stream data. In 1998 the County began a project in cooperation with SWFWMD and the University of South Florida called the Hillsborough Lake Atlas. The goal was to develop a comprehensive geographic database that would be fully accessible to County citizens and provided a multi-level data source for the County's Lakes and eventually for its Stream and Pond programs. The Lake Atlas was published in March 1999 on CDROM and as a World Wide Web site (www.lakeatlas.usf.edu).

In the last three years, Hillsborough County has seen a significant growth in partnership programs that meet both citizen and government objectives. These programs were begun with community support, involve several governmental agencies and have significant citizen involvement. They are examples of a successful approach to joint problem solving called Community-Based Volunteer Monitoring.

STREAMWATER WATCH Volunteer Program

Andreas A. Paloumpis, Ph.D., Fisheries Biologists, Hillsborough Community College; and
Pamela Stinnette, Ph.D., Assistant Professor, Hillsborough Community College

Monitoring the physical, chemical and benthic organisms of streams on a regular basis is important in assessing changes in the health of a stream. It is not financially feasible to assign the number of trained biologists necessary to perform these duties on the large number of stream sites located in Hillsborough County.

The alternative was to develop a cadre of trained volunteers capable of performing the physical and chemical qualities of the water and the collection and identification of benthic organisms in the stream site. Identification of benthic organisms would be to the ORDER level.

The original plan proposed the development of 30 (thirty) sites in the area including the Hillsborough River and the Alafia River. In excess of 30 sites have been established on the Alafia, Hillsborough and Little Manatee Rivers and numerous creeks throughout the county.

Six training sessions were held with the volunteers. The first training session held at the English Creek Environmental Center of Hillsborough Community College, focused on the physical and chemical activities to be performed by the volunteers. The session consisted of laboratory and fieldwork regarding sampling techniques and analysis of the samples. The second session, held at Nature's Classroom, was devoted to laboratory and fieldwork regarding sampling techniques and field identification of benthic organisms collected.

The following sessions were devoted to collecting benthic organisms and assisting the volunteers in the identification of the organisms. Having the volunteers retain identified specimens in vials for future reference furthered the identification process. Volunteers will be certified in the identification of benthic organisms at workshops to be held this summer. Additional chemical training was provided and many of the volunteers were certified in the physical and chemical aspects of the program.

The volunteers will monitor their selected stream site on a monthly basis for water chemistry and on a quarterly basis for macroinvertebrates. The information will then be forwarded to the County for compilation and analysis. The program will be continued and expanded to include other streams in Hillsborough County in the next few years. The STREAM WATERWATCH program is also designed as a model for other counties with similar resources and needs.

Practical Problems Maintaining Stormwater Retention Ponds in South Florida

James M. Reed
Florida Yards and Neighborhoods Program Assistant
Palm Beach County Cooperative Extension Service

Summary: The Estates of Silverlake is a Planned Urban Development (PUD) in Palm Beach County, Florida. Its stormwater retention pond has been "managed" by the developer or homeowners' association, with the activities performed by a commercial aquatic maintenance firm. The instructions given to the maintenance company come from a volunteer member of the community. Over the past twenty years the stormwater retention pond has had a number of water quality and appearance issues typical of this type of water body. Efforts to solve these problems have been generally successful, but not always recognized by the community. The community does not have measurable standards which define acceptable quality and the environmental issues related to lake management are not well-understood or accepted by most of the community. As a result, the homeowners' association responds largely to short-term questions of cost and of achieving a minimum level of acceptable appearance with less regard for longer-term environmental questions.

Silverlake History: The stormwater retention pond ("Silverlake") was dredged in the late 1970s. When finished it covered 26 acres and the deepest points were over 40 feet deep. Silverlake services 169 homesites on 75 acres. In most parts of the lake there is little or no littoral shelf. There are only a few places along the shoreline where there is an area adequate for littoral planting. There is no quantitative lake data from the 1980s. At that time there was no one actively monitoring the lake's quality or appearance, and all maintenance was a result of individual homeowner complaints or advice from the aquatic management company.

Dates and Comments:

1980s, Silverlake:	– had a resident population of native waterfowl, primarily mallards; – Had good fishing for bass and panfish; – Developed a problem with hydrilla.
1991	– Taken over by flocks of Muscovy Ducks; – Most of the native waterfowl were gone. – Lake was stocked with triploid carp to combat hydrilla.
1993-94	– Most hydrilla cleared, either by chemical spraying or the triploid carp. – 90-100 Muscovy ducks; few other waterfowl; – Bass in the lake were grossly underweight, some with large red sores – Little else in the fish food-chain living -- very few small fish, no frogs, etc. – Lake was barren of plant life

– Erosion problems caused by wave action;
– Green water, visibility of 18" - 24"
– Little understanding of forces causing problems, or of environmental issues

1995, the community:

– Created a set of lake management principles, emphasizing environmental aspects of lake management and moving away from personal opinion as a discriminator for lake actions;
– Sought advice from experts in several agencies, including the aquatic management company;
– Installed Littoral zone plants (pickerelweed and arrowhead) in one area;
– Began a trapping program which removed all but about 10 of the 90-100 Muscovy ducks
–Joined the Lakewatch program

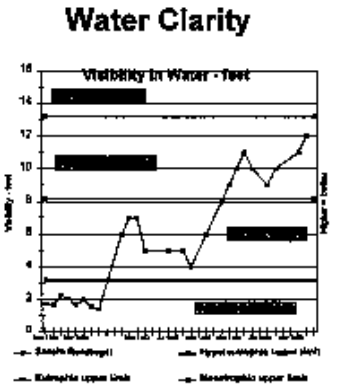
Also, without action on the association's part, *Vallisneria* appeared at several locations in the lake.

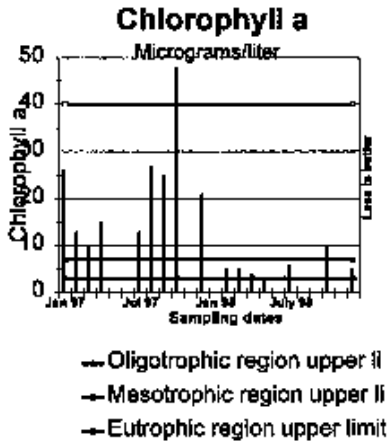
Interim results:

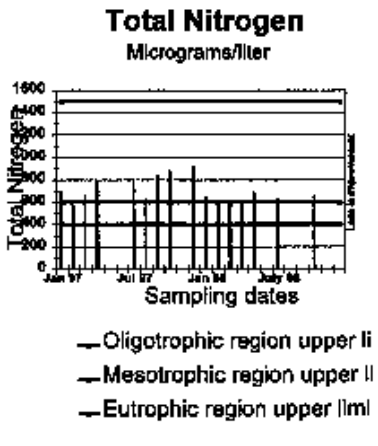
– Littoral plantings needed fencing to protect them from the triploid carp
– Landscape maintenance firms during periods of low water cut down all littoral plants – four times!
– The Association relied on volunteers and did not fund any maintenance for littoral plants
– Overall, little understanding of retention ponds or environmental issues

Overall results:

– Waterfowl returned; 46 different species of birds, including wood storks, sandhill cranes, limpkin,
– Secchi depths improved from 18" (1994) to 10-12' (1998-9)
– Fishing greatly improved, with bass of 7 pounds and over; large yearly bass and panfish spawn
– Littoral plants overcome by torpedograss during high water; beyond capability of volunteers
– Primary complaint became presence of *Vallisneria* in the water







Latest Activities and Problems:

– Association Board voted to remove littoral zone plants rather than fund their maintenance
– Increased funding to chemically treat *Vallisneria* and remove as much as possible
– Little understanding of environmental issues

Public Awareness and Community Involvement in the City of Orlando

Bruce D. Fallon, Stormwater Utility Bureau, City of Orlando, FL.

The City of Orlando has developed a unique relationship with its citizens over the years. Seeing the need for positive communication early in its existence, the Stormwater Utility launched what has turned onto a marquee public awareness and volunteer public participation program. Public awareness methods varying from neighborhood talks to informative brochures have been developed with the goal of taking a proactive educational stand. The volunteer opportunities include Florida Lakewatch, Shoreline Cleanup, and installing Storm Drain Signs. Beginning in 1990, the City partnered with Florida Lakewatch to bring the volunteer water monitoring concept to central Florida. Since its inception, over half of the City's lakes have been monitored monthly by residents and students. City support of Lakewatch is provided by recruiting, training and communicating with volunteers. Riding on the wave of volunteerism, a shoreline cleanup program was implemented. Initially part of statewide effort, the shoreline cleanup event eventually became part of the St. Johns River Celebration held each spring. To bring awareness into neighborhoods which may not be directly adjacent to waterbodies, the Storm Drain Sign program was initiated. Volunteers were recruited to install the small blue signs which read: "No Dumping! Drains To Lake." Through these community involvement projects, a greater awareness for the need to protect our natural resources is accomplished.

Volunteer Lake Management Programs in Orange County, Florida

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Orange County, Florida has close to 1,000 water bodies greater than 5 acres. Some of these are retention ponds which have been developed as amenities and sold by developers as lakes to our friends from the north. Many of these are natural water bodies which are very desirable locations to live near. The Orange County Environmental Protection Division is annually, able to collect water quality data on less than 200 of these water bodies. The abundance of aquatic resources across the state stretches the resources of government's to monitor them in a timely fashion. To this end, a variety of local volunteer programs with their own unique elements have developed. From the most successful program Lakewatch to Orange County's own Adopt-A-Lake program the need for information is beginning to be met. Orange County's Adopt-A-Lake was implemented during a time when Lakewatch was unable to accept new volunteers due to funding constraints. The Adopt-A-Lake program gathers interested lakefront homeowners or members of lakefront associations or anyone with an interest and access to a lake and trains them in basic water quality sampling techniques. They collect samples and return them to our local laboratory. In our laboratory, because we are close to our lakes we can offer bacteria analysis, special metals analysis and other speciality tests that can not be done when samples are frozen and stored for batch analysis. We utilize our Adopt-A-Lake volunteers in a variety of ways. We have recently used them to be bird spotters on Lake Fairview and assist in special sampling for a lake contamination problem. They routinely bring potential pollution problems to our attention, both in the lake and in the lake basin. We try to hold regular meetings to discuss issues they are interested in and we produce a newsletter with, hopefully interesting information for them. We enlist their help in staffing special educational weekend events, as needed. They are a very valuable resource for our program and we are finding new opportunities for them every week.

The Nature Conservancy of the Florida Keys - Sea Stewards Program

Mary Enstrom-Warner - The Nature Conservancy, 2250 Overseas Highway, Marathon, FL 33505, menstrom@tnc.org, 305-289-9060, 305-289-9084 fax.

One of the great challenges facing the Florida Keys National Marine Sanctuary is to monitor ecological conditions and detect significant changes in animal and plant populations, community composition, and ecological processes. To be able to do these things is important to evaluating the effects of management actions and to adapting management strategies to an evolving situation. The Nature Conservancy of the Florida Keys Sea Stewards program is designed to help meet the objectives of the Sanctuary's Research and Monitoring Action Plan by engaging Florida Keys residents in ecological monitoring activities. The program is specifically focused on the needs of the Sanctuary's monitoring program by: targeting species and ecological processes not otherwise monitored, providing useful data to the five-year evaluation of the protective zones in the Sanctuary, and engaging Keys residents and Sanctuary users in evaluating the condition of Sanctuary resources and the effectiveness of Sanctuary management. The basic organizing principles behind Sea Stewards are:

1. *Site focus*. *Sea* Stewards are recruited to monitor and care for individual sites. They return to the same site over-and-over, eventually coming to know it better than anyone else does. Their knowledge transcends the data collected, and they will become reliable sources of additional information to Sanctuary managers. Highest priority has been given to recruiting Sea Stewards for sites in Sanctuary "no-take" zones and associated control sites, but other sites that represent the full diversity of habitats in the Sanctuary will also be monitored.

2. *Simple, reliable methods*. The Sea Stewards program limits its monitoring targets to those that can be studied with methods that have low inter-observer variability and require a minimum amount of equipment. Our goals in this regard are to collect only reliable data and to make the volunteer experience enjoyable and rewarding.

3. *Large sample window*. By building the program around sites, rather than an event or some limited period of data collection, the opportunities to take advantage of good weather and water conditions are increased. As a consequence, however, the program is focused on conditions that are unlikely to change more often than seasonally (i.e., twice per year). Priority will be given to tracking long-term trends and recognizing unusual changes or events.

4. *Continuing training*. Over time, Sea Stewards will be offered a curriculum of monitoring modules focused on new targets of interest to Sanctuary managers. As they complete each course they will be competent to collect additional data for the ecological monitoring program. Additional courses are focusing on boating and diving safety and underwater data collection techniques. These courses build new skills and educate the participants, thus rewarding the volunteers as well as increasing the scope and effectiveness of the program.

5. *Volunteer leadership*. In addition to receiving training, Sea Stewards will be invited to become trainers themselves as they gain expertise. The teams also have volunteer team leaders that schedule their team as well as keep track of data sheets and safety issues.

6. *Results provide feedback to volunteers*. The data from the program will be reported to the Sanctuary but also to the volunteers. We are holding workshops on the results so volunteers can discuss the data and compare their sites to others. Exceptional Sea Stewards will play another leadership role in this regard by analyzing and reporting on summary data at such events.

7. *Constant evaluation and troubleshooting*. The Sea Stewards program is an exercise in adaptive management. Staff of The Nature Conservancy and the Florida Keys National Marine Sanctuary, together with the volunteers, will constantly evaluate what is working and what needs to be adjusted. Building a long-lasting program over time affords us the opportunity to make the adjustments and employ lessons learned in each new module.

Specific species chosen to be monitored in 1998 and 1999 will be discussed at the Florida Lake Management Society's meeting as well as issues that have been identified by the volunteers at their annual workshop.

Oral History: An Important Tool for Understanding Florida's Lakes

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Dr. James C. Griffin, Hillsborough County, Public Works/Stormwater Section, PO Box I 110, Tampa FL 33601, 813-272-5912 (T), 272-6458 (F), DrDuckjr@aol.com

The Hillsborough County Lake Atlas *(http://www.1akeat1as.usfedu)* is a cooperative project between Hillsborough County Public Works Department (Stormwater Section), the Southwest Florida Water Management District, and the University of South Florida's Florida Center for Community Design and Research at the School of Architecture and Community Design. The purpose of the Atlas is to provide the citizens, scientists, and planners of Hillsborough County a comprehensive and current data library on our lakes and their respective watersheds. In addition, the Atlas provides a communications forum for people to discuss lake management, get feedback from experts, access online rules, regulations, permits governing freshwater resources in Florida, and educational materials concerning lake ecology and management.

The oral history process has been incorporated within the Hillsborough County Lake Atlas to gather information from residents of the County's lakes. On a daily basis residents experience the effects of policy decisions affecting water resources. The perspectives of the residents are an important source of practical knowledge that compliments the technical knowledge gathered through traditional lake assessment protocols. The information residents provide facilitates the creation of a "quality of life" baseline of what life and water quality was like on the County's lakes before scientific data began to be amassed by public agencies. It adds a social element to an Atlas based mostly on biological and technological data, showcasing diverse types of social and historical information that would otherwise not be presented in one source. In addition, its inclusion supports an interdisciplinary perspective that can lend greater depth to the data being amassed and to the exploration of its meaning.

Oral history is a unique means to access the memories, perspectives and opinions of residents from all parts of the population. It is a cooperative effort, blending the skills of the researcher and the information held by citizens to develop an account of reality as it is experienced from an individual's perspective. Augmented by data provided by survey and secondary historical documents and images, the oral history interview enables a transfer of knowledge, anecdotes and concerns from the local level that would potentially be overlooked in other documentation methods.

Knowledge gained from the interviews is joined with photographs and presented in a narrative format. The narrative covers four sections that include citizen information, lake history, development and future trends. The format for the presentation of the narrative makes use of up-to date technology to combine the text, historic and contemporary images, and audio clips from the interview on a user-friendly web-site.

Our diverse sample population has been culled from Lakewatch volunteers, avid historians, and multi-generation property owners. The motivations of participants in the project are as numerous as their backgrounds and have supplied an array of preliminary findings and trends emerging from the first year of research. Early exploration of research indicates that the quality of life perceived by lake residents is correlated with the quality of the lake as identified by assessors and with the density of development in the surrounding area. Lake organizations, formed by residents of lakes, are often developed to protect the lake and the quality of life from threats identified by the lake community. As redevelopment occurs, new markers of quality of life are emerging, often creating a tension between newer and older residents. Further exploration of these trends will help to assess the effectiveness and sustainability of decisions made by government agencies and developers, information that will contribute to facilitating a positive relationship among stakeholders in our water resources.

The use of social science methodologies in planning and policy making for our natural resources is not a new occurrence. Trends have become apparent on all levels of government from NEPA legislation to local government partnerships with communities. The opportunity to maximize on government interest in such collaborative approaches to policy making and planning now rests with us, the researchers and agency workers, whose data will inform local policy for resource use. It is our contention that efforts such as those pursued by, the Hillsborough County Lake Atlas can facilitate a productive collaborative among public agencies, private developers, researchers and citizens. The inclusion of oral history in lake management helps answer a call for meaningful participation of all stakeholders to ensure sustainable development of our natural resources

Welcome to the Florida Lake Management Society Conference

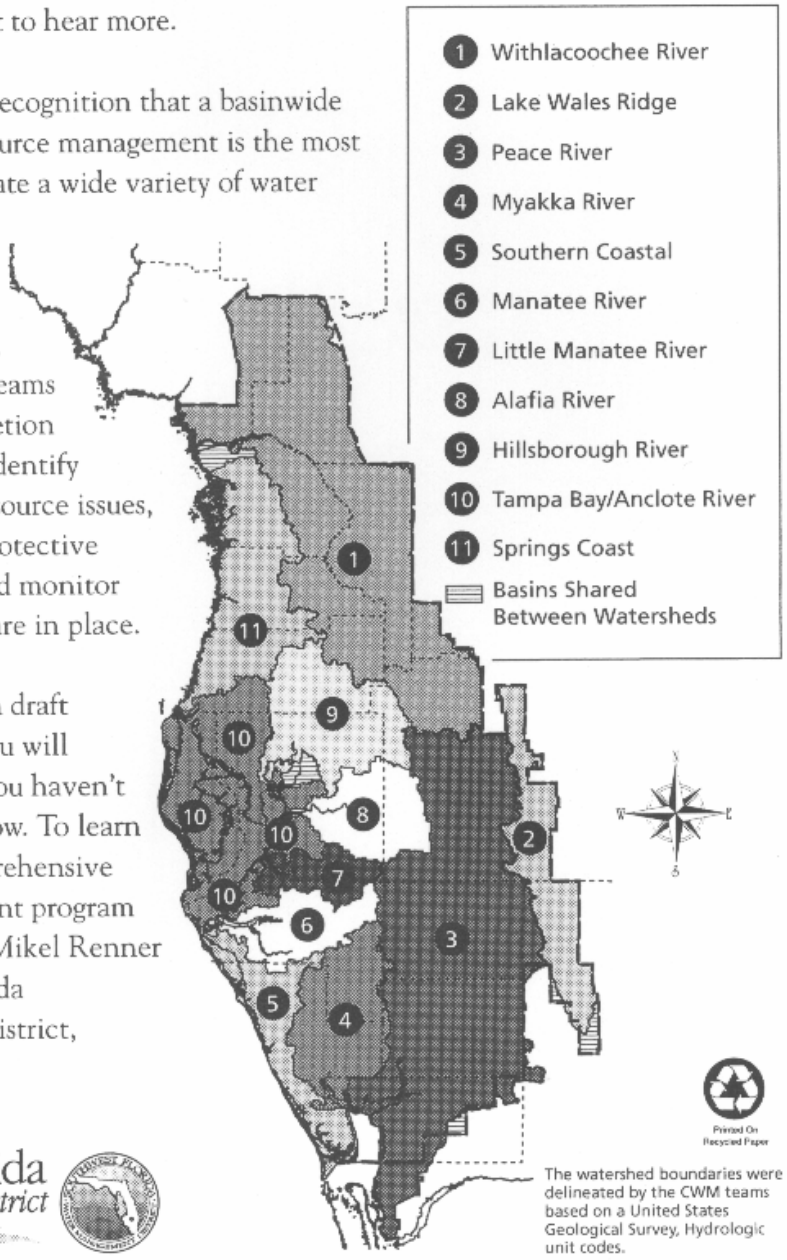
You may have recently heard a lot of talk about CWM, a Comprehensive Watershed Management program underway by the Southwest Florida Water Management District.

We hope you will want to hear more.

CWM is the agency's recognition that a basinwide approach to water resource management is the most effective way to integrate a wide variety of water resource activities.

To complete the watershed assessments, 11 multi-disciplinary teams are nearing the completion of a 5-year project to identify and prioritize water resource issues, develop remedial or protective actions, implement and monitor progress once actions are in place.

Watershed plans are in draft form now. We hope you will join in the process if you haven't been involved until now. To learn more about the Comprehensive Watershed Management program contact Craig Dye or Mikel Renner at the Southwest Florida Water Management District, 1-800-423-1476.



The watershed boundaries were delineated by the CWM teams based on a United States Geological Survey, Hydrologic unit codes.

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