Florida Lake Management Society

13th Annual Symposium

Program & Proceedings

Naples Beach Hotel
Naples, Florida
June 10 – 13, 2002

Welcome to the 13th Annual Symposium of the

Florida Lake Management Society

June 10 – 13, 2002

At the Naples Beach Hotel, Naples, Florida

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Lucee Price
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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: Lucee Price, P.O. Box 950701, Lake Mary, Florida 32795-0701

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AWARDS

The Florida Lake Management Society presents the following annual awards

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

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

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

The Aquatic Resource Management Award - is given to a professional who has worked to restore, protect and/or advance our understanding of Florida's aquatic resources.

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

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

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

The FLMS Board of Directors solicits nominations for awards to be presented by the Society at the 2003 annual meeting. In your nomination, please include the name of the award; your name, address, telephone number, and email address; the name of your nominee; and the justification for your nomination. Submit nominations to FLMS, P.O. Box 950701, Lake Mary, Florida 32795-0701

Exhibitors

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1412 Tech Blvd.
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Phone: 321-636-5783, Fax: 321-636-5787
email: mwilkie@elastec.com

ECT

Environmental Consulting & Technology, Inc.

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Contact: Gary P. Dalbec, Staff Scientist
Address: ECT, 3701 NW 98th Street, Gainesville 32606
Telephone: 352/332-0444 ext. 359

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Contact: Environmental Research & Design, Inc.
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E-mail: hharper@erd.org

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HYDROLAB CORPORATION
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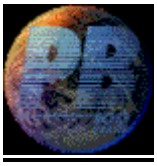

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2002 FLMS Conference Session Schedule

Monday June 10

8:00 - 4:30	Registration
8:30 - 10:00	Workshops (Session 1) Immokalee Rooms Room L - **Lake and Pond Restoration** Room M - **Water Quality Monitoring** Room N - **Aquatic Plant ID (AM) /** **Biological Monitoring Methods (PM)**
10:00 - 10:20	Break (refreshments provided)
10:20 - 11:50	Workshops (Session 2) Immokalee Rooms Room L - **Lake and Pond Restoration** Room M - **Water Quality Monitoring** Room N - **Aquatic Plant ID (AM) /** **Biological Monitoring Methods (PM)**
11:50 - 1:00	Lunch (On Your Own)
1:00 - 2:30	Workshops (Session 3) Immokalee Rooms Room L - **Lake and Pond Restoration** Room M - **Water Quality Monitoring** Room N - **Aquatic Plant ID (AM) /** **Biological Monitoring Methods (PM)**
2:30 - 2:50	Break (refreshments provided)
2:50 - 4:20	Workshops (Session 4) Immokalee Rooms Room L - **Lake and Pond Restoration** Room M - **Water Quality Monitoring** Room N - **Aquatic Plant ID (AM) /** **Biological Monitoring Methods (PM)**

2002 FLMS Conference Session Schedule

Tuesday June 11

8:00 - 5:00 Registration

8:20 - 8:30 Welcome and Opening Remarks

8:30 - 9:50 Session 1: **Ecology and Management of Cyanobacteria Blooms**

Moderator: John Burns

1 Joyner – Molecular characterizations of the benthic cyanobacterial bloom-former *Lyngbya wollei* in freshwater environments.
2 McGlynn – Long term chlorophyll trends in relation to harmful algal blooms in selected North Florida Lakes.
3 Ehrlich – Ecology of *Cylindrospermopsis* in temperate zone reservoirs: Evidence of thermal adaptability.
4 Dobberfuhl – *C. raciborskii* in three central Florida lakes: population dynamics, controls, and management implications.

9:50 - 10:10 Break (refreshments provided)

10:10 - 11:50 Session 2: **Ecology and Management of Cyanobacteria Blooms**

Moderator: John Burns

5 Backer – Cyanobacteria harmful algal blooms (CyanoHABs): Developing a public health response.
6 Perry – Cyanobacteria monitoring in the Harris Chain of Lakes… – Which is a bigger problem, the cells, the data or the media?
7 Pettit – Development of a protocol: Monitoring for Microcystins by ELISA at Lake Manatee.
8 Piehler – Experimental manipulations to assess phytoplankton-nutrient relationships in Lake George.
9 Dyble – Detection and characterization of *C. raciborskii* populations in northeast Florida using molecular approaches.

11:50 - 1:20 Lunch (On Your Own)

2002 FLMS Conference Session Schedule

Tuesday June 11

1:20 - 3:00 Session 3: **Fish and Wildlife Studies**

Moderator: Chuck Hanlon - SFWMD

10 Allen – An evaluation of fish and invertebrate communities in Sulphur Springs, Florida during a period of water diversion.
11 Glenn – Herpetofaunal distribution and occurrence on the Kissimmee River floodplain prior to restoration.
12 Melvin – Initial response by wading birds to Kissimmee River Restoration.
13. Dockendorf – Effects of zoopl. avail. On age-0 black crappie (*P. nigromaculatus*) abundance and growth in three Florida Lakes.
14 Champeau – Littoral zone restoration of Lake Istokpoga: Enhancing aquatic habitat, flood control, and water quality.

3:00 - 3:20 Break (refreshments provided)

3:20 - 5:00 Session 4: **Watershed Action for Lake Remediation**

Moderator: Carlos Fernandes - Hillsborough County Public Works

15 Fernandes – Evaluation of pollution prevention programs on the status of surface water quality in Hillsborough County, FL.
16 Cabezas – Lake management planning issues in Florida
17 Brunty – Watershed education – Highlands County's bottom-up approach.
18 Araj – Lake Okeechobee watershed assessment project.
19 Richardson – Design of Lake Armistead water control structure using an integrated surface water/ground water modeling software.

5:15 - 6:15 Exhibitors Reception (cash bar after 6:15 if needed)

2002 FLMS Conference Session Schedule

Wednesday June 12

8:00 - 5:00 Registration

8:20 - 8:30 Announcements and Door Prizes

8:30 - 10:10 Session 5: **Effects of Water Level Fluctuation on Aquatic Macrophytes**

Moderator: Bruce Scharfstein - SFWMD

20 McGlynn – Lake Jackson's natural drawdown and restoration.
21 Harwell – SAV recovery following desiccation and re-inundation of the seed bank: A case study of Lake Okeechobee.
22 Hopson-Fernandes – Growth of native submersed macrophytes on sediments from an hypereutrophic urban lake.
22 Brady – Integrating GIS, GPS, and IR Video Technologies to map submerged macrophytes in Lake Okeechobee, Florida.
24 Grimshaw – The effects of shading on *Chara* and its epiphytes.

10:10 - 10:30 Break (refreshments provided)

10:30 - 11:50 Session 6: **Human Health Issues/Exotic and Invasive Species**

Moderator: Rick Baird - Orange County Environmental Protection Division

25 Lukasik (HI) – Use of ribotyping for the identification of sources of fecal pollution in environmental waters.
26 Scott (HI) – The coliforms and the need for alternative indicators.
27 Pernas (EIS) – Exotic plant management in Florida's national parks.
28 Bielinski (EIS) – An analysis of human disturbances on vegetation of Lake Disston, Florida.

11:50 - 1:50 Banquet Lunch Provided / Awards / Business Meeting
Board Meeting
Everglades Dining Room

2002 FLMS Conference Session Schedule

Wednesday June 12

1:50 - 3:30 Session 7: **Exotic and Invasive Species**

Moderator: Mike Bodle - SFWMD

29 Bodle – *Hydrilla* and torpedograss management programs in South Florida.
30 Schardt – An overview of Florida DEP's invasive plant management programs.
31 Harper - Optimization of wet detention pond performance using lake eutrophication and mass balance models for design
32 Loftus – Introduced tropical freshwater fishes in Florida.
33 Mongin/Pell – Precision release, advancements in product formulation technology for SONAR herbicide.

3:30 - 3:45 Break (refreshments provided)

3:45 - 5:05 Session 8: **Water Quality / Water Quality Modeling**

Moderator: R. Thomas James - SFWMD

34 Willis – Florida LAKEWATCH Program.
35 Hoyer – Nutrient, chlorophyll and water clarity relationships in nearshore coastal waters with comparisons to freshwater lakes.
36 James – Does submerged aquatic vegetation control total phosphorus concentrations in Lake Okeechobee?
37 DelCharco – Restoration alternatives for a eutrophic, tidal lake in Northeastern Florida.

Sunset Beach Party 7:30 - 9:00 (Drinks and Snacks Provided)
Coconut Grove Beach area

2002 FLMS Conference Session Schedule

Thursday June 13

8:20 - 8:30 Announcements and Door Prizes

8:30 - 10:10 Session 9: **Total Maximum Daily Loads**

Moderator: Jan Mandrup-Paulsen - DEP

38 Griffin – When a problem becomes a solution: Getting ahead of the TMDL requirement.
39 Pope – Implementing a successful TMDL Process.
40 Fulton – PLRG development for lakes in the Upper Ocklawaha River Basin.
41 Shugar – The development and implementation of the Lake Okeechobee phosphorus TMDL.
42 Bachmann – An evaluation of the new phosphorus TMDLs for Lake Okeechobee.

10:10 - 10:30 Break (refreshments provided)

10:30 - 1 11:50 Session 10: **Critical Issues in Lake Restoration**

Moderator: Shailesh Patel - BCI Engineers and Scientists, Inc.

43 Ford – Investigation of on-site sewage treatment and disposal systems on surface water quality.
44 Ford – Is stormwater the worst that can happen to your lake?
45 Henderson – ^{227}Ac as a new geochronological tool.
46. Dooris/Kolasa – A lake assessment procedure as an aid in developing a lake improvement and protection strategy.

11:50-12:00 Closing Remarks

12:00 Adjourn

Abstracts in Alphabetical Order By Author

(Presenting author is underlined)

An Evaluation of Fish and Invertebrate Communities in Sulphur Springs, Florida During a Period of Water Diversion by Assistant Professors Mike S. Allen and Debra J. Murie, Department of Fisheries and Aquatic Sciences, The University of Florida, 9722 NW 71st Street, Gainesville, Florida 32653, and Gary Warren, Biological Scientist, Florida Fish and Wildlife Conservation Commission, 9722 NW 71st Street, Gainesville, Florida 32653.

Reduced water flow due to anthropogenic withdrawals in coastal rivers and springs of Florida is of concern due to potential changes in salinity with reduced freshwater flow rates. Saltwater intrusion due to low freshwater flows may extirpate freshwater fishes and invertebrates. We evaluated the fish and invertebrate communities in Sulphur Springs Run (SSR), Florida, which flows into the Lower Hillsborough River, during a period of water diversion (summer 2000). The fish community was also assessed during a period of regular flow (September 2000). Salinities averaged 10-12 ppt during summer 2000 when the SSR was under full diversion but averaged about 1.5 ppt in September 2000 when the SSR was flowing at 30 cfs. Thus, water diversion dramatically altered the salinities throughout entire SSR. The fish fauna in the SSR included mostly marine or estuarine-tolerant taxa, and no obligate freshwater fishes were collected during summer or September of 2000. Full flow from the SSR in September 2000 did not result in changes in the fish community, likely due to the short period of freshwater flow. The invertebrate community diversity and evenness values during May 2000 were reflective of low species richness and extreme dominance by few species. Results suggest that diversion of flow from the SSR likely eliminates most freshwater fishes and may negatively impact invertebrate communities.

Lake Okeechobee Watershed Assessment Project by Elie G. Araj, PE, Senior Vice President, Berryman & Henigar, Inc., 1412 Tech Boulevard, Tampa, FL 33619

The South Florida Water Management District (SFWMD), in cooperation with the U.S. Army Corps of Engineers, has selected a consulting team comprised of HDR, Inc., as the prime consultant, and Berryman & Henigar, Inc., as one of the major sub-consultants for developing a watershed assessment and Project Implementation Report (PIR) for the restoration of the Lake. The five-year, $6 million project represents the first major component of the Comprehensive Everglades Restoration (CERP) Plan.

The project entails the execution of four primary tasks associated with this Project.

1. Preparation of Lake Okeechobee Watershed Assessment Report
2. Development of the PIR Work Plan
3. Preparation of Interim PIR for TC/NS
4. Preparation of PIR for Lake Okeechobee Watershed Project Components

Tasks 1 and 2 of the work plan will consist of development of a public involvement plan and initial project management tasks prior to embarking on four watershed assessment tasks that will be compiled to produce the Lake Okeechobee Watershed Assessment Report. These four tasks are Performance Measures, Inventory of Existing Conditions and Forecast of Future Conditions, Spatial Data Model, Hydrologic/Water Quality Characterization of Tributaries

"Hydrologic/Water Quality Characterization of Tributaries - A Watershed Assessment Report" will be developed which will document all work and results of the above analyses. The Report also will incorporate the results of PIR Work Plan, which will detail the necessary activities to complete the advanced plan formulation process for the four components of the Project.

Tasks 3 and 4 will be developed in the following year.

An evaluation of the new phosphorus TMDLs for Lake Okeechobee by Roger Bachmann, Prof., Mark Hoyer, Sci. Res. Manager, and Daniel E. Canfield, Jr., Prof., Department of Fisheries and Aquatic Sciences, University of Florida, Gainesville 32653

The USEPA proposed a total maximum daily load (TMDL) of 198 metric tons (mt) of P/yr for Lake Okeechobee and the Florida DEP followed with a TMDL of 135 mt/yr. These are substantially less than the "maximum allowable" loading rate of 311 mt/yr proposed by the Lake Okeechobee Technical Advisory Committee in 1986 and our estimate of a pristine loading of 380 mt/yr. We review the process of setting the target concentration of 40 ppb TP for the lake and also how the lake responds to year-to-year fluctuations in phosphorus loading. There is no correlation between chlorophyll concentrations and TP in the pelagic zone, and a target of 70 ppb TP in the pelagic zone is sufficient to protect the near littoral zone from algal blooms. There is no relationship between open-water phosphorus concentrations and phosphorus inputs from the watershed. There seems to be less phosphorus retention by the sediments in recent years, possibly related to reductions in calcium concentrations in the lake in this time period. Water level fluctuations are related to changes in TP in the lake and also play a role in controlling aquatic macrophytes important to the fish populations. We recommend a TMDL of approximately 400 metric tons be set as a more reasonable goal. The focus of lake management at Lake Okeechobee should shift from stringent phosphorus control to other management aspects such as water level management.

Cyanobacteria Harmful Algal Blooms (CyanoHABs): Developing a Public Health Response by Lorraine C. Backer, National Center for Environmental Health, 1600 Clifton Rd., NE, MS E-23, Atlanta, GA 30333.

Cyanobacteria, or blue-green algae, are photosynthetic organisms that grow in marine, brackish, or fresh water. Some species produce potent toxins that can induce severe illness in animals and people. Although cyanobacterial toxins are important environmental contaminants, public health activities are typically limited to emergency responses to specific animal or human poisoning events. However, potentially long-term public health issues have recently been identified. For example, investigators in Florida found that many surface water bodies (including both current and potential drinking water sources) contained toxin-producing blue-green species. Algal blooms occur year-round in Florida, making it even more likely that people will be exposed to these toxins via their tap water. In addition to the naturally occurring incidents of drinking water contamination, the blue-green algae toxins could potentially be used as a terrorist weapon against populations in the U.S. and elsewhere. Although the toxins are not commercially available, the threat of drinking water contamination with potent neurotoxins and hepatotoxins could incite panic and inappropriate demands on medical and public health infrastructure. Research in epidemiology, biochemistry, pharmacology, ecology, and water treatment is needed to understand the public health impact of cyanobacteria and cyanobacterial toxins.

An Analysis of Human Disturbances on Vegetation of Lake Disston, Florida by Dana Bielinski. Environmental Science, Stetson University, DeLand, FL 32723.

The purpose of this study was to determine if the logging, farming, and settlement on the shores of Lake Disston, near Bunnel, Florida had affected lakeshore vegetation. It was hypothesized that human disturbances have changed the composition of vegetation in Lake Disston.

To determine if Lake Disston's vegetation composition had been affected by human disturbances, a vegetation map and cross-section diagrams of the four areas were produced. Logged, farmed, settled and undisturbed cross-sections, corresponding to the near-shore environments around Lake Disston, were created using a cartographic system. The data were collected by visually scanning the shoreline for type of vegetation present and locations checked using a GPS unit. Statistical analysis was performed on species groupings made for the map to see if the number of disturbance and exotic species differences between areas that were disturbed and undisturbed was significant.

The statistical results were suggestive but inconclusive. The largest difference between areas that were disturbed and those undisturbed was the presence of plant species that were disturbance tolerant. The areas of the lake that had been farmed and logged had the most exotic and disturbance vegetation. The statistical analysis did not show a significant difference between areas that were disturbed and undisturbed but p-values indicated that human disturbances might have an effect on vegetation composition. The map and analysis revealed that human disturbances have already affected vegetation composition with the presence of more exotic and disturbance species in areas farmed and logged.

***Hydrilla* and torpedograss management programs in South Florida**. Mike Bodle, South Florida Water Management District, PO Box 24680, West Palm Beach, FL 33416-4680

Two invasive plants in South Florida, torpedograss (*Panicum repens*) and hydrilla (*Hydrilla verticillata*) are each being targeted in separate multi-million dollar management projects. Each poses separate characteristics which have enabled their invasions in Florida. These characteristics also affect management choices.

State funds have been available to the local cooperator, SFWMD, for *Hydrilla* management in central Florida's Kissimmee chain of lakes for two decades. Methods and results have varied during this time.

Torpedograss has been the subject of operational control for only two years. Populations of this grass threaten to overwhelm all 100,000 acres of Lake Okeechobee's valued emergent marshes. Techniques are evolving, often as operational refinements to a program that will continue to find the most effective methods to manage this highly invasive aquatic weed.

Integrating GIS, GPS, and Infrared Video Technologies to Map Submerged Macrophytes in Lake Okeechobee, Florida by Mark Brady, Geographer, SFWMD, West Palm Beach Florida, 33406 and Rick Householder, Staff Geographer, SFWMD, West Palm Beach , Florida, 33406.

Lake Okeechobee is a 740 square mile lake located in south central Florida. It is managed for flood control as well as an important source of water for agricultural use, urban water supply, and supports valuable commercial and sport fisheries. Historically the lake has supported extensive submerged aquatic vegetation (SAV) communities, which provide both valuable forage and cover habitat for fish and stabilize bottom sediments; thereby reducing turbidity and nutrient levels in the water column. Mapping the spatial extent and temporal changes in these beds helps water managers better understand the potential ecological effects of lake level regulation activities.

Our current method for sampling the extent of coverage of SAV is to visit each cell of a systematic grid that covers the lake. GPS is used to navigate to the center point of each cell in the grid where the bottom is sampled for SAV presence or absence either by diving or by using a set of oyster tong-like rakes. This method is very time consuming and labor intensive. The method described in this presentation uses an infrared camera to acquire images of the bottom of the lake, captures the data (presence/absence of SAV), and directly maps the spatial extent of the macrophyte bed using ARCPAD on a laptop computer. Using this method, SAV maps are generated in real time, in the field, with no post processing needed.

Investigation of on-site sewage treatment and disposal systems on surface water quality in Highlands County, Florida by Jennifer Brunty, Natural Resource Specialist, and Clell Ford, Lakes Manager, Highlands County Soil and Water Conservation District, Sebring, Florida 33875

There are over 90 lakes located in Highlands County, Florida, many of which are at least partially surrounded by homes serviced by on-site sewage treatment and disposal systems (OSTDSs). Central sewer coverage only extends through some of the most densely populated areas of the county. Installation of central sewer for all county residents is cost prohibitive and therefore methodology was developed to determine which lakes are at greatest risk of contamination. The potential for shallow groundwater and surface water contamination is high when housing density is high in sandy soils or where the high water table approaches the drainfield in muck soils, especially in older systems. Individual lake watershed extents were estimated and the number of OSTDSs in each watershed were counted. A ranking system was developed using housing densities, age of OSTDS's and soil parameters to determine areas where threats to surface water quality are the greatest. The use of the soil survey and GIS mapping was combined with field testing to further establish which surface waters have the greatest risk of OSTDS contamination. Seventeen lakes were chosen for intensive water quality sampling in March, May, and September 2001 and March 2002, for organic and inorganic nitrogen and phosphorus. Caffeine, *Enterococci spp.* bacteria, and nitrogen isotope ratios were also measured for all samples to determine whether the source of any pollution is anthropogenic waste. Some areas, particularly canals densely populated with older homes, showed consistently poor water quality most likely due to the presence of human waste.

Lake Management Planning Issues in Florida by Moris Cabezas, Ph.D., P.E., Water Resources Technical Manager, PBS&J, Tampa FL

Management of lake systems in Florida has become an important water resources planning issue in response to public concerns over declining water clarity and the proliferation of nuisance aquatic vegetation in many of our water bodies. The purpose of these plans is to provide a comprehensive, yet specific, framework for action aimed at both meeting levels of service for flood control and water quality while improving and maintaining the natural resource functions of the lakes.
This paper addresses the issues associated with lake management plan development in Florida from the identification of specific concerns including water quality, aquatic vegetation management, fisheries, wildlife and associated habitat, recreation and aesthetics, flood control and public education to plan implementation and monitoring. It is recognized that the keystone of any planning process is the establishment of goals. Furthermore, for each goal there must be defined targets by which degree of attainment of those goals can be measured.

Once the goals and corresponding targets are defined, specific action plans can be developed. These plans must describe in detail the management actions that will be implemented to meet the desired targets. Management actions may include construction of structural improvements or implementation of non-structural pollution control measures in the watershed. Other management measures may include a variety of legal, regulatory and policy guidelines that will serve to improve lake management flexibility or control growth and development in the watershed. Policy recommendations may include amendments to local comprehensive plans or recommendations on compliance and enforcement of existing and proposed regulations. Finally, lake management must also include the recreational and public education components. Recreational planning components may include construction of recreational facilities or establishment of fishing enhancement zones, whereas the public education component may involve implementation of public involvement initiatives or local lakewatch programs. The discussion is illustrated with specific case studies.

Littoral Zone Restoration of Lake Istokpoga: Enhancing Aquatic Habitat, Flood Control, and Water Quality by Thomas R. Champeau, Regional Fisheries Administrator, Florida Fish and Wildlife Conservation Commission, 3900 Drane Field Road, Lakeland, FL 33811, and J. Beacham Furse, Biological Scientist IV, Florida Fish and Wildlife Conservation Commission, 3991 S.E. 27th Court, Okeechobee, FL 34974

Lake Istokpoga, the fifth largest lake in Florida at 27,692 acres, is located in the Kissimmee River drainage basin, about 40 miles northwest of Lake Okeechobee. Istokpoga produces a $6 million sport fishery, provides flood protection, and is used as a water supply for agribusiness. As part of the Central and South Florida Flood Control Project, natural lake level fluctuation has not occurred since 1961. Four decades of restricted lake level fluctuation resulted in the encroachment of over 1,800 acres of littoral zone by cattail (*Typha* sp.) monocultures and floating vegetative mats (tussocks) with associated organic detritus. Advanced succession of the littoral shelf reduced habitat required by fish and other aquatic organisms including many species of wading birds, degraded littoral zone water quality, displaced total lake water volume, impeded navigation, and reduced lakefront property aesthetics and recreational potential. In the event of a major tropical storm near the lake, floating tussock mats threaten flood prevention capabilities by potentially blocking water flow through the S-68 structure to Lake Okeechobee via the C-41A canal. Tussocks and associated organic sediments represent a potential source of suspended organic matter, nitrogen and phosphorous in littoral and limnetic zones as well as downstream to Lake Okeechobee. A major littoral zone restoration project was accomplished during 2001 as drought conditions allowed for partial de-watering of the lake to three feet below high regulated pool stage. From March through July, 1,308 acres (21 miles of shoreline) were scraped and an estimated 2,370,420 cubic yards of tussock/muck were either transported upland or consolidated into in-lake islands. Total project cost was $2,740,320 ($2,095/acre or $1.16/cubic yard). Rapid lake refill to high pool occurred and cleared areas already demonstrate improved water quality, recruitment of desirable aquatic plants, utilization by fish and wading birds, improved aesthetics, and other economic/social/recreational benefits.

Restoration Alternatives for a Eutrophic, Tidal Lake in Northeast Florida by Michael DelCharco, P.E., and Philip Dompe, P. E., Taylor Engineering Inc., 9000 Cypress Green Drive, Jacksonville, FL 32256

Doctors Lake, a 5.5 mi^2 eutrophic lake located in northeast Florida, connects to and exhibits many of the same water quality characteristics and algal blooms as the lower St. Johns River. However, nonpoint source nutrient loading and inadequate flushing exacerbate the poor water quality and ecological health of the lake.

Objectives of this St. Johns River WMD restoration study included reviewing existing data, applying water quality and hydrodynamic models, and recommending restoration alternatives. These alternatives included improving lake water residence time/flushing and reducing nutrient loading.

RMA2/RMA4, a coupled 2-D hydrodynamic/water quality model, simulated the lakes circulation and flushing patterns. Restoration alternatives modeled included surface water connections to the St. Johns River and Black Creek. The WMM model simulated nutrient loading in five Doctors Lake watershed subbasins. Restoration alternatives modeled included retrofitting stormwater treatment facilities at select locations on the main tributaries.

Results of the study objects are summarized. A review of water quality data in the lake and the lower St. Johns River show their similarity in nutrient levels. However, chlorophyll and algal biomass tend to reach higher levels in the lake. Increased nutrient loading and poor flushing of the lake may explain these elevated levels. Hydraulic modeling of surface water connections to improve flushing showed residence time (for 90% reduction in concentration) reduced from 134 to 109 days. However, regulatory, technical, and economic constraints preclude enlarging the connections to an effective size. Nutrient loading model results indicate stormwater treatment facilities as the best alternative for restoration.

***Cylindrospermopsis raciborskii* in three central Florida lakes: population dynamics, controls, and management implications** by Dean R. Dobberfuhl, St. Johns River Water Management District, Division of Environmental Sciences, P.O. Box 1429, Palatka, FL 32178-1429.

Cylindrospermopsis raciborskii is a toxic blue-green alga that has begun appearing, and in some cases dominating, many Florida water bodies. *C. raciborskii* began exponentially increasing in Lake Jesup, Florida in 1995. As a result, the phytoplankton community in the lake has declined in terms of species richness and diversity. Compared to other lakes in the region, this species is still maintaining relatively dynamic population cycles in the lake. Lake stage appears to affect *C. raciborskii* differently than the aggregate phytoplankton community in Lake Jesup. Correlation analysis suggests that magnesium limitation, among other factors, may be an important factor influencing *C. raciborskii* growth in Lake Jesup, but appears absent in the Lake Apopka and Lake Griffin. Finally, increases in *C. raciborskii* are associated with increases in phytoplankton biomass yield per unit phosphorus, having important implications for lake management and restoration.

Effects of zooplankton availability on age-0 black crappie *Pomoxis nigromaculatus* abundance and growth in three Florida lakes by Kevin J. Dockendorf, M. S. candidate, and Mike S. Allen, Asst. Professor, Department of Fisheries and Aquatic Sciences, University of Florida, Gainesville, FL, 32653

We investigated relations between larval and juvenile black crappie *Pomoxis nigromaculatus* abundance, size, and prey availability at three Florida lakes. Age-0 black crappie were collected at Lakes Wauberg, Lochloosa, and Tarpon using surface and bottom trawls during summer-fall 2000 and 2001. Zooplankton abundance was measured concurrent with trawl sampling. In both fall seasons, juvenile size was largest in Lake Tarpon and smallest in Lakes Lochloosa and Wauberg. However, abundance of age-0 black crappie and summer crustacean zooplankton abundances were higher in Lakes Lochloosa and Wauberg than Lake Tarpon in both years. The lack of a relationship between crustacean zooplankton density and black crappie size across lakes suggests that age-0 black crappie summer growth may not be related to food availability. However, abundance of age-0 black crappie may be the result of high zooplankton abundance during early life. Ontogenetic diet shifts, density dependence, and environmental variables may determine summer growth in age-0 black crappie.

A lake assessment procedure as an aid in developing a lake improvement and protection strategy by Patricia Dooris, Manager, Environmental Section, and Keith Kolasa, Environmental Scientist IV, Southwest Florida Water Management District, Brooksville, FL 34604.

In the Lake Wales Ridge area of central Florida, lake water quality has been identified as a significant surface water issue, and the Southwest Florida Water Management District in cooperation with Polk and Highlands Counties, have funded projects aimed at improving water quality in several lakes. In order to address quality concerns on the remaining 140 lakes in the area, District staff have developed an assessment procedure to support a future District decision-making effort to improve and preserve lake water quality. The assessment procedure results in a ranking of lakes done on the basis of several factors, including: the Florida Trophic State Index, a field evaluation of lake habitat quality, the relative size of the lake and its watershed, and the influence of stormwater and wastewater treatment plant discharges on the lake. The lake habitat quality evaluation component of the procedure emphasizes the biological characteristics of the lake's emergent zone and the apparent effect of stormwater on the lake as estimated by the percent impervious land cover in the lake's basin and evidence of untreated stormwater inflow. In the emergent zone, the species composition and areal coverage of both submerged and emergent plants, together with the nature of the bottom substrate, are noted. The assessment process makes use of data generated as part of the District's Comprehensive Watershed Management Program in the Ridge Lakes and Peace River Basins in addition to newly collected field and laboratory information. A technical evaluation and environmental ranking of each lake is prepared which will assist in guiding resource allocations for lake improvement for low ranking lakes and preservation for high-ranking lakes.

Detection and characterization of *Cylindrospermopsis raciborskii* populations in northeast Florida lakes using molecular approaches by Julianne Dyble, PhD candidate; Michael Piehler, Research Assistant Professor; Hans Paerl, Kenan Professor, UNC-CH Institute of Marine Sciences, Morehead City, North Carolina 28557 and Brett Neilan, Research Fellow, University of New South Wales, Sydney, NSW, Australia, 2052

The detection and accurate identification of potentially toxic cyanobacterial species is essential for monitoring their distribution and expansion in Florida lakes. Molecular approaches can be used to differentiate strains and detect cyanobacterial HAB species present in low densities. By targeting specific gene sequences, *Cylindrospermopsis raciborskii* was identified in a number of lakes in the St. Johns River watershed, including those with and without visible blooms. When compared to one another on the genetic level, *C. raciborskii* populations from different Florida lakes showed a high degree of variability compared to populations from other parts of the world. The Florida *C. raciborskii* strains were also analyzed for the degree of similarity to toxin-producing Australian populations.

Ecology of *Cylindrospermopsis* (Nostocales, Cyanobacteria) in Temperate Zone Reservoirs: Evidence of Thermal Adaptability by Linda C. Ehrlich, Ph.D., Dir. Spirogyra Diversified Environmental Services, 2232 Holland Avenue, Burlington, NC 27217 and Larry McMillan, Laboratory Supervisor, Public Utilities Department, City of Raleigh, P.O. Box 590, Raleigh, NC 27602

Until recently, the planktonic cyanobacterial genus *Cylindrospermopsis* (Nostocales) was thought to form water blooms only in tropical and subtropical regions, including Florida. However, it is rapidly invading temperate zone water bodies, predominating in eutrophic waters during the summer period of thermal stratification. Morphological variants and ecology of *Cylindrospermopsis spp*. have been studied since 1999 in three drinking water reservoirs near Raleigh, North Carolina. Water samples were collected quarterly from the euphotic zone for phytoplankton counts, chlorophyll *a*, environmental conditions, and water chemistry. Generally, results have supported the assumption that *Cylindrospermopsis* requires temperatures above 23^{o} C to proliferate. Highest populations (5.5×10^{4} - 3.1×10^{6} cells/ml) occurred during conditions of highest temperature (28-31^{o}C), low concentrations of available nitrogen (< 100 ug/L), and relatively low concentrations of total and orthophosphate phosphorus ($\leq$ 20 ug/L). Although *Cylindrospermopsis* usually is suppressed by a winter flora by November, it persisted in one reservoir at a level of 1000 cells/ml at a temperature of 19^{o} C. This suggests that the genus has a wider range of thermal tolerance in the temperate zone than previously believed.

An evaluation of the benefits of pollution prevention programs in association with pollution abatement projects on the overall status of surface water quality in Hillsborough County, FL by Carlos A. Fernandes, Chief Environmental Scientist, Hillsborough County Public Works Stormwater Section, Tampa, FL 33603 and Margaret S. Hopson-Fernandes, Department of Environmental Engineering Sciences, University of Florida, Gainesville, FL 32611.

The goal of this presentation is to discuss overall trends in surface water quality from 1995 to 2001 in lake, stream and estuarine systems located in Hillsborough County. The Hillsborough County Public Works Engineering Division Stormwater Section manages three highly operative pollution prevention programs: Hillsborough County Lake Management, Stream WATERWATCH and Hillsborough County Adopt-A-Pond. These programs depend on citizen volunteers to collect samples from nearby lakes and streams. The programs also encourage community involvement via lake and stream cleanups and stormwater pond replantings. These programs collectively involve almost 300 volunteers. Highlighted pollution prevention projects are the Cockroach Bay Restoration Project and the East Lake alum injection pump. Auto-Regressive Integrated Moving Average models (ARIMA, JMP, SAS, 2000) were used to interpret lake and stream water quality data. ARIMA models predict future values of a time series by a linear combination of its past values and a series of errors. Water quality trends in Tampa Bay, expressed as Water Quality Index (WQI), will also be presented. The results of this study demonstrate the positive effect of these pollution prevention programs in association with other County pollution abatement projects on the ecological health of the entire area.

Is Stormwater the Worst That can Happen to Your Lake? by Clell Ford, Jennifer Brunty, and Jackie Bailey, Highlands County Natural Resources Department, 4505 George Blvd, Sebring, Florida 33875, and Keith Kolasa, Southwest Florida Water Management District, 2379 Broad Street, Brooksville, Florida 34604

Local governments are beginning to investigate and abate stormwater in response to NPDES phase II TMDLs. Public education on and support for stormwater issues is critical. However, experience with three lakes in Highlands County indicates that stormwater ranks below water levels and agricultural impacts for concerned lakefront residents. Water quality records and complaints received for three lakes with similar watershed areas (> 3000 ha) and surface sizes (>1300 ha) were compared. Water quality, as reflected by Secchi transparency (m) and FTSI, has declined in each since the mid-1990s. A recent survey of Lake Jackson (1375 ha, median FTSI 37.0, median Secchi 2.4 m), the largest urbanized lake in the county, shows that stormwater runoff consistently violates state water quality standards. However, lakefront residents are generally happy with lake water quality and lake levels. Lake June-in-Winter (1416 ha, median FTSI 39.1, median Secchi 2.1 m) also has recorded few water quality complaints despite having the highest median FTSI and lowest median Secchi. Complaints about low water levels were numerous, though the lake dropped less during the recent drought than comparison lakes. Lake Placid (1335 ha, median FTSI 35.3, median Secchi 2.4m) has the least development in its watershed. However, it currently experiences unmitigated drainage from an intensive cattle operation; citizen concerns have prompted an investigation by local and federal agencies that will mitigate the runoff in both short and long term. This presentation discusses factors affecting these lakes and provides insight into divining and focusing citizen input to lake management.

Watershed Education - Highlands County's Bottom-up Approach by Clell J. Ford and Jennifer Brunty, Highlands County Natural Resources Department, 4505 George Blvd. Sebring, Florida 33875

Several efforts aimed at educating the public on watershed issues in Highlands County have been undertaken in the last few years; successful ones take the "bottom-up" approach. Watershed education in Highlands County ultimately links to impacts on the 46,000+ acres of lakes. Any education activity that addresses "non-aquatic" issues is a watershed education opportunity. Successful watershed education involves citizens and government working together to address local concerns. Activities that fit the standard education mold include the Guide to Area Lakes, the Watershed Education Video, Storm Drain Labeling, and the Master Conservationist Class. Regardless of whether the project results from grants, cooperative agreements or local funds, the hard work of dedicated employees and volunteers is critical for success. Local advocacy groups have been able to secure work on their specific lake through tireless education of their local government officials. Such efforts are underway for lakes Huckleberry, Persimmon, Placid and, in the most extreme case, Istokpoga. Local groups that have received education grants include the Highlands County Lakes Association, Keep Highlands County Beautiful, the Highlands Soil and Water Conservation District, the City of Sebring and Highlands County. However, one size does not fit all, and having watershed or education in the title is not required to qualify! Local government initiatives that provided a bounty for removal of *Melaleuca*, restored native plants to improve water quality or provided kiosks for fisheries education are also watershed education. This presentation provides an overview of several watershed education activities being conducted in Highlands County.

PLRG development for lakes in the Upper Ocklawaha River Basin by
Rolland Fulton, Environmental Scientist, St. Johns River Water Management District, P.O. Box 1429, Palatka, FL, 32178

Excessive nutrient loading from intensive agriculture and urbanization have severely degraded water quality in lakes of the Upper Ocklawaha River Basin. Water quality in the basin lakes ranges from mesotrophic to hypereutrophic. Pollutant Load Reduction Goals (PLRGs) are under development for seven major lakes in the basin: Beauclair, Dora, Eustis, Harris, Griffin, Yale and Weir. Attention is focused on phosphorus as the primary nutrient of concern in eutrophication of these lakes. Estimates of external loading of phosphorus will be developed for existing and historic conditions. Vollenweider-type trophic state modeling will be used to establish a relationship between external phosphorus loading and phosphorus concentrations in lake water. Target phosphorus concentrations for the lakes will be established from paleolimnologic information and modeling of historic watershed conditions. Finally, trophic state modeling will be conducted to establish acceptable phosphorus loading limits to meet the target concentrations.

Herpetofaunal Distribution and Occurrence on the Kissimmee River Floodplain Prior to Restoration by Lawrence Glenn, Staff Environmental Scientist, South Florida Water Management District, West Palm Beach, Florida, 33414

Channelization of the Kissimmee River resulted in the loss of approximately 14,000 ha of floodplain wetlands and substantially altered hydrologic characteristics of remaining wetland habitats. Amphibians and reptiles were identified as critical biological components for assessing restoration of the Kissimmee River ecosystem due to their role in food web dynamics, complex life cycle, including obligate association of most larvae with water, and vulnerability to anthropogenic shifts in wetland hydrology. Herpetofaunal surveys were conducted in four floodplain habitats between 1996 and 1999 to document habitat-specific abundance, community structure, and spatial and temporal patterns of reproduction prior to restoration. Visual encounter surveys (VES) indicate herps were most abundant in broadleaf marsh and woody shrub, moderately abundant in wetland forest, and least abundant in pasture. Habitat-specific species richness followed a similar trend, while species diversity and community evenness were low in all habitats. Larval salamanders were present on the floodplain only from December through April, while larval anurans were present 7 months of the year. Species richness of larval amphibians was greatest in broadleaf marsh (14) and woody shrub (10), and lowest in pasture (4). Species richness and abundance of larval and adult amphibians and reptiles are expected to increase following restoration of floodplain habitats. Twenty-four herp species are expected to occur in restored floodplain habitats, with larvae present during most of the year.

When a Problem Becomes a Solution: Getting Ahead of the Total Maximum Daily Load (TMDL) Requirement by James C. Griffin, Southwest Florida Water Management District, 2379 Broad Street, Brooksville, FL 34604-6899

This paper demonstrates that the implementation of a TMDL can be employed to achieve unrealized restoration objectives while meeting a stated goal of pollution reduction. The McIntosh Park Enhanced Stormwater Wetland (ESW) project has many potential benefits including wetland habitat restoration and creation, flood protection, public education and the creation of public recreation opportunities. Although these aspects of the project are of obvious value and benefit to the public, they may not be of great enough importance to garner the necessary funding to make the project feasible. Enter the TMDL and a realization that a future requirement of reducing non-point-source (NPS) pollutant loads is real and potentially expensive. Now the value of a wetland that can also be used for NPS pollution load reduction is easier to quantify. It also helps when grant money is available for NPS pollution reduction projects that are initiated in advance of the setting of a TMDL. The McIntosh Park ESW project transforms 100 acres of existing improved pasture into a functioning wetland treatment system containing 39.4 acres of restored wetlands, 10.5 acres of enhanced existing wetlands, and newly created wetland cells totaling 20 acres. The project also includes an aluminum sulfate (alum) pre-treatment system and an alum floc handling system. The ESW will be able to treat base and storm-event flow from the 6300 acre Eastside Canal watershed with a nitrogen removal rate of between 25 and 40 percent, and a phosphorus removal rate of between 50 and 70 percent.

The effects of shading on *Chara* and its epiphytes by H. J. Grimshaw, K. Havens, B. Sharfstein, T. East, and A. Rodusky, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, Florida 33406

The effect of shading on the growth of *Chara* was investigated in a large outdoor tank (7.7 m^3) using water, sediment, and plants from Lake Okeechobee, Florida. Plants were grown in peat sediments from the lake under ambient temperature (27- 30°C) and photoperiod (12L:12D). Treatments were established by differentially shading plants with varying numbers of layers of fiberglass window screen. Photosynthetic photon flux density ranged from 1.1 to 21.6 % of average incident photosynthetically active solar radiation (PAR), or 8 to 153 μmole photons m^{-2} s^{-1} based on continuous daytime measurements from a mid-lake PAR sensor.

Response variables examined included the growth rate and ash-free dry mass (AFDM) of *Chara*, and the AFDM of its epiphytes (primarily *Rhizoclonium africanum*). All of these variables decreased linearly with decreasing PAR, and had statistically significant treatment effects.

The apparent photosynthetic photon flux density (PPFD) for no net growth of *Chara*, measured approximately a quarter meter above the sediment surface, was found to be 17 μmole photons m^{-2} s^{-1} with 95% confidence limits of 0 and 33 μmole photons m^{-2} s^{-1}; while the compensation PPFD of the epiphytic community was estimated to be 6 μmole photons m^{-2} s^{-1} with 95% confidence limits of 0 and 10 μmole photons m^{-2} s^{-1}. These results suggest that this macroalga-epiphyte complex is capable of survival under conditions of very low light. This may be an important adaptation, given the eutrophic condition and generally poor transparency of water in this lake.

Optimization of wet detention pond performance using lake eutrophication and mass balance models for design by Harvey H. Harper, Ph.D., P.E., Environmental Research & Design, Inc. 3419 Trentwood Blvd., Suite 102, Orlando, FL 32812

Abstract: Wet detention ponds have become one of the most popular alternatives for stormwater treatment in the State of Florida. These systems, which are capable of providing flood attenuation as well as pollution abatement, provide substantial attenuation of runoff pollutants through a combination of physical, chemical, and biological removal processes. Regulations governing the design of wet detention ponds vary widely throughout Florida, particularly with respect to pond depth and minimum detention time. Wet detention ponds are typically designed using presumptive design criteria, developed by each of the individual water management districts, which regulate pond geometry, configuration, and depth. However, in some instances, these criteria may restrict pond performance compared with what could be achieved using alternative design criteria.

Since wet detention ponds are essentially man-made lakes, water quality processes can be effectively modeled using lake eutrophication and mass balance models. One method of enhancing wet detention performance is to maximize pond depth and permanent pool volume. However, to maintain both short-term and long-term pollutant removal and attenuation processes, oxidized conditions must be maintained at all depths within the pond. Oxidized conditions can be maintained as long as the photic zone depth exceeds the pond depth which ensures that photosynthesis exceeds respiration. The depth of the photic zone can be calculated using a standard Vollenweider trophic state model based on estimated nutrient and hydrologic inputs. The model can be used to estimate the maximum pond depth possible without exceeding the photic zone depth. Increasing the permanent pool volume also increases the mean detention time. Pond performance appears to be primarily regulated by detention time, suggesting that water column removal processes are the most significant removal mechanisms.

Increasing detention time can also improve effluent concentrations of virtually all runoff-related pollutants. A mass balance water quality model was developed for nutrients, TSS, BOD, and common heavy metals to evaluate pond performance and water quality characteristics under a wide range of design conditions. The model includes hydrologic and mass inputs from runoff and bulk precipitation, with losses occurring as a result of evaporation, water column processes, vegetative uptake, and outfall discharges.

Removal relationships were developed for both dissolved and particulate forms of nutrients and heavy metals as a function of detention time based on previous research. These relationships were used to predict water quality characteristics for wet detention ponds as a function of detention time and depth. Increasing the permanent pool volume of a wet detention pond substantially enhances the chemical characteristics of pond discharges as a result of both water column removal processes and dilution, increasing the likelihood of achieving water quality standards at the outfall. Overall removal efficiencies of wet detention ponds designed with larger and deeper permanent pool volumes can rival removal efficiencies achieved in dry retention systems.

Over-excavation of wet detention ponds can be beneficial to overall performance, provided that the pond depth does not exceed photic zone depth, by increasing pond volume and detention time, providing additional dilution of inputs and extended opportunities for pollutant attenuation. Increased pond volumes also provide natural control of invading macrophytes, reduce potential for scour or resuspension of bottom sediments, provide protection against shock loads, provide larger storage volumes for settled pollutants, and reduce maintenance costs.

SAV recovery following desiccation and re-inundation of the seed bank: A case study of sub-tropical Lake Okeechobee by Matthew C. Harwell, A.R.M. Loxahatchee National Wildlife Refuge, 10216 Lee Road, Boynton Beach, Fl. 33437 and Ryan Maki, South Florida Water Management District, West Palm Beach, Florida 33416

In Lake Okeechobee (South Florida, U.S.A.), an extensive drought in 2001 exposed thousands of hectares of near-shore lake bottom, killing much of the submerged aquatic vegetation (SAV) community. This raised questions about the potential for recovery of SAV from the seed bank once water levels returned to normal. In Summer 2001, the potential for recovery of SAV from the seed/oospore bank was examined with an eight-week laboratory seed germination study with cores taken from several areas that had previously supported SAV, including areas of exposed lake bottom and one area that remained inundated. There was little germination of vascular SAV species, except for a few seedlings of the native *Vallisneria americana* (eelgrass) and a few plants of *Hydrilla verticillata*. In contrast, extensive emergence of *Chara* spp., including a faster rate of emergence and a greater magnitude of emergence observed in desiccated cores relative to cores still inundated, suggests the effects of the drought may have included an increased germination response for *Chara*. These macro-algae were the dominant SAV species at the onset of the drought. It remains to be seen if this response will offset the large acreage of *Chara* that was lost as a result of the drought. This exercise documents that the first expected re-colonizer after recovery from drought in a shallow subtropical lake is *Chara*, with vascular plants most likely taking longer to re-establish because recruitment will be primarily from ex-situ sources or very small seed banks.

^{227}Ac as a new geochronological tool by Carl Henderson, Joseph Smoak and Peter Swarzenski, Coastal Marine Geology Program, U.S.G.S., 600 4th St. South, St. Petersburg, FL 33701

We are utilizing ^{227}Ac (Actinium) as a novel radioactive tracer for sediment accumulation rates, as standard Pb-210 models are sometimes invalidated in radium-rich groundwater environments. We measured ^{227}Ac in sediment samples from Saddleback Lake, Lutz Florida. This lake has a history of being augmented with radium-rich groundwater. Lake bottom sediments were collected using a grab sampler, and ^{227}Ac desorption was evaluated by placing an aliquot of chilled sediment into a calibrated barrel filled with radium-free seawater. Periodically, the sediment/water slurry was mixed to assure complete ^{227}Ac desorption. After 12-24 hours, the available ^{227}Ac was removed by filtering the water slurry through specially prepared manganese impregnated fibers. These fibers were then placed into a delayed coincidence counter, where the decay of ^{219}Rn and ^{220}Rn can be quantified.

As these sediments have been entirely isolated for the duration of the experiment, it can be expected that all parent/daughter radionuclides are in secular equilibrium. This means, for example, that the measured activity of ^{219}Rn is equal to the activity of ^{227}Ac. There is little information concerning how ^{227}Ac desorbs in saltwater. Some of the variables that control desorbtion are: sediment:water ratio, the time for sediment to remain in a salt solution, and salinity. By manipulating these factors we should be able to learn more about ^{227}Ac desorption, and its potential roll as a surrogate for ^{210}Pb geochronologies.

Comparison of growth of four species of native submersed macrophytes on sediments from a hypereutrophic urban lake in Polk County, Florida by Margaret S. Hopson-Fernandes, Department of Environmental Engineering Sciences, University of Florida, Gainesville, FL 32611, Carlos A. Fernandes, Chief Environmental Scientist, Hillsborough County Public Works Stormwater Section, Tampa, FL 33603 and Edward J. Phlips, Professor, Department of Fisheries and Aquatic Sciences, University of Florida, Gainesville, FL 32606.

Four study stations were established in the littoral zone of Lake Hollingsworth, a 354-acre, hypereutrophic, shallow urban lake located in Lakeland, Florida. Growth responses to selected sediment characteristics were determined for southern naiad (*Najas guadelupensis* (Spreng.) Magnus), Illinois pondweed (*Potamogeton illinoensis* Merong), vallisneria (*Vallisneria americana* Michx.) and chara (*Chara* sp.). Suitability of sediments from each station as a substrate for macrophyte growth was also evaluated. Growth studies were conducted in 10'x20' concrete tanks at the University of Florida Fort Lauderdale Research and Education Center (26°05'N and 80°14'W). Macrophyte growth was determined as the change in above- and belowground biomass (gDWT) over the 8-week study period. Preliminary results indicate that macrophyte biomass was most positively correlated with sediment phosphorus however, macrophyte response to the parameters investigated was species-specific. Results of studies on the growth requirements of submersed macrophytes will aid lake managers in the use of native species in restoration projects.

Nutrient, chlorophyll and water clarity relationships in Florida's nearshore coastal waters with comparisons to freshwater lakes by Mark V. Hoyer, Thomas K. Frazer, Sky K. Notestein, and Daniel E. Canfield Jr., Department of Fisheries and Aquatic Sciences, University of Florida, 7922 NW 71st Street, Gainesville, Florida 32653

Models relating chlorophyll to nutrients and Secchi depth to chlorophyll using data from 300 nearshore coastal water sites around the entire coast of Florida were successfully developed. The models suggest that phosphorus is the primary limiting factor for phytoplankton in the nearshore coastal waters of Florida and that total phosphorus concentration accounts for 81% of the variance in chlorophyll concentration. The models also show that chlorophyll is the dominant factor determining Secchi depth in nearshore coastal waters of Florida and that chlorophyll concentrations account for 68% of the variance in Secchi depth. Thus, these models are robust and should be useful for eutrophication management of Florida's coastal marine systems. The models developed with data from nearshore coastal waters of Florida are similar to models developed for freshwater lakes in Florida, but the amount of chlorophyll per unit of phosphorus and Secchi depth per unit of chlorophyll are both significantly less for marine samples. This suggests that the chlorophyll to biovolume ratios in the nearshore coastal waters of Florida are less than in freshwater systems of Florida. Therefore, nutrient to chlorophyll and chlorophyll to Secchi depth models developed for freshwater systems are probably ill suited for use in Florida's marine systems.

Does Submerged Aquatic Vegetation Control Total Phosphorus Concentrations in Lake Okeechobee? by R. Thomas James, Senior Supervising Environmental Scientist, Lake Okeechobee Division, South Florida Water Management District, West Palm Beach, FL 33416

Total phosphorus (TP) in Lake Okeechobee increased from an annual average of 54 ppb in 1973 to 93 ppb in 1980, remaining at that concentration or greater ever since. A simple mass-balance model of TP failed to track this increase. A moderately sophisticated eutrophication model, the Lake Okeechobee Water Quality Model, also failed. A number of mechanisms to explain the TP increase have been proposed: reduced sediment P assimilative capacity, reduced calcium concentration that co-precipitates with P, and increased lake level that increases the open water area and increases the P exchange to the water column. An alternate explanation involves submerged aquatic vegetation (SAV). When lake levels are high for long periods, light reaching the lakebed declines, reducing SAV. This reduction in SAV increases the potential for sediment and associated P to be resuspended into the water column. As lake levels decline and light reaching the lakebed increases, SAV increases, reducing sediment and P resuspension and reducing P concentrations in the water column. When a hypothetical SAV model was added to the simple mass-balance model, simulated annual average P concentrations closely matched observed concentrations for 1973 to 2000. Although this does not prove that SAV is responsible for the changes of TP in the lake, it does suggest that this mechanism should be evaluated.

Molecular characterization of the benthic cyanobacterial bloom-former *Lyngbya wollei* in freshwater environments by Jennifer J. Joyner, Graduate Student; Hans W. Paerl, Kenan Professor, Institute of Marine Sciences, University of North Carolina at Chapel Hill, 3431 Arendell Street, Morehead City, NC 28557, and John Burns, Director, CyanoLab-BCI Eng.&Sci., Inc., Palatka FL 32177

Lyngbya is a cosmopolitan, non-heterocystous benthic cyanobacterial genus found in both freshwater and marine environments. *Lyngbya* often occurs in nutrient-deprived waters, but can also undergo explosive growth in response to nutrient enrichment. Fishermen and swimmers have experienced respiratory irritation, eye inflammation, and contact dermatitis from exposure to *Lyngbya* blooms. *L. wollei* blooms are a recent and growing problem in Florida's springs and nearby receiving waters. Many bloom-forming cyanobacteria utilize nitrogen (N_2) fixation for obtaining biologically available nitrogen under N-limited conditions. The *nif*H gene, which encodes for the Fe protein subunit of the N_2 fixing enzyme nitrogenase, is highly conserved and therefore useful for identifying and characterizing N_2 fixing organisms. Using a protocol that removes potentially inhibitory (for the PCR reaction) extracellular polymeric substances (EPS) without damaging the DNA, we extracted and amplified the *nif*H gene from diverse *Lyngbya* species in Florida, North Carolina, Australia, and Guam, including *L. wollei*. We are using *nif*H sequence data to identify and characterize closely related, but potentially harmful, *L. wollei* strains capable of rapid expansion and toxic bloom formation. Phylogenetic analysis shows a high degree of similarity between the Florida Springs and North Carolina lake strains. Results from a field study of *L. wollei* in City Lake, NC in September 2001 show that the *L. wollei* bloom fixes N_2 in the early morning hours. In order to more fully clarify nutrient controls on these N_2 fixing strains, we are culturing *L. wollei* from Florida Springs and City Lake, NC using both solid and liquid media with and without nitrogen and phosphorus enrichment.

Introduced tropical freshwater fishes in Florida by William F. Loftus, USGS- Florida Caribbean Science Center, Everglades National Park Field Station, 40001 State Road 9336, Homestead, FL 33034

South Florida has an abundance of introduced tropical freshwater fishes because of its climate and proximity to sources of introduction. Most species belong to the cichlid family from tropical America and Africa. Other abundant species include a clariid catfish, a synbranchid eel, and a piscivorous poecilid. Newly introduced species are frequently reported. Most are the result of aquarium releases although a new pathway through the live foodfish industry is now suspected.

Some species display a pattern of rapid population growth followed by declines, then persistence at low densities. Estuarine areas, natural creeks and adjacent marshes, and man-made canals have the highest numbers of individuals and species. Undisturbed marshes and alligator ponds away from the influence of canals generally hold fewer individuals of introduced fishes. These patterns suggest that the species presently introduced in southern Florida may not be as successful in the seasonal marshes of the Everglades as they have been in canals. Introduced species reach their greatest abundances in canals, probably because this deep-water habitat offers relief from drought and cold.

Use of ribotyping for the Identification of sources of fecal pollution in environmental waters by George Lukasik, Biological Consulting Services of North Florida, Inc., Gainesville, FL USA; T.M. Scott, College of Marine Science, University of South Florida, St. Petersburg, FL USA, and S. R. Farrah, Department of Microbiology and Cell Science, University of Florida, Gainesville, FL USA

The fecal coliform, *Escherichia coli*, has been used as an indicator of human enteric pathogens and fecal pollution for many years. However, its presence is not limited to the human reservoir, but also is excreted in the feces of many other warm-blooded animals. Consequently, when detected in water with conventional bacteriological tests, its source and the full extent of potential human health risks cannot be determined. Understanding the origin of fecal pollution allows resource managers to assess mitigation options once a problem has been identified. Currently, no such tool is available to us that is reliable in identifying the source of *E. coli* of both human and non-human origin to the species level. Recent studies have reported on the use of genotypic and phenotypic based microbial source tracking (MST) methodologies. The genotypic methodologies are of interest due to their inherent stability and reproducibility. Ribotyping has been recently repeatedly documented as a powerful MST technique. We have been actively collecting and building a ribotype source isolate library for the past 3 years for use in tracking and identifying sources of fecal pollution. Our research results do indicate that this procedure can still be used effectively to differentiate human or animal derived *E. coli* over a broad geographic region.

Long term Chlorophyll trends in relation to Harmful Algal Blooms in selected North Florida Lakes by Seán E. McGlynn, Ph.D., President, McGlynn Laboratories, Inc., 568 Beverly Court, Tallahassee, Fl., 32301 and Adjunct Professor, Florida State University, Department of Biological Science

Long term trends in algal populations in selected north Florida Lakes indicate that as lakes increase in trophic status, macrophyte communities change from aquatic grasses, adapted to exist in nutrient deserts, with high root to shoot biomass specializing in extracting nutrients from the sediments, to aquatic herbs whose filamentous branches are specialized for extracting available nutrients from the water column. Eventually, as the trophic state increases the lake will loose its macrophyte population and become plankton dominated. There is a predictable pattern of succession in Florida lakes from aquatic grasses, to aquatic herbs and finally to plankton dominated systems. If the lake is dominated by blue green algae or cyanobacteria, we are identifying health risks associated with these algae.

When phosphorus concentrations cease to be limiting, primitive cyanobacteria begin to dominate algal populations since these cyanobacteria can fix atmospheric nitrogen. They can produce toxins and they possess a competitive advantage over other types of plants. Phytotoxins are designed to decrease grazing and inhibit competition from other plants. Many are harmful to humans, hence the term HAB, or HARMFUL ALGAL BLOOM. Algal blooms, composed of potentially harmful species of cyanobacteria such as *Microcystis aeruginosa, Anabaena spiroides*, and *Anabaena limnetica*, are naturally occurring in Florida waters. These algae can periodically produce toxins. Introduced species such as *Cylindrospermopsis* always produce toxins. A simple method of screening for algal blooms is the field chlorophyll sensor.

Furthermore, Field Chlorophyll sensors reveal that Algal blooms are able to migrate within the water column in order to optimize light regimes. Gas vesicles can change the relative buoyancy of these algal cells. High intensities of light cause photosaturation, and will eventually damage the chlorophyll molecule and eventually cause chlorosis or bleaching of the plant followed by death. Algal blooms can migrate within the water column to optimize their aquatic light regime. They often dive or sink to avoid the hot noon sun, but will rise to the surface under low light conditions.

Lake Jackson's Natural Drawdown and Restoration by Seán E. McGlynn, PhD., President, McGlynn Labs, Inc., 568 Beverly Court, Tallahassee, FL 32301 and Kevin R. Pope, Water Resources Manager, Berryman and Henigar, Inc., 3200 Commonwealth Blvd., Suite 101, Tallahassee, FL 32303 and.

An overview and update is provided of the restoration of Lake Jackson, in Leon County, highlighting the dramatic changes which have occurred during lake refill, including rapid development of native fish and plant communities as well as regrowth of exotic aquatic vegetation.

Two tropical storms dumped over twenty inches of rain on the Florida Panhandle during the 2001 Hurricane season rehydrating area lakes, including Lake Jackson. The extended drought and the exceptionally dry summer months of 1999 had caused water levels in Lake Jackson to drop rapidly. The central portion of Lake Jackson, a 4001-acre, closed-basin lake, designated an Outstanding Florida Waterbody and Aquatic Preserve, vanished into Porter Hole Sink on September 16, 1999, exposing 750 acres of lake bottom. Anglers were traveling from as far away as the Carolinas congregated to catch trophy bass before they plummeted into the Floridan Aquifer.

The focus was to restore two southern arms of the lake; Meginniss and Fords Arms, which are on the receiving end of tributaries that drain heavily urbanized portions of the watershed, including Interstate 10. A one-to-three foot deep layer of organic muck overlaying the sandy natural lake bottom was removed. Lead 210 dating has shown that the organic muck layer is of recent historic origin. The total project funding exceeded 8 million dollars, and resulted in the removal of about 2 million cubic yards of organic muck.

Exploration of the caverns began soon after flow into the Porter Hole Sink ceased. The cavern to the southeast leads to submerged caverns and is the potentiometric surface of the Floridan Aquifer, measured 278.8 feet in length. Portions of northern Lake Jackson once were canyons 100 feet deep. Water coursing through the ravine leading to Porter Hole Sink, sink uncovered 10,000 year old tree stumps, evidence of the ever changing plant communities within the Lake Jackson basin. An acceptance rate of 12 cfs was measured at Porter Hole Sink. Now the water has returned, divers on Porter Hole Sink have found that it is still open flowing into the Floridan Aquifer at a similar rate as when the Lake was dry.

Initial Response by Wading Birds to Kissimmee River Restoration by Stefani L. Melvin, Kissimmee Division, Watershed Management Department, South Florida Water Management District, 3301 Gun Club Road, West Palm Beach, Florida, 33406.

Aerial surveys were conducted monthly by helicopter to determine initial changes in wading bird use of the Kissimmee River floodplain following completion of the first phase of construction. Dry season densities of nine wading bird species, Great Blue Heron (*Ardea herodias*), Great Egret (*Ardea alba*), Wood Stork (*Mycteria americana*), Little Blue Heron (*Egretta caelurea*) Tricolored Heron (*Egretta tricolor*), Snowy Egret (*Egretta thula*), White Ibis (*Eudocimus albus*), Glossy Ibis (*Plegadis falcinellus*), and Cattle Egret (*Bubulcus ibis*) were compared in non-restored (Pool A) and restored (Pool C) portions of the floodplain and relative to baseline (pre-construction) survey data. Mean monthly wading bird density in Pool C increased 114% after construction and was significantly greater than in Pool A. In the restored section, mean relative abundance of Cattle Egrets, Great Egrets, Little Blue Herons, and Wood Storks decreased while means relative abundance of Great Blue Herons, Glossy Ibis, Snowy Egrets, Tricolored Herons, and White Ibis increased. These and subsequent avian response data will be included in the comprehensive restoration evaluation program to evaluate success of the restoration project. Expected responses include increased density of Wood Stork and other wading birds, and an associated decrease in relative abundance of the naturalized Cattle Egret on the restored floodplain.

Precision Release, Advancements In Product FormulationTechnology for Sonar Herbicide by Mark S. Mongin, SePRO Corporation, 11550 N. Meridian St., Suite 600, Carmel, IN 46032. Presenter: Lonnie Pell, Aquatic Specialist, SePRO Corporation

Since the commercial introduction of Sonar aquatic herbicide in 1986, Lake Managers have strived to utilize the new tool in a variety of aquatic site situations. Water bodies with heavy flow or high rates of dilution are especially challenging for the utilization of conventional Sonar SRP (Slow Release Pellet). Measuring the concentration of Sonar coming off of the SRP pellet was also very difficult, as detectable concentrations were seldom present in values useful for decision making.

Sonar* Precision Release* was developed to provide a faster, more predictable release of fluridone in convenient and economical to apply pellet formulation. This results in improved consistency of weed control in aquatic systems with measurable water flow rates that may cause herbicide dilution. Improved efficacy can also be expected where target plant populations require a higher threshold dose of fluridone.

Sonar Precision Release possesses a unique release profile. With a faster release than current SRP formulations and longer-lasting residuals than Sonar A.S., Sonar Precision Release delivers enhanced performance in difficult treatment sites. A review of this new technology will be provided with results and discussion of the new product's performance in Midwest trials.

**Trademark of SePRO Corporation*

Exotic plant management in Florida's national parks by Tony Pernas, U.S. National Park Service, Everglades National Park Field, 40001 State Road 9336, Homestead, FL 33034

Invasive plants interfere with natural functions and recreational activities in all of Florida's three national parks and fifteen national wildlife refuges. Invading plants include *melaleuca* in Everglades sloughs, Old World climbing fern and leatherleaf in mangrove forests, and Chinese tallow, Asian privet, and Japanese climbing fern in north Florida properties. Each property is inventoried for invasive species, management plans developed and implemented. Management activities must prevent adverse impacts to native flora and fauna at each property, all of which harbor endangered species.

Cyanobacteria Monitoring in the Harris Chain of Lakes in Lake County, Florida -- Which is a Bigger Problem, the Cells, the Data or the Media? by Michael J. Perry, Executive Director, Lake County Water Authority, 107 N. Lake Avenue, Tavares, Florida 32778

Extremely high counts of cyanobacteria in the Harris Chain of Lakes has been the subject of considerable media attention. The media has relied on occasional samples and from that limited information has made several broad sweeping assertions regarding the toxic properties of the lakes. The Harris Chain of Lakes is a major lake chain in Lake County, Florida, which has become extremely degraded. The Board of Trustees of the Lake County Water Authority desires to take management actions based on fact. As such, they have started a biweekly monitoring program to determine the cyanobacteria populations and the toxic properties associated with the presence of the cells. The data available will be presented as will a discussion of the use and potential abuse of the information generated as a result of the monitoring program.

Development of a protocol: Monitoring for microcystins by ELISA at Lake Manatee by Karen Pettit, Chemist, and Mark Simpson, Laboratory Supervisor, Manatee County Water Treatment Plant QC Laboratory, Bradenton, Florida

A protocol was developed for monitoring microcystins utilizing a commercially available enzyme linked immunosorbent assay (ELISA) kit at Manatee County Water Treatment Plant QC laboratory. Evaluation of the kit yielded a method detection limit (MDL) of 0.035 ug/l with a practical quantitation limit (PQL) of 0.105 ug/l. The protocol was determined to be useful for detection of low concentrations (<0.120 ug/l), but the reliability of quantitation at those levels was suspect. Check standards, at a concentration of 0.15 ug/l, had recoveries ranging from 73% to 126% with an average recovery of 103.3%, similar to many other organic analytical recoveries. The World Health Organization guideline for microcystin-LR, 1 ug/l, can be measured by this protocol.

Lake Manatee, a shallow, 729 hectare, eutrophic reservoir located in eastern Manatee County serves as the drinking water source for 2/3 of the water consumed by 250,000 people in Manatee and Sarasota Counties. The lake has periodic summertime blue green algae blooms of *anabaena* and *oscillatoria/planktothrix*. *Microcystis aeruginosa* has also been noted in small numbers. These three cyanobacteria have, in other parts of the world, produced toxins (microcystins) that are injurious and sometimes lethal to animals and people. For this reason it was decided to develop a lake monitoring protocol at Manatee County Water Treatment Plant QC Laboratory. This paper will describe the evaluation process of the kit, show how one utility is using this as part of their routine monitoring program for raw and finished water, and provide some procedural helpful hints to maximize data quality.

Experimental manipulations to assess phytoplankton-nutrient relationships in Lake George by Michael F. Piehler, Research Assistant Professor, Julianne Dyble, Ph.D. Candidate, Amy Waggener, Research Technician and Hans W. Paerl, Kenan Professor. UNC-CH Institute of Marine Sciences, Morehead City, NC 28557 and Andrew Chapman, Staff Phycologist, CyanoLab-BCI Eng. & Sci., Palatka, FL 32177

Nutrient bioassays were conducted on samples from Lake George to assess the relationship between phytoplankton community structure and function and nutrient concentrations. Experiments were conducted seasonally for 2 years. Nutrient treatments included nitrogen (N) and phosphorus (P) additions and dilutions. Primary productivity (^{14}C bicarbonate incorporation), biomass (fluorometric chlorophyll *a* analysis), taxonomic composition (HPLC diagnostic photopigment analysis) and phytoplankton species composition (microscopy) were assessed following experimental manipulations. Phytoplankton biomass and primary productivity were most often co-limited by both N and P. Cyanobacteria (particularly *Cylindrospermopsis raciborskii*) were able to respond favorably to either N or P enrichment. Abundance of *C. raciborskii* increased in response to N additions while N_2 fixation and the number of heterocysts per cell was increased by P additions. These data support consideration of management of both N and P to control phytoplankton productivity in Lake George.

Implementing a Successful TMDL Process by Kevin R. Pope, Water Resources Manager, Berryman and Henigar, Inc., 3200 Commonwealth Blvd., Suite 101, Tallahassee, FL 32303 and Seán E. McGlynn, Ph.D., President, McGlynn Labs, Inc., 568 Beverly Court, Tallahassee, FL 32301.

Successful implementation of the Total Maximum Daily Load (TMDL) process is a complex and time-consuming task that will require full utilization of all available resources, including those of all levels of government, business, and the public. In order for TMDL's to actually be implemented and achieve measurable water quality improvement, rather than lengthy litigation, there must be broad based support for the concept and process by which the TMDL's were set and allocated. Such broad support is best achieved by early and complete inclusion of all parties. The high cost of implementing the capital projects required to meet TMDL limits will require considerable public funding, at levels best achieved by aggressive inclusion of public comment throughout the entire TMDL process.

Data used to support impaired waters listing and TMDL setting and allocation must be sufficiently robust to reassure the public of the necessity of the limits set and to withstand legal challenge during the allocation phase. All appropriate and available data need to be incorporated into the STORET database and included in TMDL assessments. Even in the early phases of impaired waters determination, accurate and appropriate data are necessary to ensure that resources are focused on the waterbodies most in need of improvement.

Based upon experiences with on-going projects in Group 1 basins, suggestions are made regarding improvements to the data acquisition and analysis process and the inclusion of stakeholder input.

Design of Lake Armistead Water Control Structure Using an Integrated Surface Water/Groundwater Modeling Software by Clay Richardson and Subrata Bandy, Ayres Associates; Adam Munson and David Arnold, Southwest Florida Water Management District.

Ayres Associates has been retained by Southwest Florida Water Management District to design a water control structure in the Rocky Creek Watershed at the outlet of Lake Armistead in Northwestern Hillsborough County. The surrounding area is rich in water resources with dozens of lakes in the vicinity, and has been impacted by three nearby municipal wellfields. Lake Armistead is the most downstream in a chain of five lakes. In addition to impacts from the wellfield, Lake Armistead as well as the other upstream lakes have been altered due to bottom dredging and spoiling within the cypress ring around the lake shore. The goal of this project is to increase water level elevations in Lake Armistead, thus enhancing both the esthetics and the natural systems contiguous with the lake.

The analysis to determine adverse offsite impacts is being performed with the Mike SHE/Mike 11 integrated surface water/groundwater modeling software. The Mike SHE (hydrologic) component of the model is fully distributed with 100 square meter grid cells. The saturated zone is represented by three aquifers, the Floridan, intermediate, and the surficial and flow is predicted with the full Darcy Equations in three dimensions. The unsaturated zone is represented by a one layer and flow is predicted using a form of Richards Equation that ignores the tension term. Overland flow is two dimensional based on a 1"=1000 foot scale, 2 foot contour interval DEM. Potential evaporation is met from the tree canopy, surface ponding, the unsaturated, and the saturated zone. The Mike 11 (hydraulic) component of the model is fully integrated with the SHE (hydrologic) component of the model, and solves the full St. Venaunt equations, so as to characterize backwater effects and hydraulic energy losses. Mike 11 features particularly detail structure operations options, which provide the ability to model the historic water control structure operations of the upstream lake chain with records provided by the owner agency.

The model has been calibrated with 3 year long simulations. The model results had to match historic Floridan aquifer potentiometric levels, and lake and surficial aquifer water levels. The calibrated model is now being used to simulate various water control structure configurations and types. The model results provided the ability to evaluate the changes in to the lake's water surface elevation in terms of stage-duration. With reliable predictions of stage-duration, potential ecological and esthetic benefits derived from the proposed structure could be thoroughly evaluated.

An overview of Florida DEP's invasive plant management programs by Jeff Schardt, Fla Department of Environmental Protection, Bureau of Invasive Plant Management, 3900 Commonwealth Blvd.,Tallahassee.

DEP's Bureau of Invasive Plant Management oversees state funds to manage invasive plants on public properties of the State. The program is administered by two sections, one predominantly aquatic and another for uplands. Approximately $30 million are available each year between the two programs. Local cooperators submit annual work plans which are then evaluated and prioritized to allocate funds to the properties managed by the cooperators. Cooperators include state parks, local governments, water management districts and others.

DEP allows local entities to manage invasive plants with their own staff, contractors or resources. Also, DEP-contracted companies can be made available to do the work. Contracts supporting large, ongoing projects may be executed for 10-year periods granting one total amount to the cooperator. This minimizes paperwork associated with execution of contracts and makes funds readily transferable from one cooperator to another, allowing the best use of funds.

The Coliforms and the Need for Alternative Indicators by Troy M. Scott and Joan B. Rose, University of South Florida, College of Marine Science, St. Petersburg, FL 33701

Indicator microbes are used to predict and/or minimize the potential risk from pathogenic microbes. Indicator organisms are useful in that numerous pathogens may be transmitted via a water route. Indicators circumvent the need to assay for each and every pathogen. Ideally, indicators are rapidly detected, easily enumerated, and have survival characteristics that are similar to those of the pathogens of concern.

Fecal coliforms have been used extensively for many years as an indicator for determining the sanitary quality of surface, recreational, and shellfish growing waters. In recent years, scientists have learned more about the ways in which the coliforms' ecology, prevalence, and resistance to stress differs from many of the pathogenic microorganisms they are proxy for. These differences are so great that they limit the utility of fecal coliforms. Therefore, additional microbes have been suggested for use as alternative indicators, including *E. coli*, enterococci, *Clostridium perfringens*, male-specific coliphages, and bifidobacteriaphages. Alternative chemical indices have also been suggested as complements to fecal coliforms. These include coprostinol or caffeine compounds. A drawback to these alternatives is that their ability to assess risk from water usage is unclear.

Before alternative indicators replace or augment fecal coliforms, their application must be specifically defined to ensure that they provide more information than the coliforms themselves in reflecting health risk.

The Development and Implementation of the Lake Okeechobee phosphorus TMDL
by Kim Shugar, Florida Department of Environmental Protection, Tallahassee, FL, 2600 Blairstone Road, MS 3500, Tallahassee, FL 32399

Over the past decades, Lake Okeechobee, Florida's largest lake, has experienced a steady decline in water quality resulting from the delivery of nutrient-rich stormwater runoff from activities in the watershed coupled with the release of phosphorus from the lake's underlying mud, where past phosphorus loads have accumulated. In November 1999, the Florida Department of Environmental Protection initiated the development of the phosphorus TMDL as required by the Florida Watershed Restoration Act, Section 403.067, Florida Statutes. Substantial stakeholder participation at public meetings and the convening of a technical advisory committee highlighted the two-year long process that was completed in May 2001. The attention given to this process and the stakeholder involvement has set a favorable stage for implementing the TMDL and restoring Lake Okeechobee. The implementation of the TMDL using phased watershed-based approach to reduce phosphorus loadings to the lake and downstream receiving waters is outlined in the Lake Okeechobee Protection Act, section 373.4595, Florida Statutes. This legislation and associated state appropriations coupled with stakeholder agreement and cooperation has given the initial support required to begin a successful restoration project.

Florida LAKEWATCH Program by Daniel J. Willis, Department of Fisheries and Aquatic Sciences, University of Florida, 7922 NW 71st Street, Gainesville, Florida 32653

The Florida LAKEWATCH program is a citizen based water chemistry monitoring program in which volunteers work with researchers to collect basic water chemistry information on Florida lakes and some coastal waters. Florida LAKEWATCH was initiated at the University of Florida in 1986. In 1990, the Florida Legislature recognized the importance of involving citizen volunteers in monitoring water quality and officially established the Florida LAKEWATCH program within the Department of Fisheries and Aquatic Sciences/Institute of Food and Agricultural Sciences. Over 1500 water bodies have been sampled throughout the life of LAKEWATCH and currently, the program has approximately 650 active lakes with 75 lakes that have been sampled for more than 10 years and approximately 300 lakes that have been sampled for more than 5 years. Florida LAKEWATCH has three primary objectives: 1) build long-term baseline water chemistry data on as many lakes as possible, for current and future trend analyses both within individual lakes and among the Florida population of lakes, 2) research goals of examining the Limnology within and among Florida lakes and 3) outreach to help citizens of Florida understand the Limnology of Florida lakes and help them learn how best to manage their individual lake. Accomplishing these objectives,

LAKEWATCH Staff recruit, train, and equip volunteers to sample their lake once per month for total phosphorus, total nitrogen, chlorophyll, and water clarity which are the core variables for the program. Staff also meet with the volunteers annually at regional meetings where data are returned, discussed and outreach information given to the volunteers along with answering management questions the volunteers may have. Based on feedback from the volunteers, Florida LAKEWATCH has expanded into new areas to respond to questions where there is little or no data available. Currently, Florida LAKEWATCH is expanding data collecting from selected lakes in the following areas: 1) additional water chemistry parameters, 2) aquatic plant sampling, 3) bathymetric maps, 4) fish populations, 5) bird populations, 6) total and fecal coliforms, and 7) development of lake management plans for individual lakes using a modified TEAM Approach (Canfield & Canfield, 1994.

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Symposium Schedule

Tuesday June 11

8:00 - 5:00 Registration
8:20 - 8:30 Welcome and Opening Remarks
8:30 - 9:50 **Session 1: Ecology and Management of Cyanobacteria Blooms**
9:50 - 10:10 Break (refreshments provided)
10:10 - 11:50 **Session 2: Ecology and Management of Cyanobacteria Blooms**
11:50 - 1:20 Lunch (On Your Own)
12:00 - 2:00 Board Meeting (**Goodland Room**)
1:20 - 3:00 **Session 3: Fish and Wildlife Studies**
3:00 - 3:20 Break (refreshments provided)
3:20 - 5:00 **Session 4: Watershed Action for Lake Remediation**
5:15 - 6:15 Exhibitors Reception

Wednesday June 12
8:00 - 5:00 Registration
8:20 - 8:30 Announcements and Door Prizes
8:30 - 10:10 **Session 5: Water Level Fluctuation & Aquatic Macrophytes**
10:10 - 10:30 Break (refreshments provided)
10:30 - 11:50 **Session 6: Human Health Issues/Exotic and Invasive Species**
11:50 - 1:50 Banquet Lunch Provided / Awards / Business Meeting
Everglades Dining Room
1:50 - 3:30 **Session 7: Exotic and Invasive Species**
3:30 - 3:45 Break (refreshments provided)
3:45 - 5:05 **Session 8: Water Quality / Water Quality Modeling**
7:30 - 9:00 Sunset Beach Party (Drinks and Snacks Provided)
Coconut Grove Beach area

Thursday June 13
8:20 - 8:30 Announcements and Door Prizes
8:30 - 10:10 **Session 9: Total Maximum Daily Loads**
10:10 -10:30 Break (refreshments provided)
10:30 -11:50 **Session 10: Critical Issues in Lake Restoration**
11:50-12:00 Closing Remarks
12:00 Adjourn