LAKE ECOSUMMARY

Lake Weir, October 28, 2010

The Department of Environmental Protection (DEP) conducted chemical and biological sampling at Lake Weir in Marion County on October 28, 2010 in response to complaints about rapidly changing water quality. Overall, the water quality indicated an impairment of nutrients and chlorophyll *a*. Plant community data indicated that the lake met expectations for a healthy, well-balanced lake, but phytoplankton data indicated a potential imbalance in the algal community.

Background

Although healthy, well balanced lake communities may be maintained even with some level of human disturbance, human activities may result in lake degradation. Human stressors include increased inputs of nutrients, sediments and/or pesticides from watershed runoff, alteration of native shoreline and/or upland buffer vegetation, and introduction of nuisance (generally exotic) plants and animals. DEP has methods to evaluate if human activities have resulted in the condition where a particular waterbody has exceeded water quality criteria (Chapter 62-302, Florida Administrative Code), including whether adverse impacts to biological communities have occurred. DEP water quality standards are designed to protect designated uses of the waters of the state (*e.g.,* recreation, aquatic life support), and exceedances of these standards is associated with interference with the designated use. Chlorophyll *a* is a measure of algal biomass in the water column. In clear, low alkalinity lakes (lakes where color is < 40 PCU and alkalinity is < 20 mg/L $CaCO_2$), a healthy system is expected to have $\leq$ 6 µg/L of chlorophyll *a*. In colored ($\geq$ 40 PCU) lakes or clear, high alkalinity ($\geq$20 mg/L $CaCO_2$) lakes, healthy systems are expected to have $\leq$ 20 µg/L of chlorophyll *a*. Chlorophyll *a* values greater than those shown above may result in unwanted shading of aquatic plants and/or greater potential for harmful algal blooms. The Lake Vegetation Index (LVI) assesses how closely the plant community of a lake resembles a native undisturbed community. These tools are often used in conjunction with one another because it is possible to detect imbalance in the plant community while the algal community appears healthy (and vice versa).

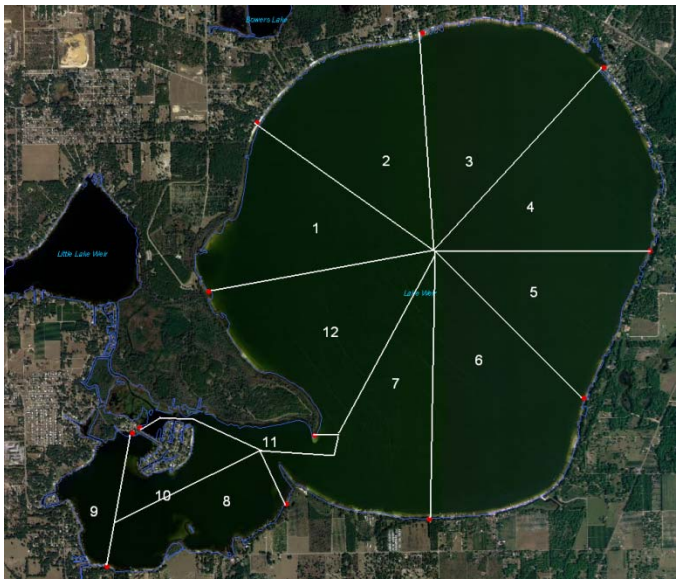
Methods

This lake was sampled on October 28, 2010 by the DEP Central District Office. Surface water samples were collected for analysis of nutrients, chlorophyll *a*, color, and other field measurements following DEP Standard Operating Procedures (SOPs; DEP SOPs can be found at http://www.dep.state.fl.us/water/sas/qa/sops.htm) and met DEP quality assurance/quality control standards (see http://www.dep.state.fl.us/water/sas/qa/index.htm).
For the LVI, species lists were developed for four of twelve sections of the lake (Figure 1), and the following information was derived from those lists: percent native species, percent invasive exotic species, percent sensitive species, and the coefficient of conservatism (C of C; a measure of how tolerant a species is to disturbance) of the dominant species. According to DEP SOP LT 7000, the LVI score ranges and categories are: (78-100) Exceptional; (38-77) Healthy; and (0-37) Impaired. DEP plans to propose a revised impairment threshold, in which scores of 46 and higher fully meet the expectation of a healthy, well balanced community, and scores below 46 are considered impaired. The LVI was sampled per DEP SOP FS7310 and calculated per DEP SOP LT7000.

Site Information

Lake Weir, located in the Ocklawaha River watershed, is approximately 7062 acres in area. The surrounding watershed is primarily composed of low density residential and agriculture. Water enters this system as storm water from the surrounding watershed or from ground water seepage. Lake Weir has minimal upland buffer between dwellings and the lake edge. Aerial photographs show littoral zone vegetation has also severely diminished over time. A 2010 general survey by FDEP Submerged Lands Environmental Resource Permitting division found as many as 200 areas (totaling approximately one linear mile) in which shoreline and littoral vegetation may have been altered around the near fifteen mile perimeter of the lake. Lake Weir has been verified as impaired for nutrients based on annual average Trophic State Index (TSI) values calculated in 2002 and 2008. Lake Weir will potentially be verified impaired for nutrients in 2012 when the federally promulgated numeric nutrient criteria take effect.

Figure 1. Sampling map of Lake Weir. Sections 9, 12, 3 and 6 were sampled for the Lake Vegetation Index. The water quality sample was collected from the lake center.



Results

Water Quality

Chlorophyll *a* measured in Lake Weir (20 µg/L) during the October 28, 2010 sampling event exceeded the federally promulgated criterion of 6 µg/L for clear (≤40 PCU), low alkalinity lakes (≤ 20 mg/L $CaCO_3$)(Table 1). Total Phosphorus (0.012 mg/L) and Total Nitrogen (1.0 mg/L) also exceeded federally promulgated criterion of 0.01 mg/L and 0.51 mg/L respectively. Note that the federally promulgated thresholds require the calculation of an annual geometric mean; a single sample is not used to determine compliance.

Phytoplankton

The algal community in the water column consisted of 15.56% green algae, 72.19% cyanobacteria (blue-green algae), 5.96% diatoms and 4.64% cryptomonads. Dominance in algal groups varies naturally throughout the year, but prolonged dominance of cyanobacteria may be associated with a higher risk for harmful algal blooms. The large proportion of cyanobacteria in the 2010 sampling is cause for concern, as extended dominance of cyanobacteria could lead to imbalances in aquatic flora.

Table 1. Water quality results from October 28, 2010 at Lake Weir.

Analyte	Result	Remark	Applicable Class III Water Quality Criteria
Field Temperature (°C)	26.5		
Field pH (SU)	8.5	J	
Field Dissolved Oxygen (mg/L)	8.59		≥ 5
Field Specific Conductance (µmhos/cm)	225		Not to exceed 50% of background or 1275
Color (PCU)	<5	U	
Chlorophyll *a* (µg/L)	20		*6.0
Total Phosphorus (mg/L)	0.012		* 0.01
Nitrate+Nitrite (mg/L)	<0.004	U	
Ammonia (mg/L)	<0.01	U	
Total Kjeldahl Nitrogen (mg/L)	1.0		
Total Nitrogen (mg/L)	1.0		*0.51

*Federally promulgated numeric nutrient criteria for Florida lakes will take effect in March 2012. Alkalinity sampling by FDEP on February 28, 2011, as well as historic alkalinity data, indicates that the chlorophyll *a* criterion of 6 µg/L is appropriate for Lake Weir.
J – Estimated Value – The field calibration verification did not meet calibration acceptance criteria.
U - Undetected

Lake Vegetation Index

The LVI score for this lake was 69 out of a possible 100 points, corresponding with a "Healthy" designation. Table 2 contains the species list and occurrence information for this sampling event. Several beneficial, native submersed plants were identified: *Vallisneria americana*, *Utricularia foliosa* and *Najas guadalupensis*. The dominant submersed plant was *Nitella*, macro algae generally accepted as beneficial. A total of two Florida Exotic Pest Plant Council (FLEPPC) invasive exotic plant species were observed in the lake: *Ludwigia peruviana* and *Panicum repens*. The Lake Weir LVI score would increase if these species were better controlled and if growth of native species were promoted.

Table 2. Species list for the October 28, 2010 LVI at Lake Weir. An asterisk (*) indicates an invasive exotic plant species. P = present, D = dominant, C = codominant.

Lake Weir October 28, 2010					
Species	COMMON NAME	SECTIONS:	9	12	3	6
Acer rubrum	RED MAPLE		P	P	P	P
Andropogon glomeratus	BUSHY BLUESTEM		P	P	P	P
Baccharis glomeruliflora	SILVERLING		P	P	P	P
Bidens mitis	SMALLFRUIT BEGGARTICKS		P	P	P	P
Cephalanthus occidentalis	COMMON BUTTONBUSH		P			
Cladium jamaicense	JAMAICA SWAMP SAWGRASS		P	P		P
Cyperus odoratus	FRAGRANT FLATSEDGE		P			
Eleocharis elongata	SLIM SPIKERUSH		P			
Eupatorium capillifolium	DOGFENNEL		P	P	P	
Fuirena scirpoidea	SOUTHERN UMBRELLASEDGE		P	P		P
Hydrocotyle	MARSHPENNYWORT		P			P
Ilex cassine	DAHOON		P			
Juncus marginatus	SHORE RUSH; GRASSLEAF RUSH		P			
Lachnanthes caroliniana	CAROLINA REDROOT		P			
Liquidambar styraciflua	SWEETGUM			P		
Ludwigia leptocarpa	ANGLESTEM PRIMROSEWILLOW		P	P		P
Ludwigia peruviana *	PERUVIAN PRIMROSEWILLOW		P	P	P	P
Magnolia virginiana	SWEETBAY		P			
Mikania scandens	CLIMBING HEMPVINE		P		P	P
Myrica cerifera	SOUTHERN BAYBERRY; WAX MYRTLE		P	P	P	P
Myriophyllum	WATER MILFOIL		P			
Najas guadalupensis	SOUTHERN WATERNYMPH		P	P		
Nitella	NITELLA		D	C	D	C
Nuphar	COW LILY		P	P		
Nymphaea odorata	AMERICAN WHITE WATERLILY		P			
Panicum hemitomon	MAIDENCANE		P	C	P	C
Panicum repens *	TORPEDO GRASS		P		P	P
Paspalidium geminatum	EGYPTIAN PASPALIDIUM; KISSIMMEEGRASS		P		P	P
Paspalum repens	WATER PASPALUM					P
Pontederia cordata	PICKERELWEED		P	P		
Potamogeton illinoensis	ILLINOIS PONDWEED		P	P	P	P
Sabal palmetto	CABBAGE PALM		P			
Saccharum giganteum	SUGARCANE PLUMEGRASS		P	P		P
Sagittaria lancifolia	BULLTONGUE ARROWHEAD		P	P	P	P
Salix caroliniana	CAROLINA WILLOW; COASTALPLAIN WILLOW		P	P	P	P
Sambucus canadensis	ELDERBERRY		P			
Solidago	GOLDENROD		P		P	P
Taxodium	CYPRESS TREE		P			
Typha	CAT TAIL		P			P
Utricularia foliosa	LEAFY BLADDER WORT		P			
Vallisneria americana	TAPE GRASS; EEL GRASS		P		P	P
Xyris	YELLOW EYED GRASS		P			

Summary

On this particular sampling event, chlorophyll *a* values measured in Lake Weir exceeded the federally promulgated criterion. Because the federally promulgated criterion is based on annual geometric mean, additional sampling is required to definitively determine compliance with standards. Elevated chlorophyll *a* may be considered aesthetically unfavorable (limiting recreation in the water) and may interfere with healthy biological function. The phytoplankton community was dominated by blue-green algae. If this dominance of cyanobacteria persists, it could lead to an imbalance of aquatic flora. Human stressors such as physical alterations to shorelines and buffer zones, and nutrient loading from the surrounding watershed have likely influenced Lake Weir's condition. As beaches are cleared or enhanced, the buffering and soil stabilization benefits of the littoral zone are reduced. Through wind and wave action, exposed shoreline may be eroded, leading to increased turbidity, decreased light penetration and release of organic nutrients into the water column. As light penetration decreases, conditions become increasingly favorable for algae to become the principle consumer of Lake Weir's nutrients instead of beneficial native submersed plants such as *Vallisneria americana*, *Utricularia foliosa or Najas guadalupensis*. Lake Weir would benefit from a management plan focused on reducing nutrient loads from its watershed, promotion of native submersed and littoral vegetation and upland buffers, and control of submersed and emergent exotic vegetation. Thank you for your interest in maintaining the water quality of Florida's lakes. Please feel free to contact us if you have any questions.

Contact and resources for more information

David Scharr, (407) 894-7555,
david.scharr@dep.state.fl.us

DEP publications on Best Management Practices and Environmental Stewardship and Education:
http://www.dep.state.fl.us/water/nonpoint/pubs.htm
DEP biological assessment resources:
http://www.dep.state.fl.us/water/bioassess/index.htm
FWCC Aquatic Plant Management:
http://myfwc.com/wildlifehabitats/habitat/invasive-plants/aquatic-plant/
Freshwater Algal Bloom information:
http://www.dep.state.fl.us/labs/biology/hab/index.htm