

LAKE ECOSUMMARY

Lake Carlton, July 13, 2011

DEP conducted chemical and biological sampling at Lake Carlton in Orange County on July 13, 2011 to monitor chemical and biological trends in the lake. Overall, the water quality, plant community, and phytoplankton data indicated that the lake did not meet expectations for a healthy, well-balanced lake.

Background

Although healthy, well balanced lake communities may be maintained 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, undesirable removal 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 are 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 CaCO₂), a healthy system is expected to have ≤ 6 µg/L of chlorophyll *a*. In colored (≥ 40 PCU) lakes or clear, high alkalinity (≥ 20 mg/L CaCO₂) lakes, healthy systems are expected to have < 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 July 13, 2011 by the DEP Central District Office. Surface water samples were collected for analysis of nutrients, chlorophyll *a*, color, and alkalinity following DEP Standard Operating Procedures (SOPs; see <http://www.dep.state.fl.us/water/sas/ga/sops.htm>) and met DEP quality assurance/quality control standards (see <http://www.dep.state.fl.us/water/sas/ga/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's new draft F.A.C. Chapter 62.302 requires at least two temporally independent LVIs with an average score of 43 or above in order to meet the expectation of a healthy, well balanced community. The LVI was sampled per DEP SOP FS7310 and calculated per DEP SOP LT7000.

Site Information

Lake Carlton, located in central Florida approximately 30 miles northwest of Orlando, is part of the Upper Ocklawaha River Basin. Lake Carlton has a drainage area of approximately 3,217 acres. According to the Lake Watch website, the lake has a surface area of approximately 397 acres and an average depth of 3 m (9.8 ft). Surface outflow from the lake is toward Lake Beauclair.

Lake Carlton was verified as impaired by nutrients, and was included on the verified list of impaired waters for the Ocklawaha Basin that was adopted by Secretarial Order on August 28, 2002. The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A

target goal for Total Phosphorus concentration was adopted (32 µg/l) with expectations of reducing the amount of chlorophyll *a* to levels more consistent with unimpaired lakes.

To meet the restoration targets specified in the TMDL report, Lake Carlton was included in the Upper Ocklawaha Basin Management Action Plan (BMAP). The action plan was developed in partnership with cities, counties, the St. Johns River Water Management District, Lake County Water Authority, Florida Department of Transportation, Florida Department of Agriculture and Consumer Services, Florida Fish and Wildlife Conservation Commission and other local stakeholders. The BMAP was adopted on August 14, 2007.

Results

Water Quality

The concentrations of total nitrogen and total phosphorus in the sample collected July 13, 2011 exceeded the proposed state water quality criteria and the established TMDL Total Phosphorus concentration (Table 1, note that compliance with lake numeric nutrient criteria involves an annual geometric mean, and is not based on single samples). The chlorophyll *a* concentration was 110 µg/L, over five times the proposed standard of 20 µg/L.

Phytoplankton

The algal community in the water column consisted of 97.36% cyanobacteria (blue-green algae), 1.32% green algae, 0.33% diatoms, and 0.33% 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. During the July 13, 2011 sample event, Lake Carlton's algal community was dominated by cyanobacteria.

Table 1. Water quality results July 13, 2011 at Lake Carlton

Analyte	Result	Comments	Applicable Class III Water Quality Criteria
Field Temperature (°C)	30.6		
Field pH (SU)	8.69		
Field Dissolved Oxygen (mg/L)	9.57		≥ 5
Field Specific Conductance (µmhos/cm)	399		
Alkalinity (mg CaCO ₃ /L)	80		
Color (PCU)	23	A	
Chlorophyll <i>a</i> (µg/L)	110	A	*20
Total Phosphorus (mg/L)	0.039		**0.032
Nitrate+Nitrite (mg/L)	0.004	U	
Ammonia (mg/L)	0.016	I	≤0.02
Total Kjeldahl Nitrogen (mg/L)	2.7		
Total Nitrogen (mg/L)	2.7		*1.05

*proposed 62-302 thresholds for Annual Geometric Mean Total

** TMDL Established Concentration

U - Material was analyzed for but not detected. The reported value is the method detection limit for the sample analyzed.

I - The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

A - Value reported is the mean of two or more determinations

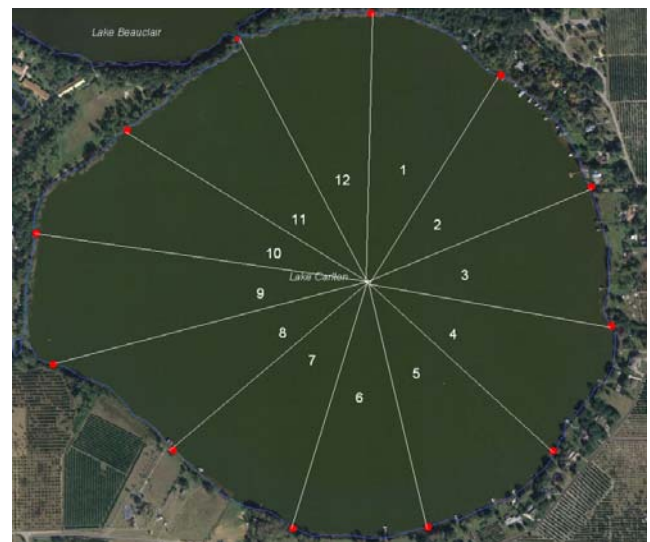


Figure 1. Sampling map of Lake Carlton. Sections [1,4,7,10] were sampled for the Lake Vegetation Index. The water quality sample was collected from the lake center.

Lake Vegetation Index

The LVI score for this lake was 30 out of a possible 100 points, corresponding with a Category III "Not Healthy" designation. Table 2 contains the species list and occurrence information for this sampling event. A total of 11 invasive exotic plants were observed in the lake. One invasive exotic, *Panicum repens*, dominated one section and codominated another.

Table 2. Species list for the July, 13 2011 LVI at Lake Carlton.
An asterisk (*) indicates an invasive exotic plant species.
P = present, D = dominant, C = codominant.

Species	Common Name	Sections:	1	2	3	4
<i>Acer rubrum</i>	RED MAPLE		P	P	P	P
<i>Alternanthera philoxeroides</i>	*ALLIGATOR WEED		P			
<i>Amaranthus</i>	PIG WEED		P	P	P	P
<i>Baccharis glomeruliflora</i>	SALT MYRTLE		P			
<i>Canna</i>	CANNA		P			
<i>Cephalanthus occidentalis</i>	COMMON BUTTONBUSH		P	P	P	P
<i>Cinnamomum camphora</i>	*CAMPHOR TREE					P
<i>Cladium jamaicense</i>	SAWGRASS					P
<i>Colocasia esculenta</i>	*TARO; WILD TARO		P	P	P	P
<i>Cyperus alternifolius</i>	*UMBRELLA SEDGE		P	P		
<i>Cyperus odoratus</i>	FRAGRANT FLATSEDEGE				P	P
<i>Cyperus polystachyos</i>	MANYSPIKE FLATSEDEGE				P	
<i>Cyperus surinamensis</i>	TROPICAL FLATSEDEGE				P	
<i>Dioscorea bulbifera</i>	*AIR-POTATO		P	P	P	P
<i>Echinochloa</i>	BARNYARD GRASS		P	P		
<i>Eichhornia crassipes</i>	*WATER HYACINTH					P
<i>Eupatorium capillifolium</i>	DOGFENNEL		P	P	P	P
<i>Hydrocotyle</i>	MARSHPENNYWORT		P	P	P	
<i>Ludwigia octovalvis</i>	MEXICAN PRIMROSEWILLOW				P	P
<i>Ludwigia peruviana</i>	*PERUVIAN PRIMROSEWILLOW		P	P	P	
<i>Magnolia virginiana</i>	SWEETBAY		P		P	
<i>Myrica cerifera</i>	SOUTHERN BAYBERRY; WAX MYRTLE		P			
<i>Nelumbo lutea</i>	AMERICAN LOTUS		P	P		
<i>Panicum hemitomon</i>	MAIDENCANE				P	
<i>Panicum repens</i>	*TORPEDO GRASS		P	D	P	C
<i>Parthenocissus quinquefolia</i>	VIRGINIA CREEPER; WOODBINE				P	
<i>Paspalidium geminatum</i>	EGYPTIAN PASPALIDIUM; KISSIMMEEGRASS		C	P	D	C
<i>Polygonum</i>	SMARTWEED				P	
<i>Pontederia cordata</i>	PICKERELWEED		P	P	P	P
<i>Sabal palmetto</i>	CABBAGE PALM		P		P	P
<i>Sagittaria lancifolia</i>	BULLTONGUE ARROWHEAD		P	P	P	P
<i>Salix caroliniana</i>	CAROLINA WILLOW; COASTALPLAIN WILLOW		P	P	P	P
<i>Schoenoplectus californicus</i>	BULL RUSH		P		P	P
<i>Taxodium</i>	CYPRESS		P	P	P	
<i>Thelypteris</i>	FERN				P	
<i>Toxicodendron radicans</i>	EASTERN POISON IVY				P	
<i>Typha</i>	CAT TAIL		C	P	P	P
<i>Urochloa mutica</i>	*PARA GRASS		P	P		P
<i>Vallisneria americana</i>	TAPEGRASS; AMERICAN EELGRASS		P		P	
<i>Vitis</i>	GRAPEVINE		P	P		
<i>Wedelia trilobata</i>	*CREEPING OXE EYE				P	
<i>Xanthosoma sagittifolium</i>	*ELEPHANT EAR				P	

Summary

Nutrient levels in Lake Carlton were associated with imbalances in the lake's floral and algal communities. Chlorophyll *a* concentration in Lake Carlton (110 µg/L) during the July 13, 2011, sample event indicates that phytoplankton has become the primary consumer of the lake's elevated nutrients instead of beneficial, submersed native plants.

Consequently, the LVI score (30) was less than expected for a healthy lake when applied to FDEP's proposed calibration of the LVI. The lake was also dominated by blue-green algae (*Cylindrospermopsis raciborskii*), which have the potential to produce toxins (although toxins were not analyzed). Lake Carlton 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

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Lake Carlton's TMDL document:

<http://www.dep.state.fl.us/water/tmdl/docs/tmdls/final/gp1/carlton-tp-tmdl.pdf>

Basin Management Action Plan for Upper Ocklawaha River basin;

<http://www.dep.state.fl.us/water/watersheds/docs/bmap/AdoptedUpOcklawahaBMAP.pdf>

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>