LAKE ECOSUMMARY

Crescent Lake

May 9, 2012

DEP conducted LVI biological sampling, at Crescent Lake in Putnam, and Flagler Counties on May 9, 2012 to assess attainment of designated uses. The St. Johns River Water Management District sampled Crescent Lake on April 17, 2012 as part of the Integrated Watershed Resource Monitoring Status Network probabilistic sampling program. The April chlorophyll *a* value (25µg/L), exceeded the 20µg/L threshold (compliance with lake numeric nutrient criteria involves an annual geometric mean, and is not based on single samples), which suggests a potential for the lake to be in non-compliance with proposed numeric nutrient criteria. The Lake Vegetation Index (LVI) showed the plant community to be a healthy balance of macrophytes, with an overall dominance of submersed plants.

Background

Although healthy, well-balanced lake communities may be maintained with some level of human activities, such 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 water body 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 $CaCO_2$), 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

The LVI was performed on May 9, 2012 by the DEP Northeast District Office. On April 17, 2012 surface water samples were collected by St. Johns River Water Management District for analysis of nutrients, chlorophyll *a*, color, and alkalinity following DEP Standard Operating Procedures (SOPs; see http://www.dep.state.fl.us/water/sas/qa/sops.htm). Additional samples were taken for phytoplankton, Algal bloom identification and analyzed per DEP Biology Section SOP-AB05. Samples were also collected for analysis of sucralose as part of human source tracking effort and analyzed by DEP. (Sucralose DEP Chemistry Section SOP:LC-001-2[EPA 8321b] and EPA 200.8 rev.5.4, respectively).
Sampling and analyses 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, Table 2), 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 has proposed a revised impairment threshold, in which scores of 43 and higher fully meet the expectation of a healthy, well balanced community, and scores below 43 are considered impaired. The LVI was sampled per DEP SOP FS7310 and calculated per DEP SOP LT7500.

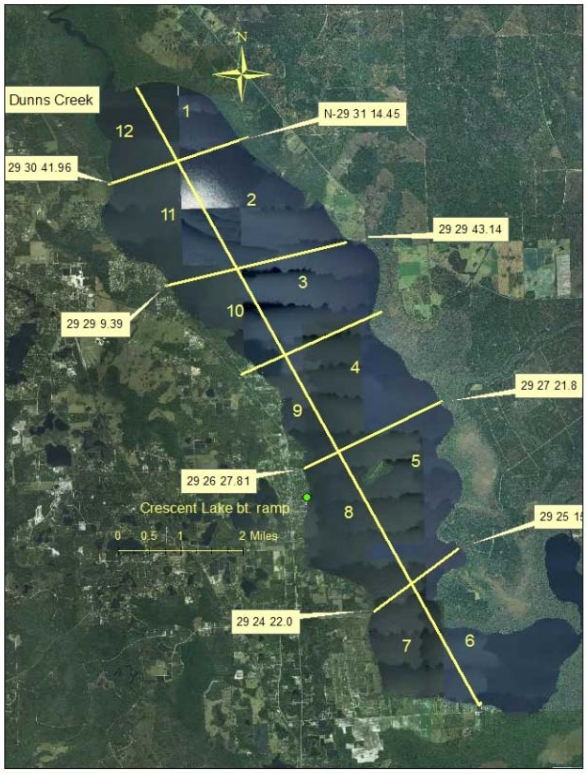


Figure 1. Sampling map of Crescent Lake. Sections [2,5,8,11] were sampled for the Lake Vegetation Index. The water quality sample was collected from the lake center.



Figure 2. Photo of Crescent Lake.

Site Information

Crescent Lake is a large lake divided by two counties, Putnam and Flagler (Figure 2). Crescent lake drains into Dunn's Creek on the north end of the lake which travels five miles downstream to the St. Johns River. Crescent City is on the western shore of Crescent Lake. The Crescent City Wastewater Treatment Plant historically discharged into the lake, but has not discharged to the lake in the last five years; all discharges have gone to land reuse. The lake is not listed for any water quality impairments under the Impaired Waters Rule. Crescent Lake has high natural specific conductance, and high color due to its connection with the tidally-influenced St. Johns River. The Landscape Development Intensity (LDI) Index score for Crescent Lake is 2.02. The LDI score indicates relatively little- development surrounding the lake, and low potential for human disturbance.

Results

Water Quality

The majority of water quality results complied with Class III water quality standards (Table 1). The concentrations of total nitrogen and total phosphorus in the sample collected April 17th did not exceed the proposed state water quality criteria (Table 1, note that compliance with lake numeric nutrient criteria involves an annual geometric mean, and is not based on single samples). However, the chlorophyll *a* value (25 µg/L) exceeded the proposed water quality criteria (20 µg/L). The elevation in chlorophyll *a* values indicates a moderate abundance of algae on the sampling date. The high dissolved oxygen also indicates high amounts of phytoplankton producing oxygen during the day, while at night the oxygen may be depleted by phytoplankton respiration. Boron and sucralose were both detected. The presence of sucralose, an artificial sweetener, indicates human sources (possibly from previous wastewater discharging into the lake). Boron is naturally occurring so further analysis is necessary to determine if the boron detected is from human or natural sources.

Table 1. Water quality results from Crescent Lake, 4/17/2012.

Analyte	Result	Remark	Applicable Class III Water Quality Criteria
Field Temperature (°C)	25.2		
Field pH (SU)	8.5		
Field Dissolved Oxygen (mg/L)	10.0		> 5 mg/L
Field Specific Conductance (µmhos/cm)	1198		Not to exceed 50% of back-ground or 1275 µmhos/cm
Alkalinity (mg $CaCO_3$/L)	85		
Color (PCU)	55		
Chlorophyll a (µg/L)	25		*20 µg/l
Total Phosphorus (mg/L)	0.042		*0.05 mg/l
Nitrate+Nitrite (mg/L)	0.004	U	
Ammonia (mg/L)	0.01		
Total Kejldahl Nitrogen (mg/L)	1.1		
Total Nitrogen (mg/L)	1.1		*1.27mg/l
Boron	60.6		
Sucralose	0.16		

U- Indicated that the substance was analyzed for but not detected

*Federally promulgated numeric nutrient criteria for Florida lakes

Phytoplankton

The algal bloom sample consisted of a dominance of *Anabaena circinalis* (Figure 3), which is a common Cyanobacteria. Other cyanobacteria in the sample included potential toxin producers *Aphanizomenon* and *Cylindrospermopsis*. 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.

Lake Vegetation Index

The LVI score for this lake was 61 out of a possible 100 points, corresponding with a "Healthy" designation. Table 2 contains the species list and occurrence information for this sampling event. A total of 7 invasive exotic plants were observed in the lake. The dominant vegetation for all sectors was *Vallisneria americana* or tapegrass. Vallisneria is submersed vegetation, and provides important habitat for fish and invertebrates.

Table 2. Species list for the 5/9/2012 LVI at Crescent Lake. An asterisk (*) indicates an invasive exotic plant species. P = present, D = dominant, C = co dominant.

Common name	Scientific name	Sections 2	5	8	11
Acer rubrum	RED MAPLE	P	P	P	P
*Alternanthera philoxeroides**	ALLIGATOR WEED*	P	P		P
Amorpha fruticosa	BASTARD INDIGOBUSH; FALSE INDIGOBUSH	P	P	P	P
Andropogon	BROOM GRASS	P	P		
Aster carolinianus	CAROLINA ASTER	P	P	P	P
Baccharis	SALT BUSH		P		P
Bidens mitis	SMALLFRUIT BEGGARTICKS			P	P
Boehmeria cylindrica	FALSE NETTLE; BOG HEMP	P	P	P	
Carex lupuliformis	FALSE HOP SEDGE	P	P		
Carya aquatica	WATER HICKORY	P	P	P	
Centella asiatica	SPADELEAF		P		
Cephalanthus occidentalis	COMMON BUTTONBUSH	P	P	P	P
Cicuta mexicana	WATER HEMLOCK	P		P	P
Cladium jamaicense	JAMAICA SWAMP SAWGRASS		P	P	
*Colocasia esculenta**	TARO; WILD TARO; DASHEEN; COCO YAM*	P	P	P	P
Dichromena colorata	STAR RUSH	P	P		
Echinochloa crusgalli	BARNYARDGRASS	P	P	P	P
*Eichhornia crassipes**	WATER HYACINTH*	P	P	P	P
Eupatorium capillifolium	DOGFENNEL	P	P	P	P
Fraxinus americana	WHITE ASH	P	P	P	P
Hibiscus coccineus	SCARLET ROSEMALLOW	P			
*Hydrilla verticillata**	HYDRILLA*	P			P
Hydrocotyle	MARSHPENNYWORT	P	P	P	P
Hymenocallis	SPIDER LILIES	P	P		
Juncus effusus	SOFT RUSH	P	P		
Juniperus virginiana	RED CEDAR	P	P		
Kosteletzkya virginica	VIRGINIA SALTMARSH MALLOW	P	P	P	P
Lemna minor	COMMON DUCKWEED	P	P	P	P
Liquidambar styraciflua	SWEETGUM	P	P	P	P
Ludwigia leptocarpa	ANGLESTEM PRIMROSEWILLOW		P	P	
*Ludwigia peruviana**	PERUVIAN PRIMROSEWILLOW*		P	P	
Ludwigia repens	CREEPING PRIMROSEWILLOW		P		
Micranthemum glomeratum	MANATEE MUDFLOWER	P			
Myrica cerifera	SOUTHERN BAYBERRY; WAX MYRTLE	P	P	P	P
Najas guadalupensis	SOUTHERN WATERNYMPH	P			P
Nuphar	SPATTERDOCK		P	P	P
Panicum hemitomon	MAIDENCANE	P		P	P
Paspalidium geminatum	EGYPTIAN PASPALIDIUM; KISSIMMEEGRASS	P	P	P	P
Paspalum urvillei	VASEYGRASS	P			P
Phragmites australis	COMMON REED	P	P	P	

Common name	Scientific name	Sections	2	5	8	11
Pinus elliottii	SLASH PINE		P	P	P	P
*Pistia stratiotes**	WATER-LETTUCE*		P		P	P
Polygonum densiflorum	DENSEFLOWER KNOTWEED		P			
Polygonum hydropiperoides	MILD WATERPEPPER; SWAMP SMARTWEED		P	P	P	
Pontederia cordata	PICKERELWEED			P	P	P
Rosa palustris	SWAMP ROSE			P	P	
Sabal minor	DWARF PALMETTO; BLUESTEM PALM		P	P	P	
Sabal palmetto	CABBAGE PALM		P	P	P	
Sagittaria graminea	GRASSY ARROWHEAD		P	P		
Sagittaria lancifolia	BULLTONGUE ARROWHEAD		P	P		P
Salix caroliniana	CAROLINA WILLOW; COASTALPLAIN WILLOW		P	P	P	P
*Salvinia minima**	WATER SPANGLES*		P	P	P	P
Sambucus canadensis	ELDERBERRY				P	P
Saururus cernuus	LIZARD'S TAIL		P	P		
Schoenoplectus tabernaemontani	SOFT-STEM BULRUSH		P	P	P	P
Sesbania punicea	PURPLE SESBAN		P			
Spartina bakeri	SAND CORDGRASS		P	P		
Taxodium	CYPRESS TREE		P	P	P	P
Typha	CATTAIL		P	P	P	
Vallisneria americana	**TAPEGRASS; AMERICAN EELGRASS**		**D**	**D**	**D**	**D**
Woodwardia virginica	VIRGINIA CHAIN FERN		P	P	P	
Zizaniopsis miliacea	SOUTHERN WILD RICE; GIANT CUTGRASS		P	P	P	

Conclusion

The LVI results indicated a balanced macrophyte community. The water samples did not meet Class III Water Quality Standard for chlorophyll *a,* which indicates a moderate abundance of algae (however, the compliance with lake numeric nutrient criteria involves an annual geometric mean, and is not based on single samples). The algal community was dominated by a common blue green alga (cyanobacteria), *Anabaena circinalis*. The sample also contained potential toxin producers *Cylindrospermopsis*, and *Aphanizemenom*. There were approximately a dozen dead fish observed around the lake and according to Fish and Wildlife Research Institute, Crescent Lake has had two fish kill events in the past five years, attributable to low dissolved oxygen and microcystin poisoning. Low dissolved oxygen is the most prevalent cause of fish kills. Algae blooms can also cause a fish kill, when high concentrations of toxins are produced by harmful algal species. Although algae blooms may occur naturally, control of anthropogenic nutrient sources will help prevent human-induced algal blooms from occurring. This can include implementing best management practices to reduce nutrient sources such as wastewater facilities and stormwater runoff from urban and agriculture areas. Considering the results in this report and additional recent fish kills, continued monitoring will be required to determine compliance with proposed nutrient standards.

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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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

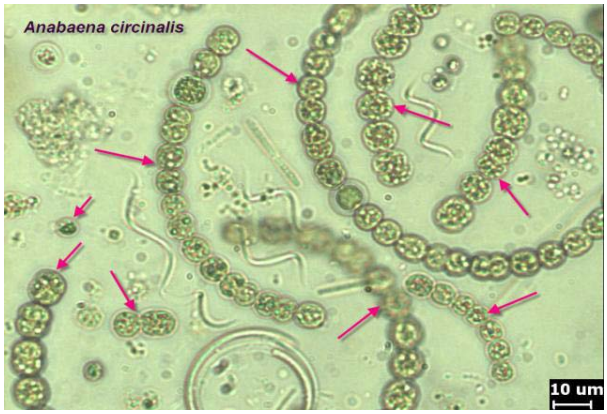


Figure 3. Microscopic image of *Anabaena circinalis*, the dominant species in the algal bloom, (400x magnification, FDEP laboratory).

Fish Kill Hotline-1-800-636-0511
http://myfwc.com/research/saltwater/health/fish-kills-hotline/