Citizen Lake Awareness and Monitoring

2011 Summary of Results

www.eyesonthewater.org/olms

Sponsored by Ohio Lake Management Society

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Introduction

The Citizen Lake Awareness and Monitoring (CLAM) program, sponsored by the Ohio Lake Management Society (OLMS), completed another successful monitoring season by documenting the water quality of twenty-seven lakes throughout Ohio in 2011 (Figure 1). Thirty CLAM volunteers recorded lake water transparency, water temperature, and water color during the months of May through October. Eight Lake Keepers submitted water temperature and dissolved oxygen profiles on nine reservoirs in the Muskingum River watershed. Lake Keepers also collected water samples for the analysis of chlorophyll *a*, nutrients, total suspended sediment, and harmful algal blooms. A summary of results are presented below.

Methods

Trophic State

Water transparency was measured by CLAM volunteers in inches using a Secchi disk during the monitoring season of May to October 2011. Trophic state classifications were determined as mesotrophic, eutrophic, and hypereutrophic for each lake, based on average Secchi depth readings. Air and surface water temperature (^{o}F) were recorded. Water color was determined according to a Custer Color Strip, reported as 1 through 11, corresponding to a color hue as greens through browns, respectively.

CLAM volunteers also submitted information on qualitative parameters; such as cloud cover, rainfall, water level, perceived turbidity and possible reasons, lake management practices, perceptions about water quality, aesthetics, lake impairment, and an estimate on the amount of lake use.

A trend analysis on water transparency was calculated on the Trophic State Index (TSI) for lakes with five years or more of data and presented as a positive or negative average TSI unit change per year.

Water Quality Indicators

Lake Keepers collected additional information at inflow and outflow sites on nine reservoirs owned by Muskingum Watershed Conservancy District (MWCD); including, Atwood, Charles Mill, Clendening, Leesville, Piedmont, Pleasant Hill, Senecaville, Tappan, and Wills Creek Reservoir.

YSI ProODO meters were used to measure seasonal dissolved oxygen (mg/L) and water temperature (^{o}C) depth profiles at one meter increments at the reservoirs' inflow and outflow. A two meter integrated water sample at each site was filtered for chlorophyll *a* (µg/L) and total suspended sediments (mg/l). Water samples were sent to a laboratory for analysis of total nitrogen (µg/L) and total phosphorus (µg/L). Detailed sampling and laboratory protocols, developed by the Ohio Department of Natural Resources Inland Fisheries Research Unit, can be obtained upon request (olms@olms.org).

Harmful Algal Blooms

Composite water samples were collected at boat docks and swimming beaches by the Lake Keepers on the nine MWCD reservoirs in July, August, and September. Samples were preserved and shipped within 24 hours to BSA Environmental Services, Inc., Beachwood Ohio (www.bsaenv.com) for analysis. Algae identification by division as a biovolume (µm^3/L), as well as cyanobacteria genera cell counts per mL and microcystin neurotoxin (µg/L) were measured. For more information about field protocols and laboratory analysis, contact olms@olms.org.

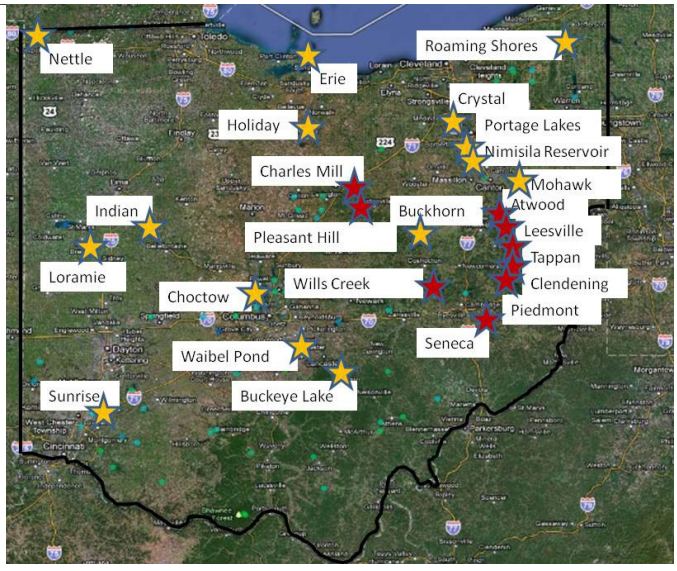

Figure 1:
CLAM lakes monitored in 2011. The Muskingum Watershed Conservancy District owned lakes are indicated in red.

Thirty active CLAM volunteers reported on 27 Ohio lakes in 2011.

Summary of Results

Trophic State

The ranking order for CLAM lakes according to their average Secchi disk transparency in 2011 is shown in Figure 2. Sunrise Lake, Lake Buckhorn, and Lake Mohawk reported the greatest average transparencies at 86.38, 84.52, and 77.20 inches, respectively. The Lake Erie shoreline (Ottawa County) and Piedmont Lake had documented average transparencies at over 54 inches. The lowest average water transparencies were found in Buckeye Lake (10.86 in.) and Lake Loramie (7.92 in.). The remaining twenty CLAM lakes in 2011 reported between 10 and 40 inches of average water transparency.

The average water color in lakes monitored by CLAM volunteers in 2011 all ranged between two and seven (green to yellow) on the Custer Color Strip, except for Crystal Lake at 1.7 (light-green) and Roaming Rock Shores Lake at 8.2 (dark-yellow) (Figure 2). None of the lakes monitored had average readings of 1 (clear) or 9 to 11 (orange to dark-brown).

A trend analysis of the Trophic State Index (TSI) shows increasing or decreasing lake water transparency as a negative or positive average change per year in TSI value, respectively. Only CLAM lakes with five or more years of data were included. Fourteen of the 27 CLAM lakes in 2011 had the necessary data to calculate trends, as presented in Figure 3.

Additional information on individual CLAM lakes, as seasonal graphs and Lake Fact Sheet, can be seen in *Appendix A* or obtained at www.eyesonthewater.org/olms/.

Water Quality Indicators

Chlorophyll *a* as a seasonal average in the nine MWCD reservoirs ranged from 9.47 µg/L for Piedmont Lake to 26.75 µg/L for Atwood Lake. Charles Mill Reservoir measured the highest in seasonal average for total phosphorus at 126 µg/L and nitrogen at 1,330 µg/L. The lowest average values for phosphorus and nitrogen were reported for Piedmont Lake at 54 µg/L and 647 µg/L, respectively. Total suspended solids (TSS) on average ranged from 10 mg/L to the highest value in Wills Creek Reservoir at 65 mg/L.

Seasonal graphs for each MWCD reservoir and comparison graphs on lake averages for chlorophyll *a*, phosphorus, nitrogen, and TSS can be viewed in *Appendix B* or at www.eyesonthewater.org/olms/. Contact olms@olms.org to request additional information on the above results.

Harmful Algal Blooms

Algae identification revealed seven different divisions of algae represented in the MWCD lakes (*Appendix C* or contact olms@olms.org for biovolume, density, and microcystin tables). Cyanobacteria, which are the genera responsible for harmful algal blooms, dominated the waters, according to biovolume ($\mu m^3/L$), during the three month period for Atwood, Clendening, Leesville, Piedmont, Senecaville, and Tappan lakes.

Cyanobacterial density is presented as cell counts per mL for each cyanobacteria genus and as totals per sampling date for each lake. Cylindrospermopsis was the most common genus present in the MWCD reservoirs, except in Charles Mill where Planktothrix dominated the July samples.

All nine reservoirs exceeded the minor bloom threshold of 4,000 cells/mL (ohioalgaeinfo.com) on every sampling date, except August 28, 2011 in Wills Creek Reservoir. Charles Mill Reservoir was the only lake that did not result in cell counts at levels considered to be severe bloom conditions, greater than 100,000 cells/mL. Atwood, Clendening, Pleasant Hill, and Tappan lakes had at least seven or all eight water samples with algae measured as a severe bloom, between 100,000 and 1,080,000 cells/mL.

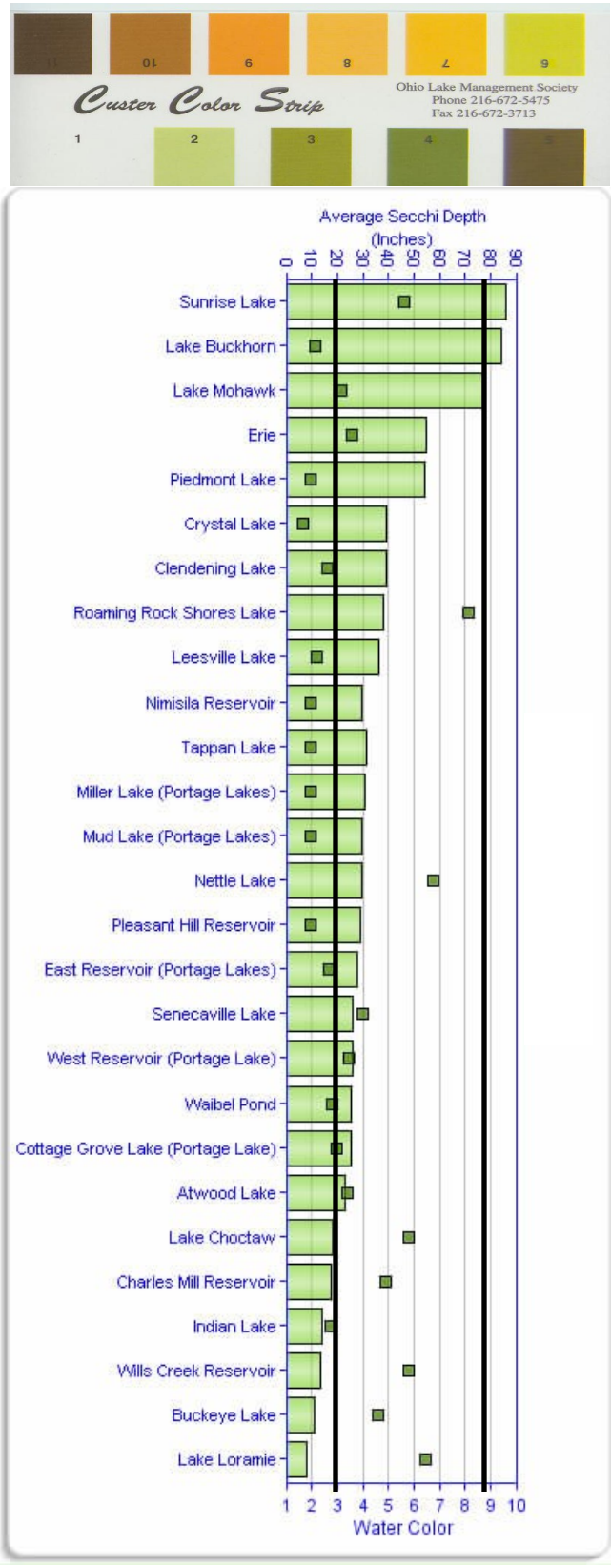

Figure 2:
CLAM lakes in 2011 with average Secchi depth values, recorded in inches, and average water color according to Custer Color Strip. Trophic state classifications are indicated as hypereutrophic (below 20 inches), eutrophic (between 20 and 78 inches), and mesotrophic (above 78 inches).

Microcystin chemical toxin was detected in the majority of the water samples from the nine reservoirs but at concentrations too low to quantify. In samples where the amount could be quantified, the levels never exceeded 1 µg/L, or 1 part per billion (ppb).

Pleasant Hill Reservoir and Tappan Lake had microcystin levels higher than the other seven lakes. Pleasant Hill values were between < .15 ppb to .749 ppb, while Tappan Lake exhibited the greatest toxin levels, ranging from .17 ppb to .991 ppb. Thresholds for a public health advisory and no contact advisory are at 6 ppb and 20 ppb, respectively.

Summary Discussion

Trophic State

Water quality monitoring by CLAM volunteers in 2011 have documented Ohio lakes as, overall; 1) eutrophic or hypereutrophic, 2) influenced by algal turbidity, and 3) changing in water transparency. Nineteen of the 27 CLAM lakes monitored in 2011 are classified as eutrophic. Lake Choctaw, Charles Mill Reservoir, Indian Lake, Wills Creek Reservoir, Buckeye Lake, and Lake Loramie are considered hypereutrophic.

Eutrophic describes a lake condition of low water clarity (Secchi depth 20 to 78 inches) and high productivity with elevated levels of algae and aquatic weeds. These water systems have green water due to algae, no oxygen at the bottom, warm water fisheries, and will have pollution tolerant invertebrate species in the sediments. In the extreme, as hypereutrophic (Secchi depth less than 20 inches), there can be heavy algal blooms, dense aquatic weed, and a complete loss of oxygen causing potential fish kills. These two trophic states are common in Ohio due to soils rich in phosphorus, agricultural practices, land construction, urban encroachment, and heavy land use in the surrounding watersheds.

Transparencies above 78 inches characterize a mesotrophic lake that has a more clear water column, less algae and aquatic weeds, less fish, and a substrate with macroinvertebrates more sensitive to pollution. According to average Secchi transparencies in 2011, Sunrise Lake and Lake Buckhorn are classified as mesotrophic.

Water color provides an indication as to the possible cause of low water clarity. Trophic state classifications and associated lake conditions are only applicable if the transparency is influenced by algae, not dissolved color or suspended sediment.

All of the CLAM monitored lakes exhibited a more green water color, except Roaming Rock Shores Lake that only reported values in October. Results indicate that algal biomass, and not suspended sediment, is influencing 2011 transparency readings. Therefore, classifications as detailed above of mesotrophic, eutrophic, and hypereutrophic for the CLAM lakes is suitable.

Results from the trend analysis suggest that eight CLAM lakes are getting clearer, while five are becoming more turbid. Leesville Lake, Lake Erie, and Lake Loramie are

Ohio CLAM lakes are mainly eutrophic or hypereutrophic.

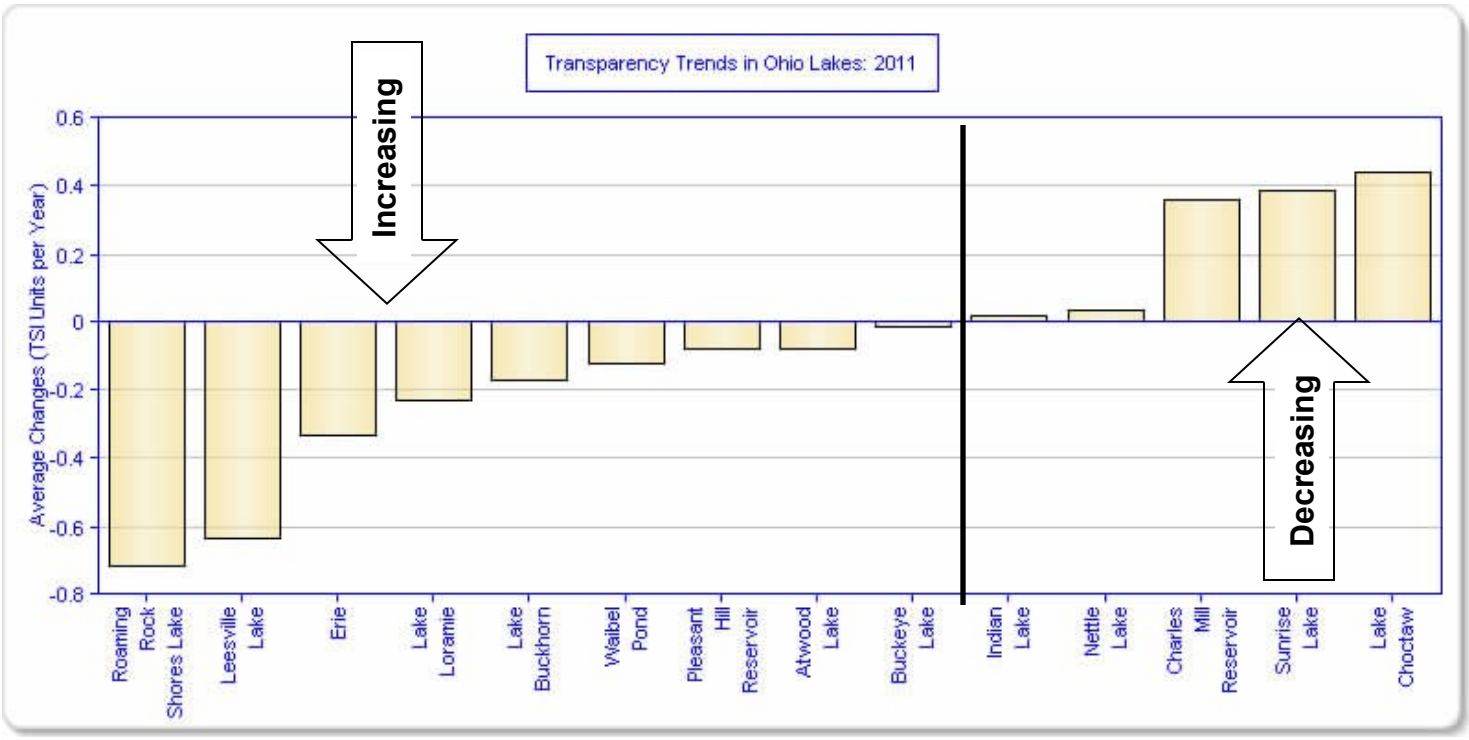

Figure 3:

Change in transparency as an average change in TSI units per year. A negative change is a trend towards a less eutrophic lake (increase in clarity), while a positive change indicates a trend to be more eutrophic (decrease in clarity). Active CLAM lakes in 2011 with five or more years of data are shown.

experiencing greater than 0.2 average change to the negative as an increase in transparency . Roaming Rock Shores Lake showed the greatest change; however, this may have been caused by the fact that 2011 data from this lake is limited to one month.

Charles Mill Reservoir, Sunrise Lake, and Lake Choctow all had positive TSI unit changes per year near 0.4, thus a decrease in transparency. In 2010, Sunrise Lake results indicated the opposite, with a significant increase in transparency. This could be due to the fact that, overall, the average Secchi disk readings from this season were lower compared to 2010.

Water Quality Indicators

In addition to Secchi transparency, chlorophyll *a* and nutrients can be used to explore the trophic state of a lake. A highly productive lake can have a large algal biomass. This is indicated when chlorophyll *a* levels are greater than 20 µg/L (www.secchidipin.org/tsi.htm) .

Five MWCD lakes exhibited levels above this amount, with Atwood Lake and Charles Mill Reservoir showing the greatest values. These two lakes were found to be within the hypereutrophic range, according to average Secchi depth, and thus appear to have lake productivity driven by algae.

Phosphorus is usually the limiting nutrient for algal growth. If measured above 24 µg/L, the lake is considered to be eutrophic. Average phosphorus levels for all nine MWCD lakes were recorded above this level, at 54 µg/L or greater. Charles Mill Reservoir exhibited the highest amount at 126 µg/L. This is consistent with the findings from Secchi transparency, where all lakes were either classified as eutrophic or, as is the case for Charles Mill Reservoir, hypereutrophic.

Wills Creek Reservoir was also classified as hypereutrophic; however, according to the TSS, this lake is influenced by suspended sediment. The TSS value of 65 mg/L in Wills Creek is almost double that found in the other lakes sampled. Wills Creek Reservoir is shallow relative to the others, with an average water depth at 11.58 feet. Re-suspension of bottom sediments could contribute to the low water clarity and high suspended solids in the water column.

CLAM Volunteer Ten+ Club

Robert Biro	*20 years, Lake Erie*
Mark Hausman	*20 years, Atwood Lake*
James Short	*19 years, Nettle Lake*
Robert Waibel	*19 years, Waibel Pond*
Carl Moore	*18 years, Sunrise Lake*
William Lewis	*16 years, Indian Lake*
Steve James	*14 years, Pleasant Hill*
Joseph Stephens	*11 years, Lake Buckhorn*

Table 1:
List of 2011 CLAM volunteers with ten or more years of service monitoring Ohio lakes.

CLAM trainee at the Ohio & Erie Canal Reservation near Cleveland on August 10, 2011.

Harmful Algal Blooms

Charles Mill Reservoir and Wills Creek Reservoir were not dominated by cyanobacteria, as were the other lakes monitored. Although total cell counts indicated severe bloom conditions for many of the lakes during most of the three month period, microcystin toxin levels remained very low.

Based on these results, Ohio EPA would not issue a Public Health Advisory (ohioalgaeinfo.com). Only a Algae Bloom Advisory is warranted, indicating that algae capable of producing toxin have been identified. The public would be advised to not drink the water and avoid direct contact with floating algal scum, but swimming, wading and boating would be permitted.

Microcystin is associated with genera such as Anabaena, Microcystis, Oscillatoria, and Planktothrix, which were not found in severe bloom numbers. Additional sampling would continue to monitor for potential health risk, including analysis for the toxin associated with Cylindrospermopsis, which was found to be the most common genus in the MWCD lakes.

Acknowledgements

This report is intended to give an overview on project results. It does not present a complete examination with a thorough investigation on individual lakes or comparisons between years or between parameters. Additional technical reports and publications can be made available upon request (olms@olms.org).

The Ohio Lake Management Society truly appreciates the hard work, many hours, and commitment to service from its CLAM volunteers and Lake Keepers. In 2011, twelve newly recruited volunteers submitted data. Eight of our thirty active CLAM volunteers have more than ten years of experience (Table 1). Congratulations to Robert Biro (Lake Erie) and Mark Hausman (Atwood Lake) who have reached their 20 year anniversary with the CLAM program!! This long-term monitoring effort provides us with robust and valuable documentation on Ohio lakes.

We sincerely thank the CLAM sponsors and supporters; *Muskingum Watershed Conservancy District, Ohio Department of Natural Resources Inland Fisheries Research Unit, BSA Environmental Services, Inc., and the Ohio Environmental Protection Agency*. Collaboration with these partners continues to enable OLMS to offer watershed education and data collection on lakes throughout Ohio.

Thank you to the CLAM volunteers for their time and dedication!

*Summary report written and compiled by Dana Oleskiewicz, CLAM Coordinator, 330-466-5631, oleskiewicz@windstream.net.