2012 Public Water System Harmful Algal Bloom Summary

Highlights

- Cyanotoxins were detected in the source waters for thirteen public water supplies, but there were no finished water detections.
- Microcystin levels at Celina's intake continued to rise, and exceeded 100 ug/L in November.
- The PWS HAB Coordinator is participating in a HAB research collaborative to better understand bloom dynamics on Lake Erie.
- The first *Planktothrix rubescens* bloom was detected on an Ohio public water supply source in November, with microcystin concentrations of 1400 mg/L. This species of cyanobacteria poses unique monitoring challenges because it exists at depth (potentially near intakes) and is not visual apparent at the lake surface during the summer months.
- The first *Euglena sanguinea* bloom was detected in Ohio. Several Euglena species are capable of producing the potent ichthyotoxin euglenophycin, which has a chemical structure similar to fire ant venom and may pose a human health threat.
- Due to the loss of the MERIS sensor on the EVISTAT satellite, inland lake HAB satellite data was not available in 2012 and probably will not be available until the EU launches a replacement satellite in late 2014.
- DDAGW reviewed 35 NOIs to apply algaecide on PWS source waters. The Village of Archbold may have violated permit conditions by applying algaecide to severe cyanobacteria blooms on their reservoirs without first contacting Ohio EPA.
- HABs continue to pose an economic burden to PWSs: $200,000/month for powdered activated carbon at Toledo and over $600,000 to replenish granular activated carbon at Clermont County.
- The Minnesota Department of Health set drinking water guidance for microcystin-LR at 0.04 ppb, which was intended to be protective of a short-term exposure for bottle-fed infants.
- Abraxis developed a new ELISA test kit for β-Methylamino-L-alanine (BMAA).
- The PWS HAB Coordinator responded to approximately 300 outside requests for information on HABs and algaecide permit issues.
- The PWS HAB Coordinator and back-up staff gave eleven HAB presentations and facilitated and presented at a 2-day Stone Lab HAB workshop.
- The PWS HAB Coordinator co-authored an article on Ohio HABs for the North America Lake Management Society's Lakeline magazine.

Ohio EPA Cyanotoxin Data

In 2012 the Ohio EPA Division of Drinking and Ground Waters collected 42 samples for cyanotoxin analysis at 8 public water systems (PWS). Two Lake County Lake Erie PWSs were sampled in response to the unusual central basin HAB and six inland lakes/reservoirs were sampled. HABs were sampled at PWSs in four of the five Ohio EPA districts. Sampling occurred at two PWSs (Findlay and Lima) in response to a request to treat a severe cyanobacteria bloom with algaecide. In both of those cases toxins were detected above drinking water thresholds in the bloom (up to 1400 ug/L microcystin) and the water systems used an alternate water source during algaecide treatment. Resampling after algaecide treatment at Findlay confirmed the absence of toxins and the water source was returned to use. Lima is still avoiding use of their affected reservoir, and plans on resampling for toxins prior to placing the reservoir online next spring. Toxins were detected in the source water for six of the sampled PWSs. Toxins were never detected in finished water. Cyanotoxin sampling in 2012 was 75% less than in 2011, largely due to a less severe cyanobacteria bloom on Lake Erie and a lack of MERIS satellite data for inland lakes.

PWS Cyanotoxin Data

Six PWSs voluntarily sampled for cyanotoxins and shared data with Ohio EPA. Oregon continued to analyze samples for themselves and for Ottawa County and Carroll Township on a weekly basis during HAB season. Toledo developed the capacity to analyze their own samples and did so weekly during HAB season. Even though the 2012 Lake Erie bloom was considered mild, Toledo detected microcystin at their intake up to 33.2 ug/L. The maximum toxins detected at the other three western basin PWSs was only 0.32 ug/L. The city of Monroe, Michigan also began sharing data from their real-time phycocyanin probe with Ohio EPA in 2012 (the HAB coordinator receives e-mail alerts when intake cyanobacteria concentrations exceed 10,000 cells/ml). This data is shared with Ohio western basin water systems as an early warning. The cyanobacteria concentrations at Monroe's intake exceeded 100,000 cells/mL in 2012 (max. 214,510 cells/ml). Since NOAA satellite data did not show the 2012 Lake Erie bloom extending out of the extreme western basin and data from the more easterly located western basin PWS did not show elevated toxins, Ohio EPA determined cyanotoxin monitoring was not required for the other Lake Erie PWSs (with the exception of the Lake County HAB response mentioned earlier). The NOAA satellite data and PWS data continue to be very useful, and help Ohio EPA determine where to target HAB monitoring. The City of Columbus sampled for cyanotoxins in response to a taste and odor event and minor bloom, but toxins were not detected in the source water. Columbus does not routinely share data with Ohio EPA, but they indicated they would contact us if they ever detected toxins in their source water. Celina continued to sample their source water weekly. Toxins in 2012 were higher than the two previous years, and toxin concentrations increased earlier than in prior years (See Figure 1).

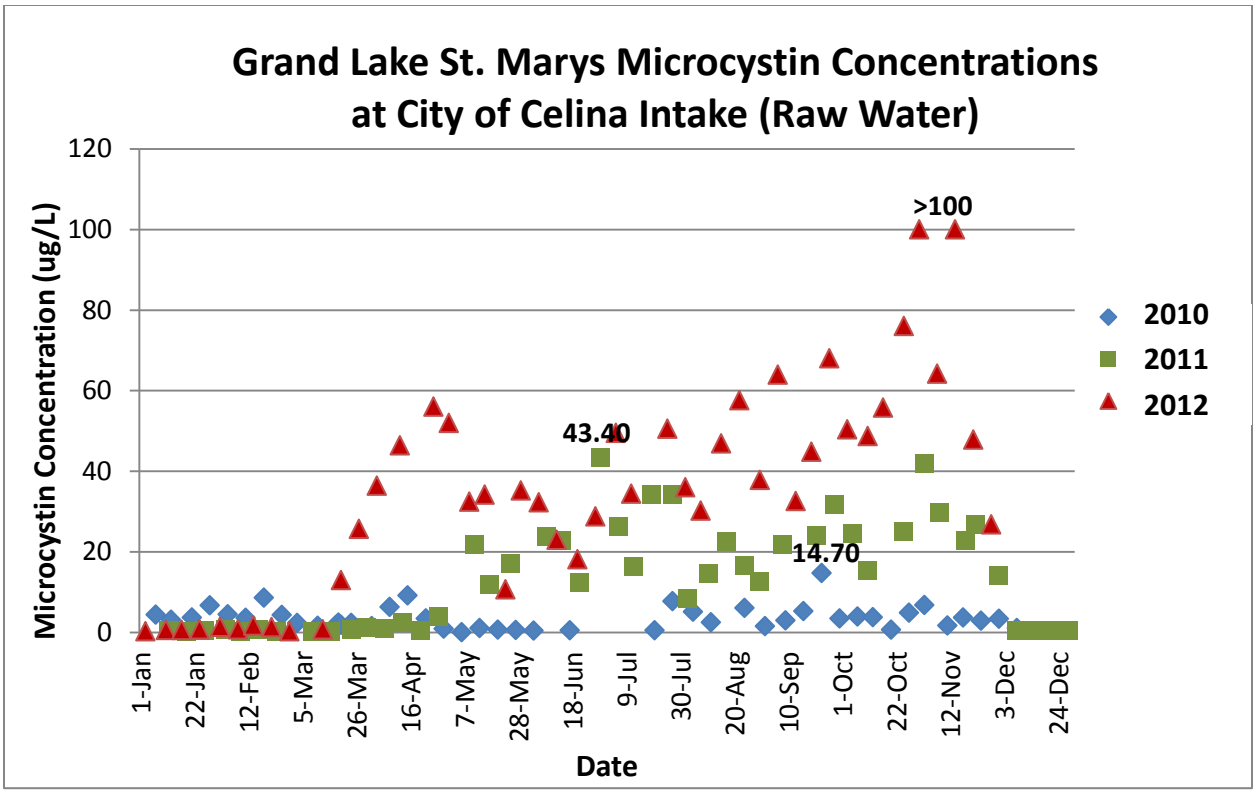

Figure 1

Additional Cyanotoxin Sampling Data

The Ohio Lake Management Society (OLMS)'s Citizen Lake Awareness and Monitoring (CLAM) program began collecting HAB data on nine MWCD reservoirs in 2011 and continued monitoring in 2012. Algae identification by division as a biovolume (µm3/L), as well as cyanobacteria genera cell counts and microcystin concentrations (µg/L) were measured, and cylindrospermopsin analysis was conducted on a subset of samples. Two of the lakes monitored are PWS source water lakes (Atwood and Tappan). Data from 2011 show cyanobacteria dominated all of the reservoirs and severe blooms (>100,000 cells /ml) were detected on the two PWS lakes. The highest levels of microcystin were detected at Tappan, but at concentrations just below drinking water thresholds (0.991 ug/L). Preliminary data from 2012 show the continued presence of low levels of toxins, and the first detections of cylindrospermopsin. Microcystin was detected at Tappan Lake on all six sampling dates, and on one occasion exceeded the drinking water threshold (1.45 ug/L on 7/28/12). Since this is a more research-oriented project phytoplankton samples are analyzed in batch at the end of the bloom season. OLMS has indicated it will attempt to provide timely toxin data to interested parties (including Ohio EPA) in the future, especially if toxins are detected above drinking water thresholds. OLMS received an Ohio EPA education fund grant to expand its HAB monitoring to other inland Ohio lakes in 2013 and additional PWS lakes may be sampled. The sampling kit OLMS uses is much more compact than the

sampling kit Ohio EPA provided to PWSs, and their receiving lab (BSA) said samples have always arrived chilled (this is a current problem with our existing kits). If Ohio EPA used a similar kit shipping expenses would be reduced and sample integrity may be improved. OLMS also did a comparative analysis on holding times and effect on microcystin results. A statistical analysis showed a three-day holding time yielded results that were not significantly different from a one-day holding time.

Lake Erie HAB Researcher Collaborative

When the Lake Erie cyanobacteria blooms began affecting the central basin public water systems in June of this year the Ohio EPA PWS HAB coordinator reached out to researchers at NOAA, University of Toledo, Heidelburg Water Quality Lab, and OSU to help understand why the bloom dynamics were different in 2012. An e-mail discussion group formed to try to coordinate data collection and help evaluate new information as it became available. At the end of the HAB season NOAA and OSU-Seagrant invited all the Ohio HAB researchers, USGS, and Ohio EPA to come together and further evaluate the Lake Erie HAB data and share information, with the hope of improving NOAA's HAB forecast models for 2013. At that meeting we learned that a few Ohio researchers are also beginning to do genetic Q-PCR testing to help improve understanding of toxin production dynamics, and there may be an opportunity for doing this type of testing on PWS source waters. Stone lab is also developing the capacity to run quantitative ELISA testing, and may be able to run samples for the Lake Erie island PWSs. A collaborative HAB research group was formed with plans on improving data sharing, targeting future sampling, and sharing models and forecasts as soon as they are developed.

New Issue: *Planktothrix rubescens*

Lima experienced what was most likely a *Planktothrix rubescens* bloom on its new Williams reservoir in November 2012 (see Figure 2). This was the first time this phycoerythrin-containing Planktothrix species was observed on a PWS source. This species of cyanobacteria poses a unique threat to PWSs. Based on limited data and research, these blooms typically have a maximum biovolume in the late summer, similar to other cyanobacteria, but the blooms are often not visually apparent until much later in the year (late fall, early winter). The reddish phycoerythrin accessory pigments in these species enable them to exist at significant depth in the water column, usually near the thermocline. Blooms are only evident at the lake surface once the lake has turned over, or limited light availability later in the year brings them closer to the surface. The Lima bloom had microcystin concentrations up to 1400 ug/L (in surface sample). If the bloom had similar toxin concentrations when it was at the thermocline, closer to intake depth, this could have posed a treatment burden to the PWS. Thankfully the bloom was detected prior to placing the new reservoir online, and toxin sampling will occur prior to placing it online next spring. Since these cyanobacteria occur deeper in the water column than typical phycocyanin-containing cyanobacteria they are not detectable by satellite sensors. Knowing when and how to sample these blooms in the summer, before they become visually apparent at the water surface is

a monitoring challenge. Planktothrix is a known odor producer, and the samples Ohio EPA collected did have a noticeable odor to them, so that may be one indication a water system could use to indicate that toxins may also be present. Information on *Planktothrix rubescens* and monitoring guidelines should perhaps be developed and added to the Ohio PWS HAB Response Strategy and HAB website.

Figure 2

New Issue: *Euglena sanguinea*

Ohio experienced its first known *Euglena sanguinea* bloom on Dillon Lake this summer (see Figure 3). *Euglena sanguinea* is not a cyanobacteria and its red pigmentation is caused by astaxanthin, not phycoerythrin. *Euglena sanguinea* is a known producer of the potent ichthyotoxin euglenophycin, which has a chemical structure similar to fire ant venom. Little is known about the toxin, especially regarding potential human health effects. Only two labs currently test for the toxin (Texas A&M and NOAA). Dr. Paul Zimba at Texas A&M indicated they could run a few samples gratis if Ohio experienced another Euglena bloom (interested in data for research purposes). If more sample analysis became necessary, they would charge $48/sample for euglenophycin analysis. DDAGW should consider developing HAB response recommendations for PWSs that may experience a *Euglena sanguinea* bloom on their source water. Dr. Zimba indicated that some of their data demonstrate that

euglenophycin can potentially be removed with activated carbon, but more research on effectiveness (regarding type of carbon, etc.) is needed.

Figure 3

New Issue: Loss of MERIS Sensor

In the spring of 2012 the MERIS sensor on the EVISTAT satellite stopped communicating with earth and NOAA lost the ability to remotely map HABs. NOAA quickly adapted their data analysis algorithms to work with the MODIS satellite data, but the MODIS sensors could not distinguish between green algae and cyanobacteria and the resolution was much poorer. Due to the limitations of MODIS, inland lake HAB satellite data was not available in 2012 and probably will not be available until the EU launches a replacement satellite in late 2014. This greatly limits the detection of HABs nearshore on Lake Erie and on inland water systems (especially HABs that do not form scums and are not as visually apparent). NOAA did develop a GIS-based HAB satellite data viewer that will provide better access to satellite data to the general public and PWSs once the new satellite is online. NOAA is also continuing to refine their algorithms and hopes to be able to provide approximate cell counts with their cyanobacteria index color ramp in the future.

New Issue: Algaecide General Permit (Reporting & Potential Violations)

Ohio EPA received 35 NOIs to apply algaecide on PWS source waters. Annual reports that provide information on the total amount of pesticide applied to each water source are due to Ohio EPA by February 15, 2013. DDAGW staff will be asked to review the reports to determine compliance with the permit conditions. The HAB coordinator plans on sending an e-mail notice to all PWS general permit holders with a link to the annual report form and a reminder that reports are due on February 15.

During work on a SWAP plan, information was provided to Ohio EPA on cyanobacteria bloom severity and algaecide application to the Village of Archbold's reservoirs in 2012. Based on that information it appears that the Village applied algaecide to severe (>100,000 cells/ml) blooms located on both of their reservoirs (100MG reservoir cell count – 526,607 cells/ml; 200 MG reservoir cell count – 384,087). 850 pounds of PAK27 were applied to the severe blooms. Since the general permit prohibits algaecide application to blooms >100,000 cells/ml that either cover >20% of the reservoir or are in the immediate vicinity of the intake, Archbold may have violated the conditions of their general permit. After a discussion with DSW about this issue they felt that at a minimum a letter needs to be sent to both the PWS and the pesticide applicator that indicates there was a potential violation of the permit, and if a bloom of that magnitude occurs in the future the PWS and applicator must contact Ohio EPA prior to algaecide application. Ohio EPA will determine if the algaecide can safely be applied or if toxin monitoring is necessary prior to application. If we would have had more complete documentation that the bloom covered greater than 20% of the reservoir or was in the vicinity of the intake DSW would have issued a NOV to both the applicator and PWS.

2012 Impacts to Public Water Systems

The advanced treatment that is often necessary to remove cyanotoxins and taste and odor compounds associated with HABs can be expensive. Toledo's carbon expense during the 2012 combined cyanobacteria and diatom bloom was $200,000/month. Clermont County's GAC was being expended quicker than anticipated due to the early cyanobacteria bloom on their source water. Their consultant had estimated the GAC would only need replenished once a year, but one of the contactors was almost completely spent after 20 days of the early HAB on Harsha. Once sampling showed cyanotoxins were not present at their intake depth they spilt their treatment stream so only a portion of their water was going through the GAC treatment, to extend the life of the contactors but still meet their DBP limits. Clermont County estimates cost for replenishing their GAC will be at least $660,000 annually (assuming the media lasts one year).

Other State Microcystin Thresholds

This summer, the Minnesota Department of Health completed a toxicity review of microcystin-LR through their Contaminants of Emerging Concern program. Multiple-duration reference doses and drinking water values were derived. Drinking water guidance was set at 0.04 ppb, which was intended to be protective of a short-term exposure for bottle-fed infants. Ohio EPA's drinking water microcystin threshold is the same as the WHO guideline of 1.0 ug/L, which was based on adult drinking water exposure. Ohio EPA's recreational exposure threshold of 6 ug/L is based on a child's recreational exposure. At some point we may want to reevaluate Ohio's drinking water exposure thresholds, and determine if using an adult exposure dose is still appropriate.

β-Methylamino-L-alanine (BMAA)

Abraxis developed a new ELISA test kit for BMAA. BMAA is a non-proteinogenic amino acid and a documented neurotoxin (based on mouse and primate lab studies). The compound has been linked to an increased incidence of ALS and alzheimers. BMAA is produced by a wide range of cyanobacteria (Microcystis, Anabaena, Planktothrix, Aphanizomenon, Cylindrospermopsis, Lygbya, etc.). USEPA and Ohio EPA currently do not have standards or thresholds established for the compound and the prevalence of the compound in source waters is not known.

Work Products and Activities

In 2012 DDAGW staff continued to refine Ohio EPA's PWS HAB strategy, assisted with the pesticide general permit process, worked to increase PWSs understanding of the risk of HABs, and responded to HABs on PWS source waters. At the request of the director's office, DDAGW staff developed a separate PWS State of Ohio Harmful Algal Bloom Response Strategy in the spring of 2012. The HAB Coordinator responded to approximately 300 outside requests for information on HABs and algaecide permit issues. The HAB Coordinator and back-up staff gave eleven HAB presentations and facilitated and presented at a 2-day Stone Lab HAB workshop. The HAB Coordinator co-authored an article on Ohio HABs for the North America Lake Management Society's Lakeline magazine. The HAB website was updated to conform to the new Agency standard, and new information was added. Two DDAGW staff attended a 2-day Algae Identification workshop to better assist PWSs in understanding algae impacts to their source waters. The HAB coordinator reviewed all pesticide general permit NOIs for drinking water sources and in 2013 will review all pesticide general permit annual reports. The HAB coordinator approved all PWS HAB data for incorporation into the Ohio EPA HAB database. As new HAB issues arose, the HAB coordinator researched potential new impacts on water supplies and stayed current on emerging technologies and issues. Finally, the HAB coordinator and district staff worked cooperatively to respond appropriately to HABs on PWS source waters.