Monitoring Harmful Algal Blooms on Cayuga Lake

By Nathaniel Launer, Outreach Coordinator
Cayuga Lake Harmful Algal Bloom Monitoring Program Coordinator
CSI partners with community-based volunteer groups to better understand and protect local streams and lakes by collecting and disseminating scientifically credible, regulatory-quality data that inform long-term, sustainable management strategies.

CSI’s Mission:

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Community Science Institute

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CSI’s Mission:

NY State and EPA Certified Lab

Online Public Database

Volunteer Water Monitoring Partnerships

Chemical Monitoring Partnerships

Biological Monitoring Partnerships

Outreach and Education Initiatives

Small Nonprofit 501(c)3

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Volunteer Water Quality Monitoring Partnerships

87,000 measurements of lake and stream water quality data

12 + Community Stream Monitoring Partnerships

Identifying where water quality can improve, and where it is good

75 Volunteers participated in the first year of the HABs Monitoring Program

Over 150 volunteer water quality monitors

Long-term datasets can reveal water quality trends

The Community Science Institute
Partnering with Communities to Protect Water
Community Science Institute

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What are Harmful Algal Blooms (HABs)?

Commonly referred to as algae, the organisms that form these blooms are actually cyanobacteria. Cyanobacteria are a natural part of the aquatic community in lakes, ponds, and oceans around the world. Cyanobacteria produce natural chemical compounds whose purposes are poorly understood, and some of these compounds are toxic to humans and other animals. This is what makes a bloom harmful.

Certain conditions can promote cyanobacteria population growth, and rapid growth can lead to the formation of a bloom.

**H: Harmful**
- Toxins, economic, aesthetic, ecological

**A: Algal**
- Freshwater HABs refer to cyanobacteria. Not true algae.

**B: Bloom**
- Proliferations of cells, dense concentrations

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Cyanobacteria

Cyanobacteria are ancient organisms, dating back 3.5 billion years ago. - they are the oldest known oxygen producing organisms, responsible for our current oxygen rich atmosphere!

There are many different taxa of cyanobacteria.

*Dolichospermum* – Can fix nitrogen from the atmosphere into a bio-available form. Also can produce the microcystin toxin.

*Microcystis* – Produces the toxin microcystin, for which the EPA set health advisories for drinking water and non-potable water that have been adopted by the New York State Department of Health as safe limits.

Safe Drinking Water Limit – 0.3 ug/L of microcystin

Safe Recreation Limit – 4 ug/L of microcystin
Cyanobacteria are present in the lake as a natural part of the aquatic community.

Blooms are the rapid growth of cyanobacteria populations, concentrated to a local area.

The factors that promote this rapid population growth are still under study. We do know that...

Cyanobacteria growth increases at higher water temperatures.

High nutrient inputs, specifically phosphorus and nitrogen, have been shown to promote cyanobacteria growth.

Still, calm, and stratified waters facilitate the formation of blooms.

However...
The Role of Nutrients – A Factor we can control

Why focus on phosphorus?
- Soluble reactive phosphorus is a decent surrogate for bioavailable phosphorus.
- Phosphorus is the limiting nutrient for the majority of freshwater autotrophs.
- An overabundance of bioavailable phosphorus can lead to eutrophication and has been associated with the proliferation of cyanobacteria blooms.

Major Findings:
- SRP concentration correlates with land use type.
- SRP concentrations are higher in the northern half of the watershed.
- SRP concentration is higher under storm water conditions.
HABs on Cayuga Lake

There is little documentation of bloom reports on Cayuga Lake in the past. However...

In 2014 there were only 2 suspicious bloom notifications and 1 bloom was confirmed to be cyanobacteria by the NYSDEC.

In 2017 the NYSDEC made 27 suspicious bloom notifications, confirmed 9 cyanobacteria blooms, and identified 3 blooms to have high toxin levels.

The Cayuga Lake Harmful Algal Bloom Monitoring Program was formed.

In 2018 the Cayuga Lake Harmful Algal Bloom Monitoring Program documented 40 confirmed cyanobacteria blooms, 23 of which were identified to have high toxin levels.

It is impossible to say how much of this increase is due to improved monitoring. Nevertheless, it appears that the frequency of blooms is increasing on Cayuga Lake.
Cayuga Lake HABs Monitoring Program

The Cayuga Lake HABs Monitoring Program is operated by a consortium of three organizations: Community Science Institute (CSI), Cayuga Lake Watershed Network (CLWN), and Discover Cayuga Lake (DCL).

The purpose of the program is to:

1. Provide timely information and hazard warnings to the users of Cayuga Lake.

2. Develop information about the occurrence of HABs, which may be useful in future responses and long-term mitigation of cyanobacteria blooms on Cayuga Lake.

The program receives no funding from the state, and is entirely supported by local municipalities, donations, and grants.

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Volunteer Driven Program

HABs Harriers attend a cyanobacteria identification and sampling training, provided by CSI and the NYSDEC prior to the monitoring season.

The program works through a lake-wide network of volunteers, titled HABs Harriers, who monitor sections of the shoreline every week from July through October.

If a volunteer observes a suspicious bloom, they record the location, take pictures, and collect a sample to be transported to the Community Science Institute lab for analysis.

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Over 75 volunteers in the first year!
Volunteers patrol their assigned zone Sat-Mon every week. Complete online “No-Bloom” report. “No-Bloom” reports go directly to DEC and CSI.

CSI examines submitted bloom photos and identifies phytoplankton present in sample by microscopy.

CSI splits sample into two bottles: one for analysis by CSI and one for analyses by DEC contract lab at UFI.

CSI ships split sample to UFI for independent analyses.

CSI determines total chlorophyll a and microcystin concentrations.

CSI enters CSI results and UFI results on CSI’s website and database as they become available. Results will be listed under a new monitoring set named “Cayuga Lake 2018 Volunteer HABs Surveillance Program.”

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Bloom Analysis at our local lab

The Cayuga Lake HABs Monitoring Program is unique because volunteers bring suspicious bloom samples directly to the Community Science Institute lab in Ithaca.

Here at the lab, suspicious bloom samples undergo three analyses:
1. Determination of microcystin toxin concentration using EPA Method 546
2. Determination of Total Chlorophyll-a concentration (a measure of bloom biomass).
3. Microscopic analysis to determine the cyanobacteria taxa present in the bloom.

Community Science Institute is able to produce results for these analysis as fast as a week to the same-day a suspicious bloom is reported. This turnaround of results is much faster than HABs monitoring programs on other lakes that have to send samples to a third-party lab and await results.

These results will help develop our understanding of cyanobacteria blooms on Cayuga Lake, useful for future response and long-term mitigation.

$200 funds the analysis of one cyanobacteria bloom

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Community Science Institute maintains a HABs Reporting Page on our website. The page has a map displaying suspicious and confirmed bloom locations, and shows whether cyanobacteria are present in the bloom, the level of microcystin toxin, and concentration of total chlorophyll-a.

The Cayuga Lake Watershed Network sends out weekly reports to the Cayuga Lake community notifying them of recent bloom activity.

If you would like to receive these notifications, please contact the Cayuga Lake Watershed Network.

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What did we find in 2018?

The Cayuga Lake HABs Monitoring Program helped to inform a few essential questions about HABs on Cayuga Lake including:

- When do cyanobacteria blooms occur on Cayuga Lake?
- Which cyanobacteria genera are associated with microcystin toxin?
- When do blooms have the highest toxin levels?
- Where do blooms occur?
Frequency of Cyanobacteria Blooms (HABs) on Cayuga Lake 2018

Number of Cyanobacteria Blooms per day Identified by the Community Science Institute

- Not Tested for microcystin
- Blooms with microcystin levels less than drinking water limit of 0.3 ug/L
- Blooms with microcystin levels greater than 0.3 ug/L and less than recreation limit of 4 ug/L
- Blooms with microcystin levels ranging from 4 ug/L to 2,533 ug/L

Cayuga Lake 2018 HABs Monitoring Season

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Microcystin Toxin Increased with Cyanobacteria Biomass when *Microcystis* Taxa were Present or Dominant

Taxa Identified under the Microscope at CSI Lab.
- **Microcystis** Present
- **Microcystis** Dominant
- **Dolichospermum** Dominant

Log Microcystin Concentration (ug/L) as Determined by Community Science Institute

Log Total Chlorophyll a Concentration (ug/L) as Determined by Community Science Institute

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Analysis results are updated as soon as they are available.

Mapping

Northwestern Quadrant

Southwestern Quadrant

Northeastern Quadrant

Southeastern Quadrant

30% Of Cayuga Lake Shoreline Monitored Weekly

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Occurrence of confirmed cyanobacteria blooms on Cayuga Lake appeared to increased in 2018 compared to the previous year, though much of this may be due to improved monitoring efforts.

Nearly all blooms on Cayuga Lake in 2018 with toxin levels above state drinking water and recreation limits contained the cyanobacteria *Microcystis*.

Toxin levels in blooms that occurred in September were much higher than those of blooms in July or August in 2018.

On Cayuga Lake in 2018, 77% of the blooms with microcystin concentrations above 4 ug/L occurred in the northern half of the lake.

Monitoring is essential for

1. Assessing the risk that cyanobacteria blooms may or may not present.
2. Data collection to support risk management
We Need Your Help This Summer Protecting Cayuga Lake from Harmful Algal Blooms (HABs)!

Who can volunteer?
• Anyone! Lake shore homeowners and avid boaters and anglers are especially encouraged to participate.

What does being a HABs Harrier entail?
• Attend a two hour HABs identification and sampling workshop in June.
• Survey assigned length of shoreline once a week, mid-July through September.
• Collect HABs samples and transport them to CSI lab for further analysis.
• Be available to respond to HABs sightings reported by members of the public.

Volunteer a few hours of your time each week this summer to be a HABs Harrier

Donate to help fund bloom analysis and extensive staff time

Community Science Institute
info@communityscience.org
607-257-6606

Cayuga Lake Watershed Network
programs@cayugalake.org
607-319-0475

Discover Cayuga Lake
(607) 327-5253