# Monitoring Harmful Algal Blooms on Cayuga Lake

By Nathaniel Launer, Outreach Coordinator Cayuga Lake Harmful Algal Bloom Monitoring Program Coordinator







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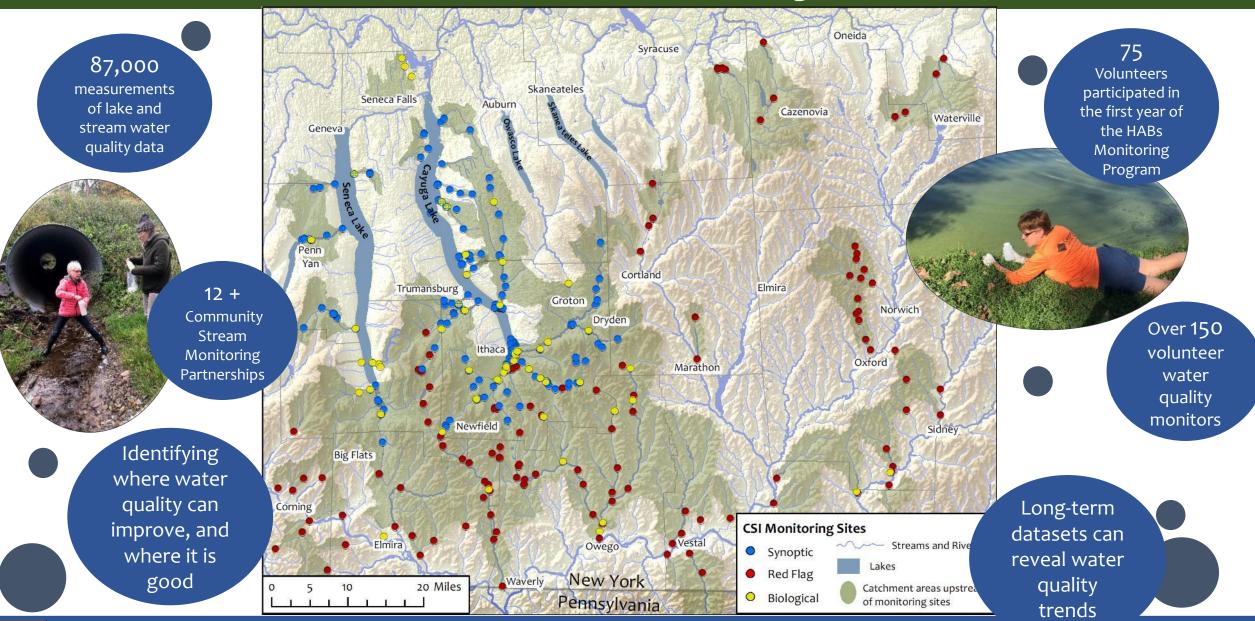






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#### Volunteer Water Quality Monitoring Partnerships







# 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

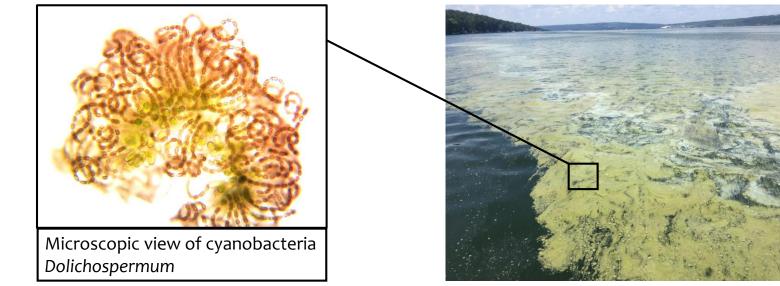
Toxins, economic, aesthetic, ecological

#### A: Algal

 Freshwater HABs refer to cyanobacteria. Not true algae.

#### B: Bloom

Proliferations of cells, dense concentrations



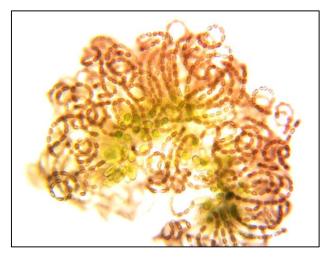


# Cyanobacteria

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



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### Blooms

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...

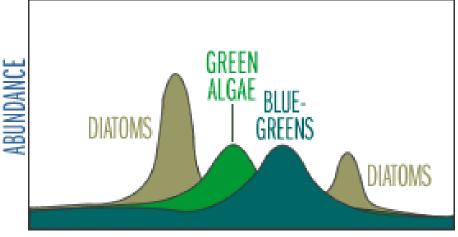
Cyanobacteria growth increases at higher water temperatures.

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...

### SEASONAL SUCCESSION OF PHYTOPLANKTON POPULATIONS



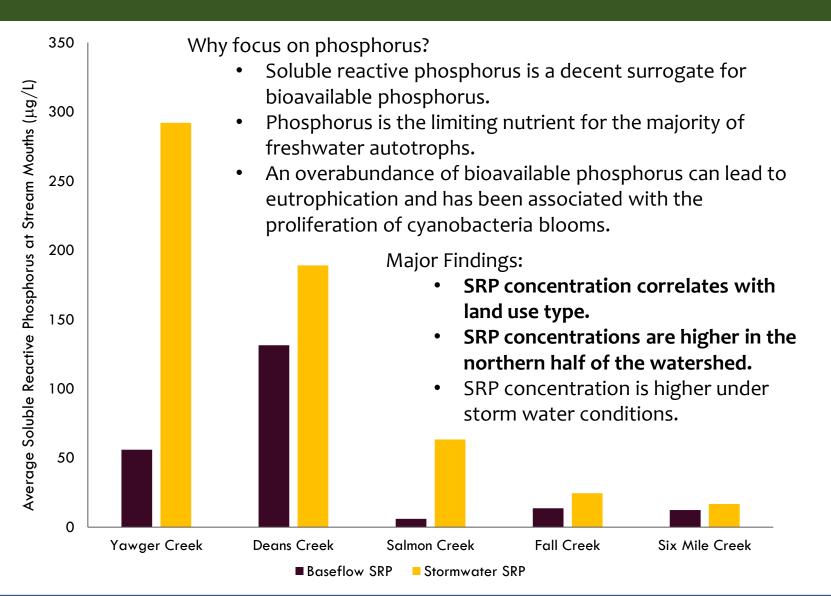
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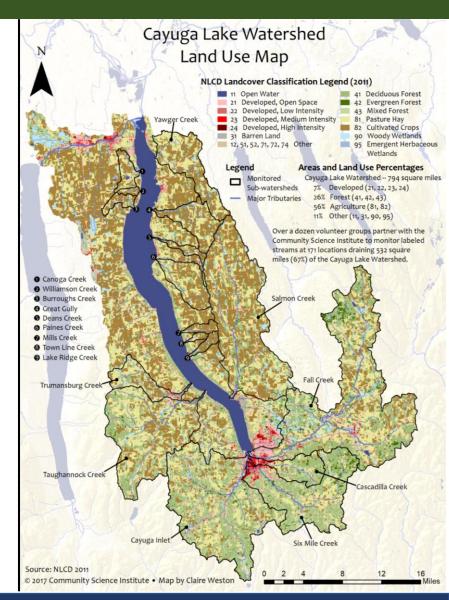


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Paerl, H. W., & Paul, V. J. (2012). Climate change: links to global expansion of harmful cyanobacteria. *Water research*, *46*(5), 1349-1363.

### The Role of Nutrients – A Factor we can control





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## 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.



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New York Departments of Environmental Conservation, Health, and Agriculture and Markets. (2018). Harmful Algal Bloom Action Plan Cayuga Lake. Retrieved from https://www.dec.ny.gov/chemical/113733.html#Plans

# 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.



# **Volunteer Driven Program**

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

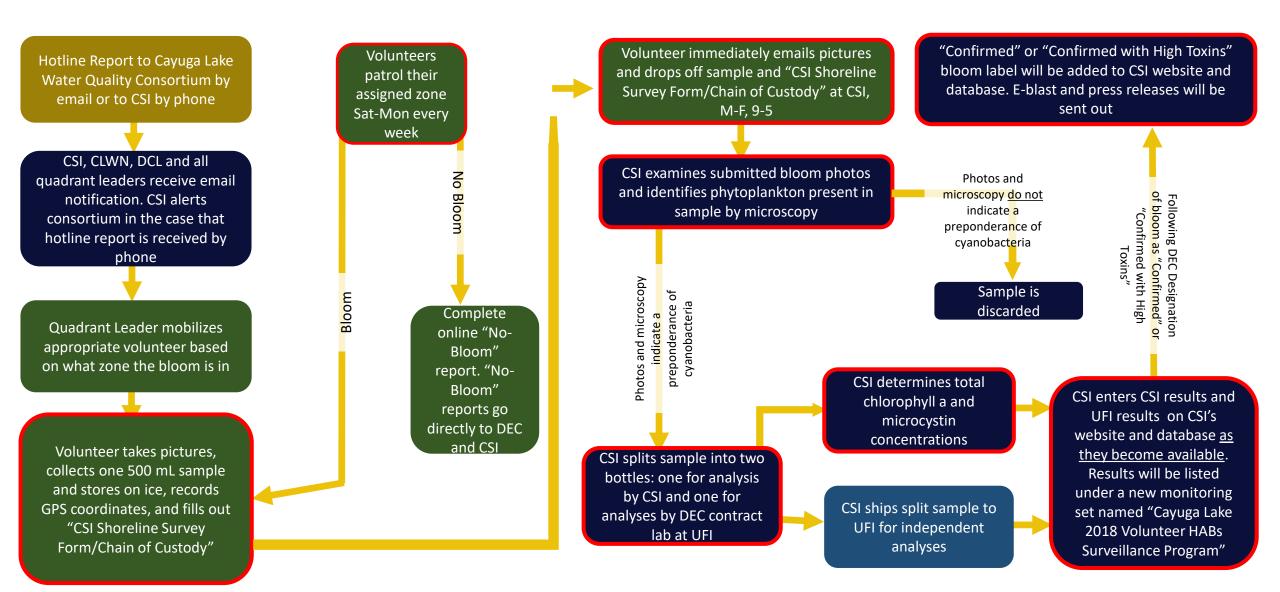
The program works through a lake-wide network of volunteers, titled HABs Harriers, who monitor sections of the shoreline every week from July through October.

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.









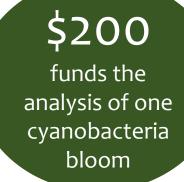


## Bloom Analysis at our local lab

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**.



# **Reporting and Risk Communication**

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**.

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2018 Cayuga Lake Harmful Algal Bloom Information,		and a second		
Testing Results, and Resources		← Confirmed with High Toxins �	nterlaken	
HABs Reporting Map	27,000 +	name Confirmed with High Toxins Bloom 9/4/18 18-3416-B3		
lease view the map in full screen mode so that you can see the full extent of information provided. Click on the broken box in the upper right ha orner of the map. This will open the full screen map in a new tab.	Views of the	ofrmed with High Toxins bloom near Atwater Point. ple collected on 9/4/18 at 1:15 PM. CSI ANALYSIS:		
he attached map serves as an interactive catalog of all of the reported blooms on Cayuga Lake in 2018. Click on an konto see important information including a picture of the bloom, local nd results when/if they become available. Yellow icons represent "scapicious" blooms, orange icons represent "confirmed" blooms, and red icons represent "confirmed with high toxins"		iscopy - Dolichospermum, Microcystis; Total pphyll a - 5434 ug/L; Microcystin toxin - 374 ug/L NALYSIS: Microscopy - Microcystis,	Covert	
looms. Map results are cumulative. It's important to note the date of sampling because blooms are transient by nature and can disappear in as little as a day. We do not track bloom durat	HABs	ospernum; BG Chlorophyll a - 12028.0 ug/ L; cystin toxin - 410 ug/L.		
I note about the toxin microcystin:		gun wan ar ar ar		
yanobacteria (blue-green algae) may produce a variety of chemicals that are harmful to other species. Including humans. The most common harmful chemical found in New York is microcy etailed toxicity studies have not been performed, and there is not yet a consensus on acceptable exposure levels. The New York State Department of Health (NYSDOH) has set upper limits	Reporting		Trumansburg	Taugrann
ubic drinking water supplies at 0.3 up.L or parts per hillion (ppb) and for public swimming baaches at 4.0 ppb (EPA. 2017). The New York State Department of Environmental Conservation WSDEC) defines a "bloom with high topin" as 20 ppb near the lake shore and 10 ppb in open water (INVSDEC) HABs Prozent Guide. Section 33.		2 photos	· · · · · · · · · · · · · · · · · · ·	
or more information check out our into page and resources from tart year's public forum on harmful algot blooms	Мар	2 proces		
2018 HABs Monitoring < < ()		Basic Bloom Information	Bloom Location Information	CSI Analyses jude reasoning if samples are not tasked: Sample set to
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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.



# 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?

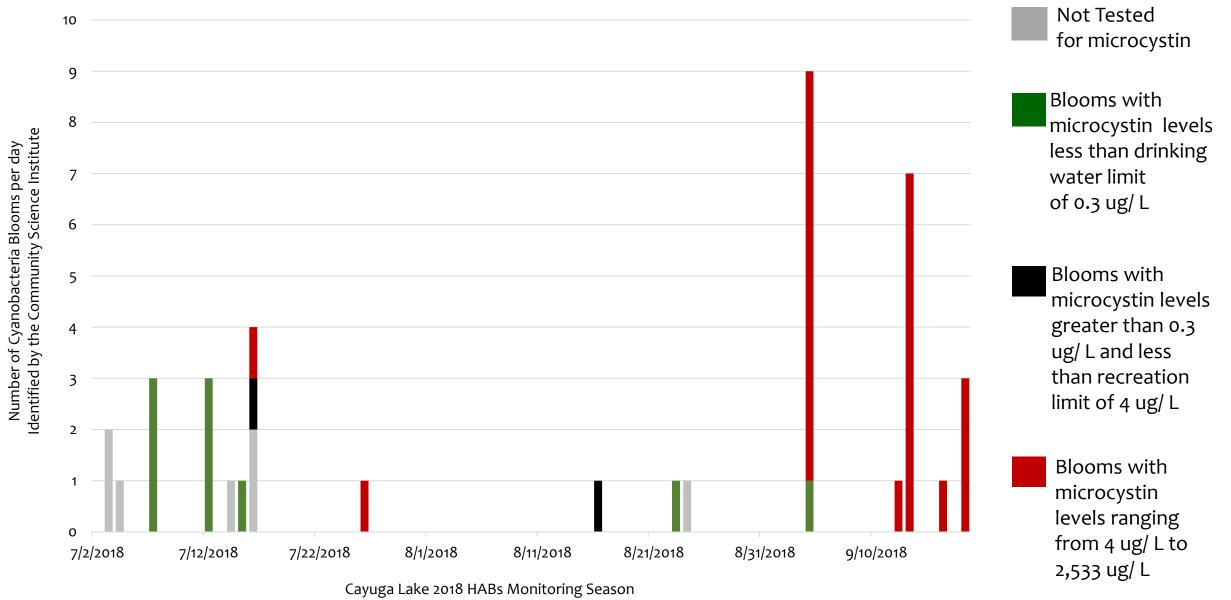
When do blooms have the highest toxin levels?

Where do blooms occur?



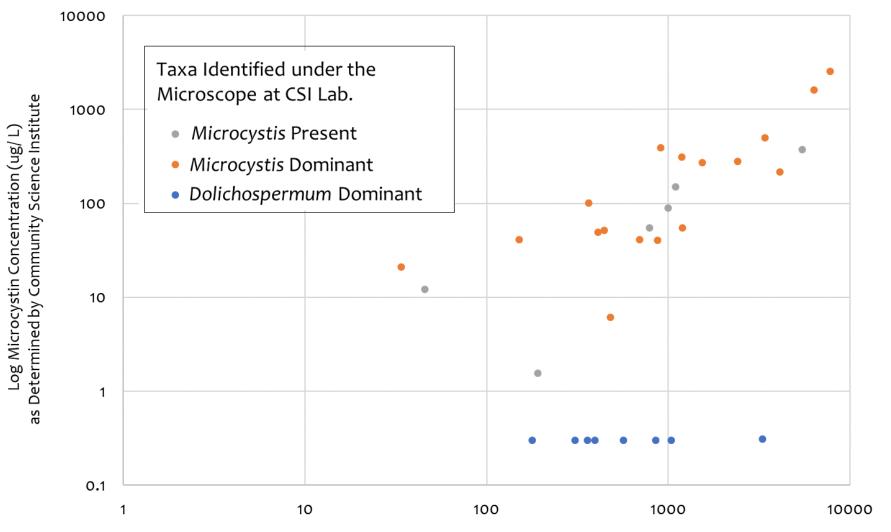


#### Frequency of Cyanobacteria Blooms (HABs) on Cayuga Lake 2018



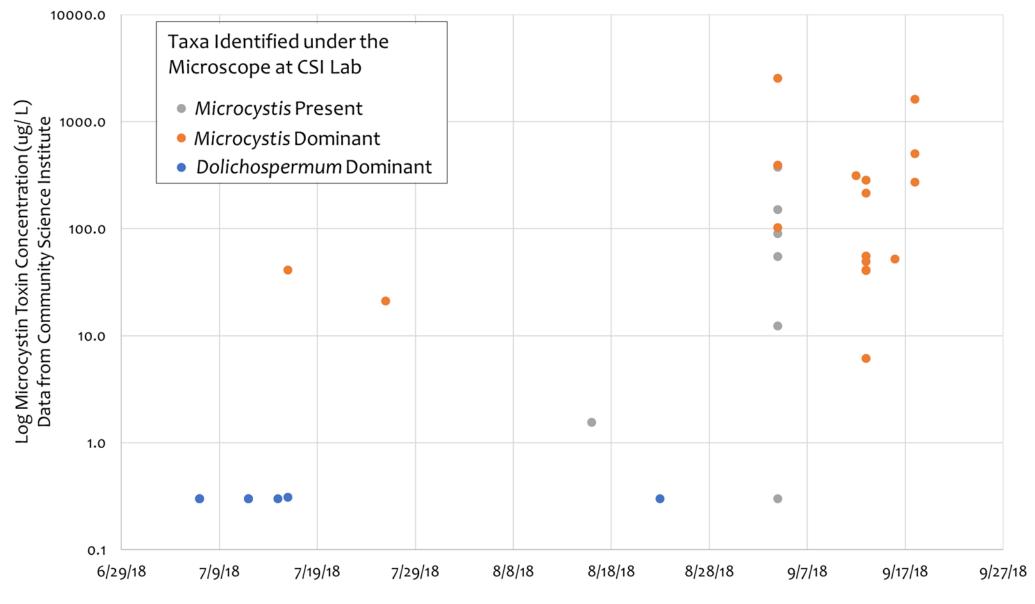
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#### Microcystin Toxin Increased with Cyanobacteria Biomass when *Microcystis* Taxa were Present or Dominant



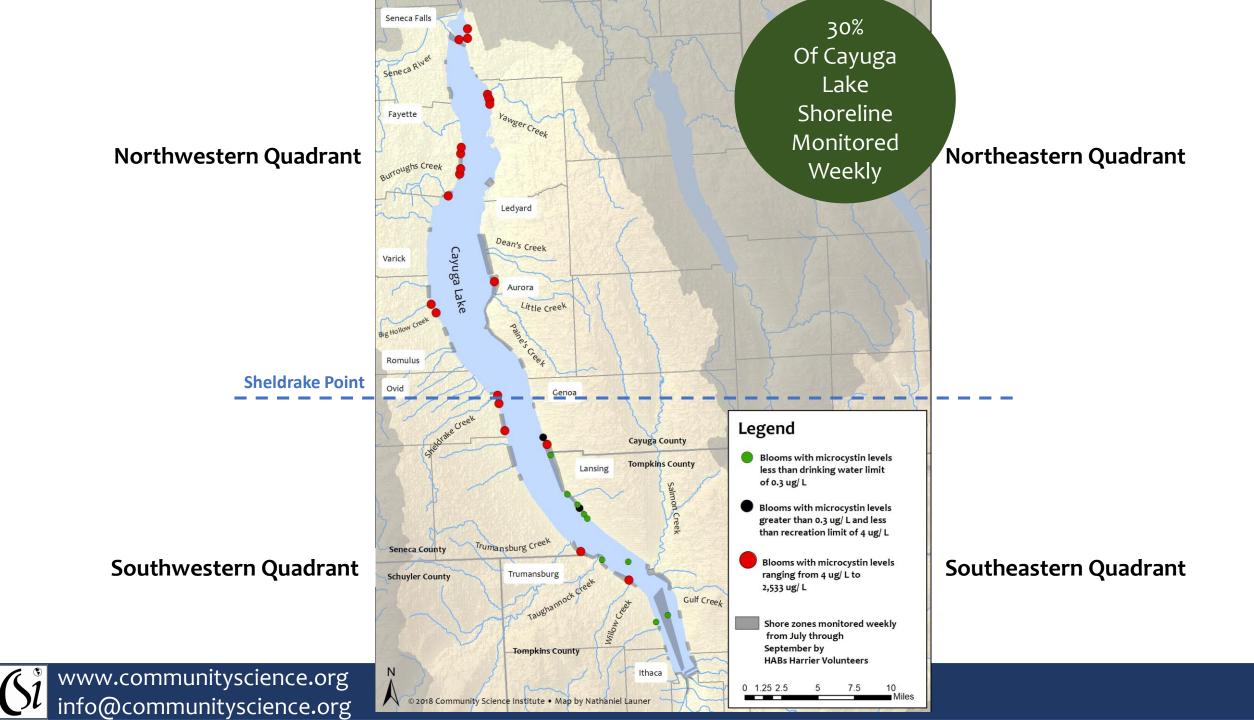
Log Total Chlorophyll a Concentration (ug/L) as Determined by Community Science Institute





Cayuga Lake 2018 HABs Monitoring Season





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

or

#### Donate to help fund bloom analysis and extensive staff time



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Cayuga Lake Watershed Network

programs@cayugalake.org 607-319-0475



**Discover Cayuga Lake** (607) 327-5253