Harmful Algal Blooms (HABs) on Cayuga Lake:

five years of monitoring

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Outreach and Programs Coordinator
Cayuga Lake HABs Monitoring Program Coordinator
Community Science Institute (CSI)

Photo by Holly Davidson, CSI HABs volunteer

Outline

Who is Community Science Institute

Mission & Community Role

What are “HABs”?

Definition & Impacts

Cayuga Lake HABs Monitoring Program

Program Structure
HABs Patterns on Cayuga Lake
Future Directions

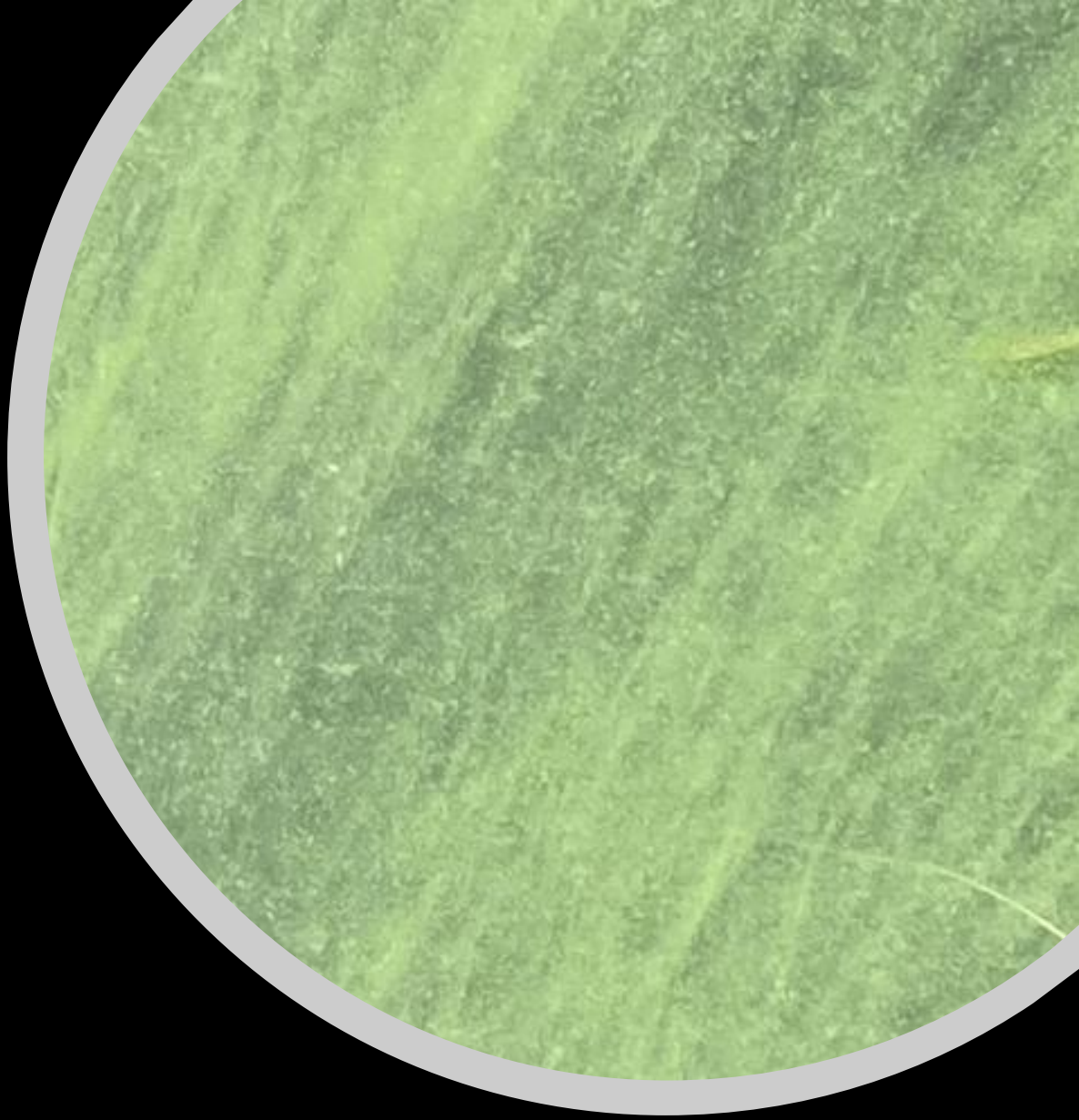
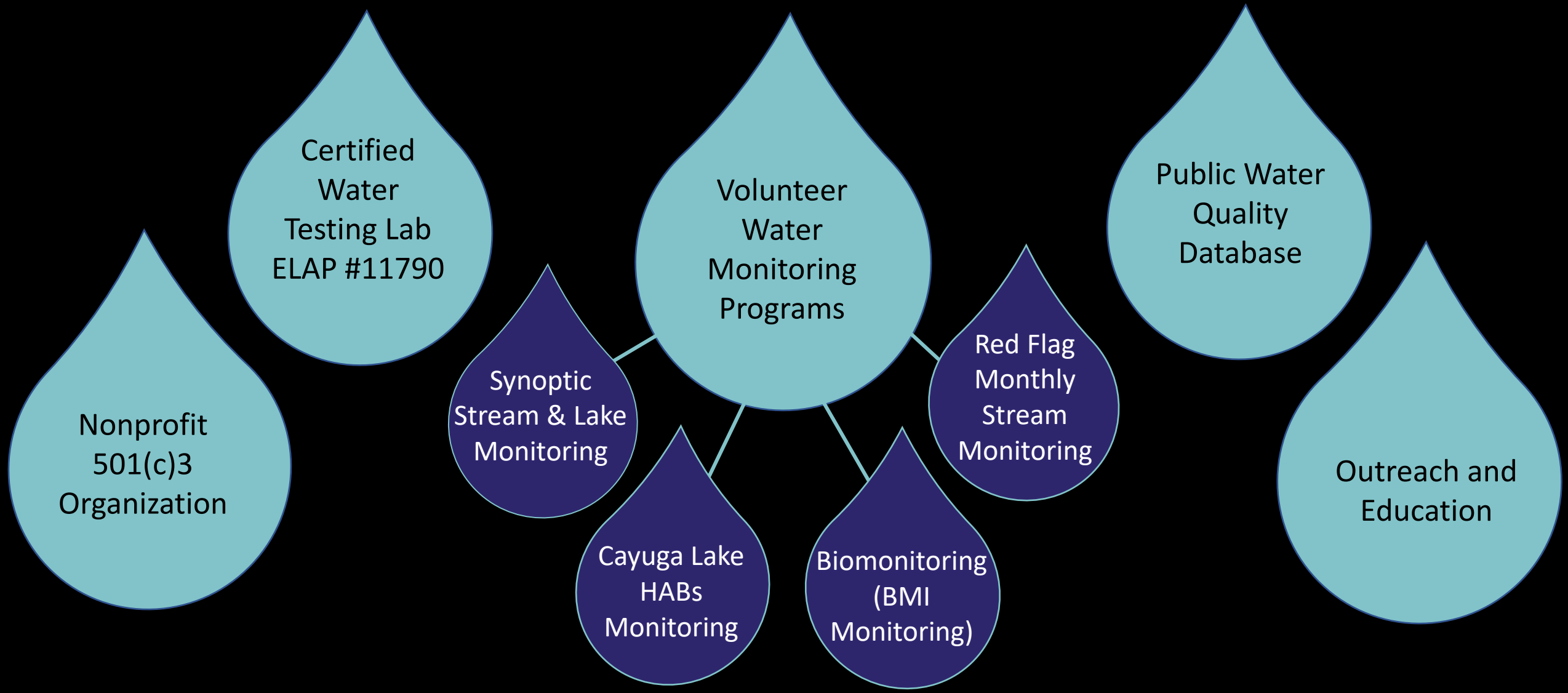


Photo by Jeanne Sullivan, CSI HABs volunteer

Community Science Institute's Mission

To empower community members to protect water through volunteer stream and lake monitoring



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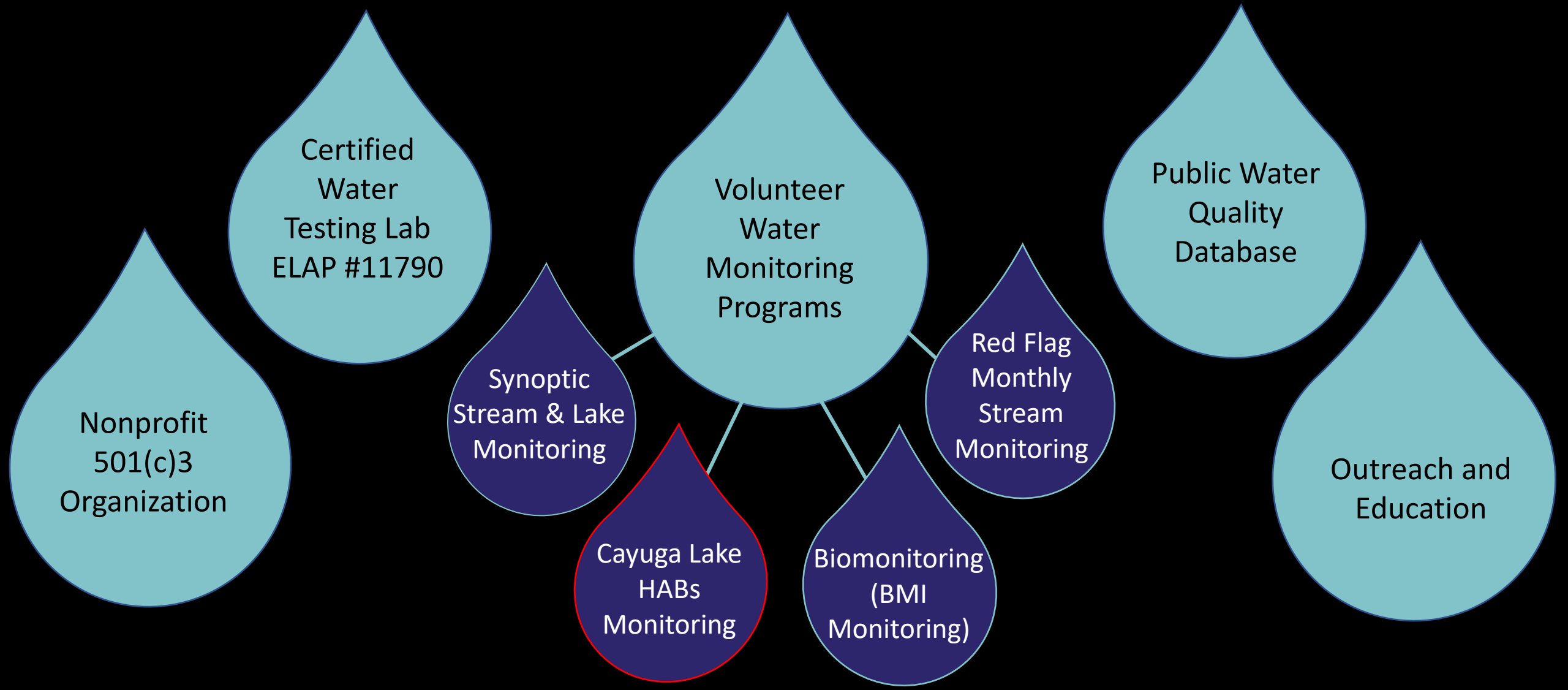

What is a “HAB”?

H = Harmful
A = Algal
B = Bloom

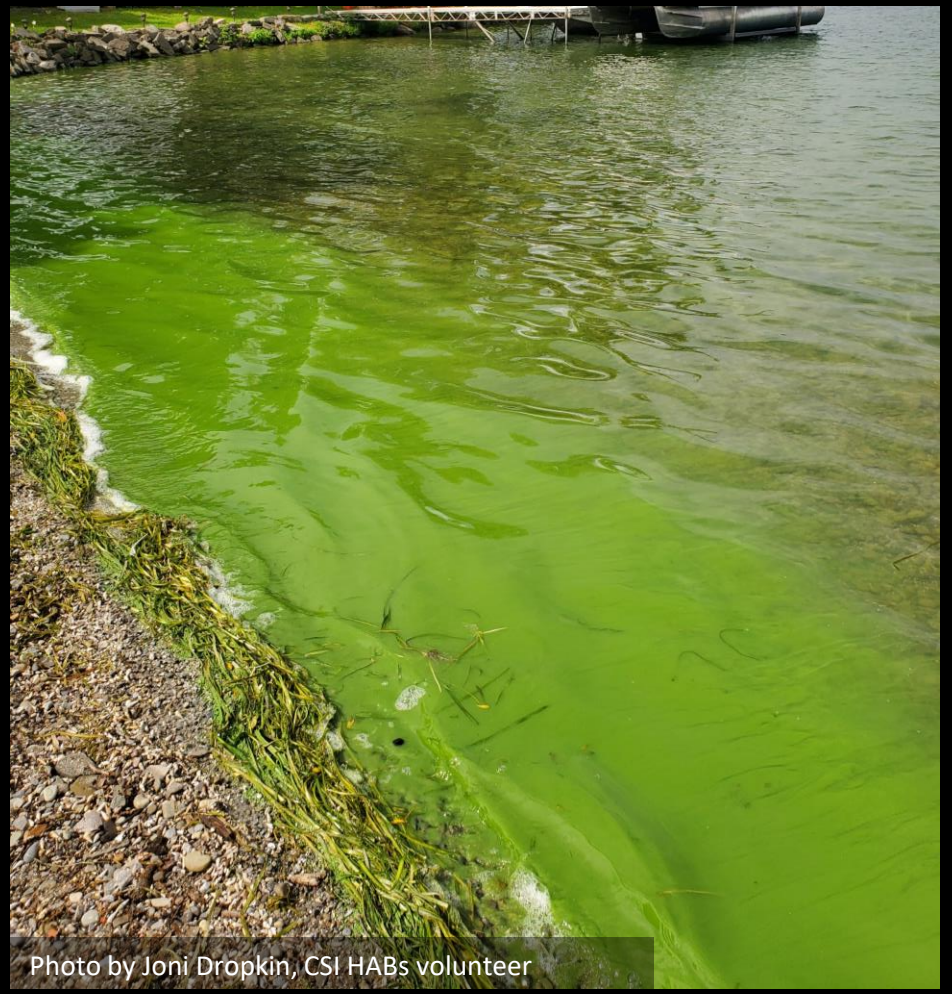
Photo by Joni Dropkin, CSI HABs volunteer

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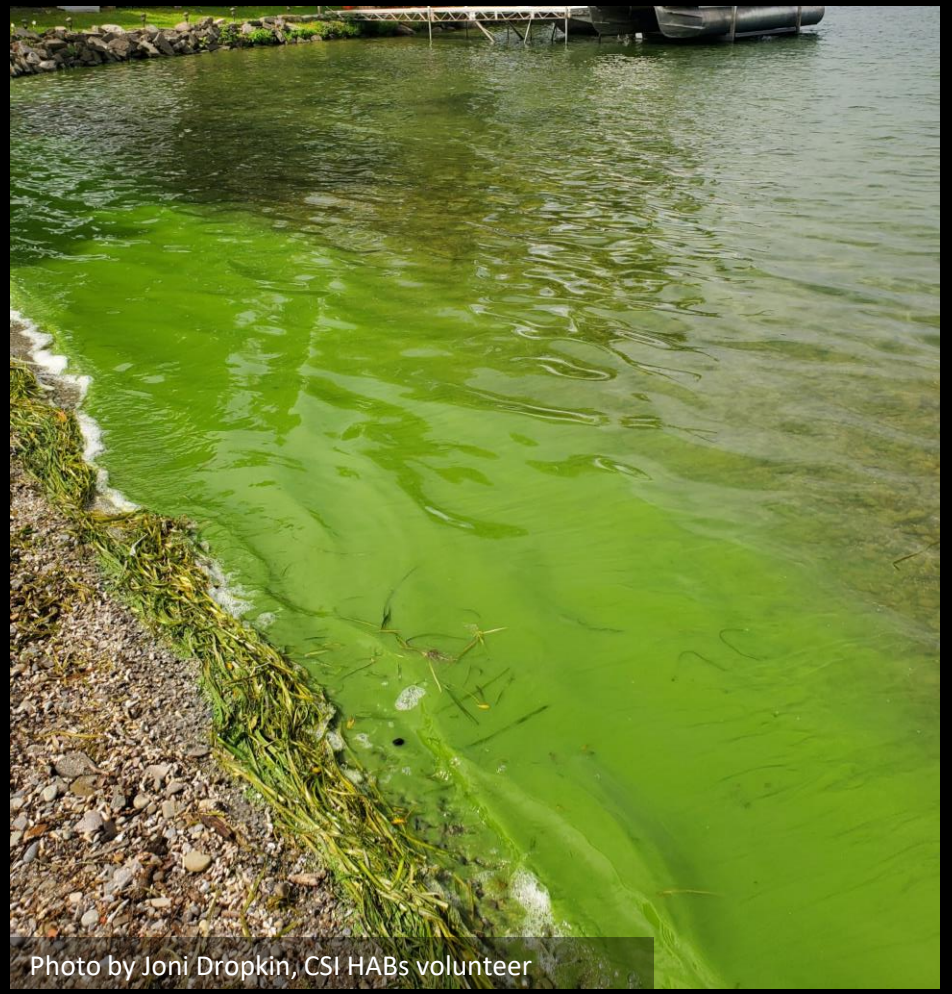

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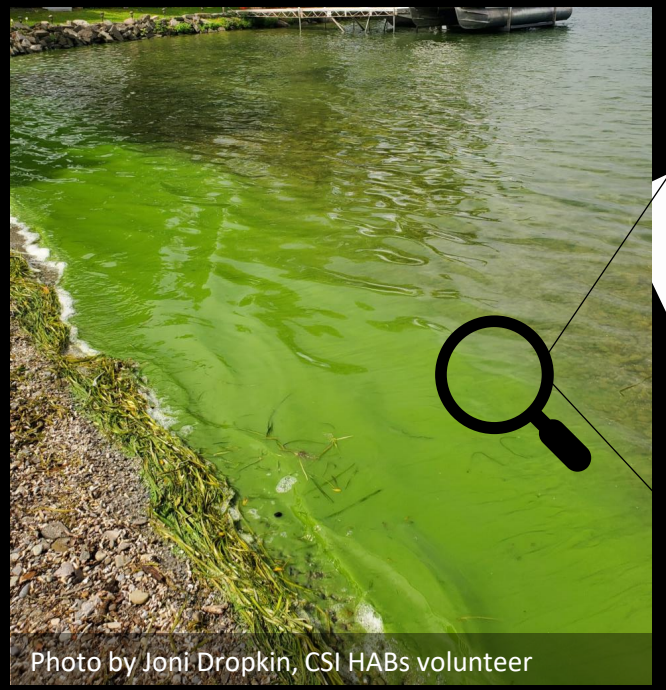

Photo by Joni Dropkin, CSI HABs volunteer

Cyanobacteria

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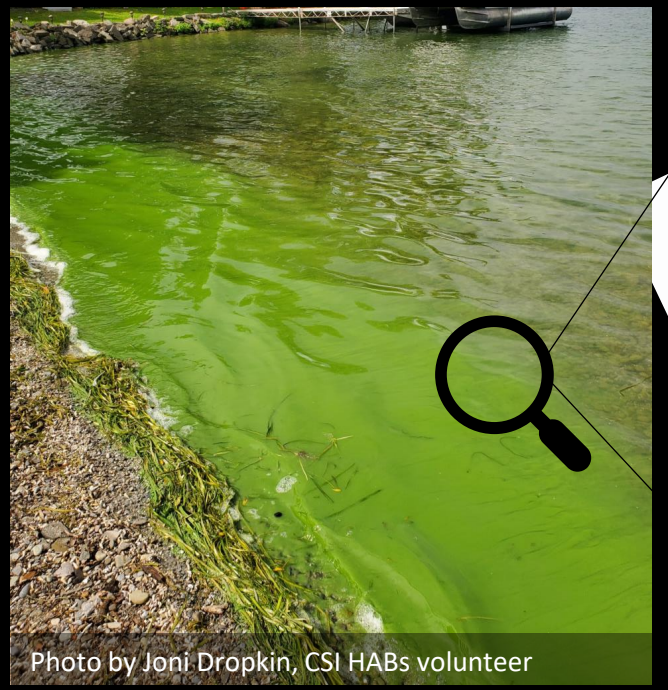

Photo by Joni Dropkin, CSI HABs volunteer

Cyanobacteria

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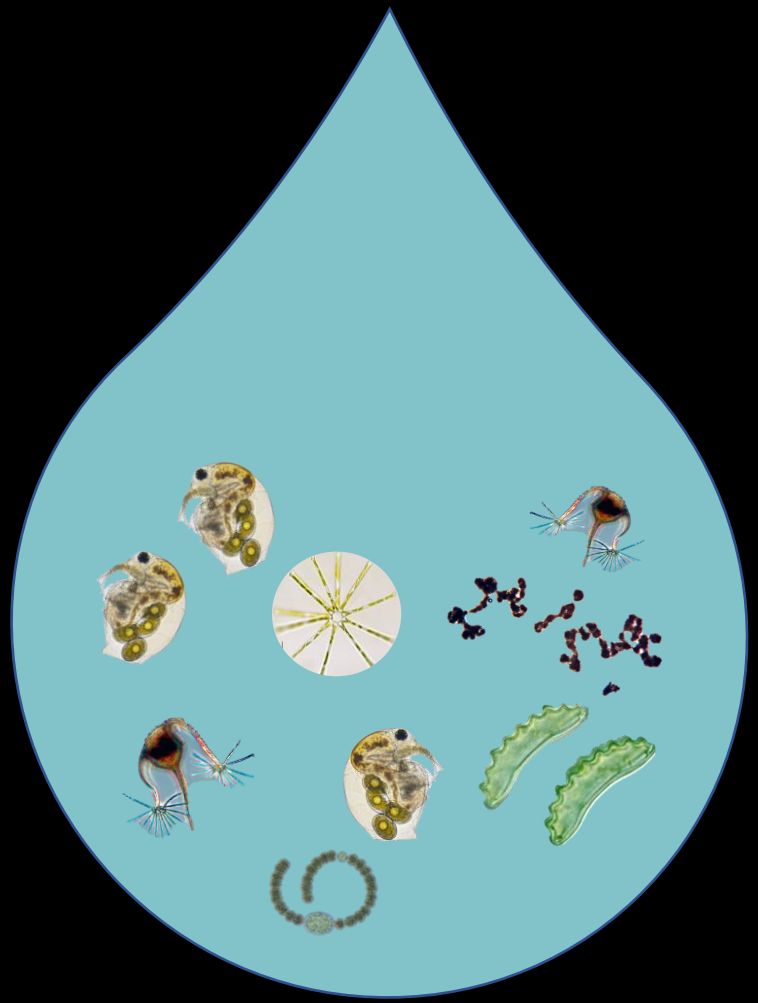
Cyanobacteria

Part of a healthy, balanced, normal freshwater ecosystem



When do they become “harmful”?

A “HAB” is an explosive population growth of these cyanobacteria, which may produce toxins

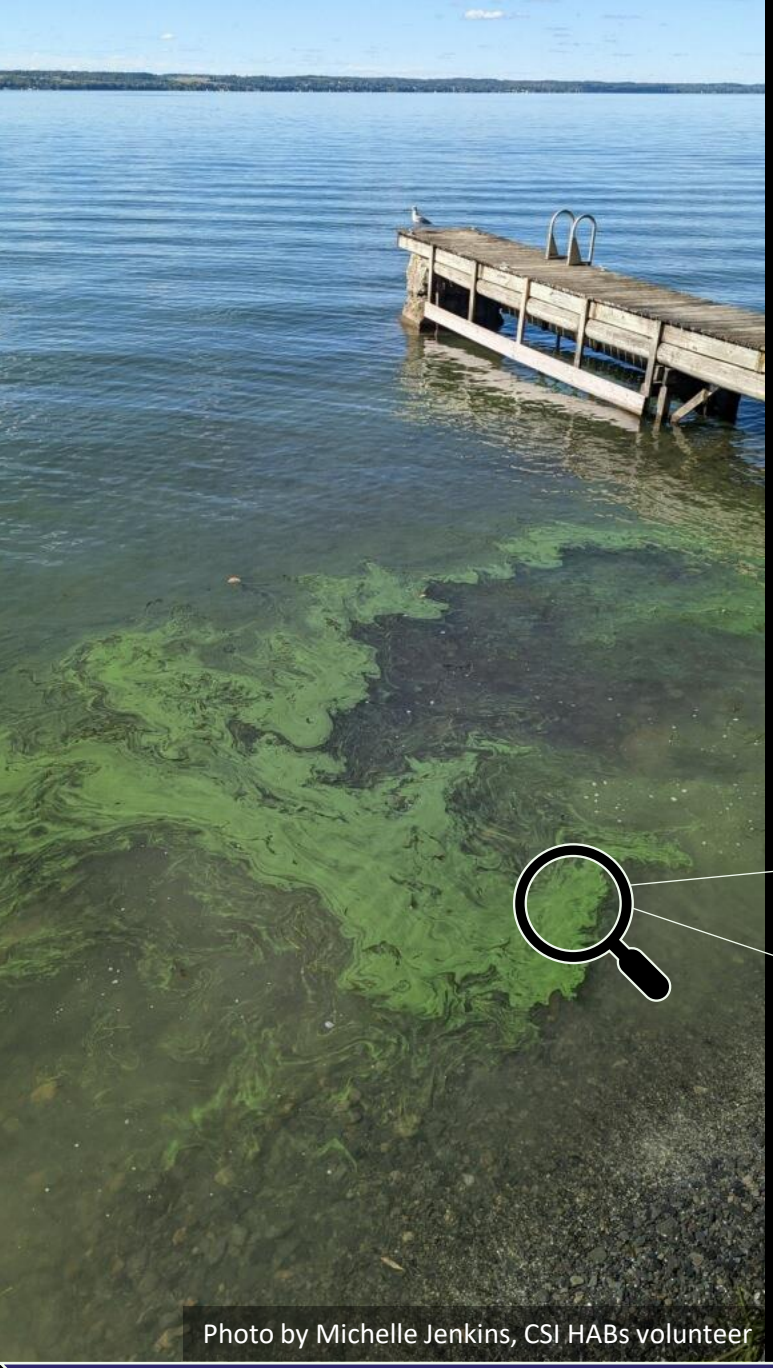
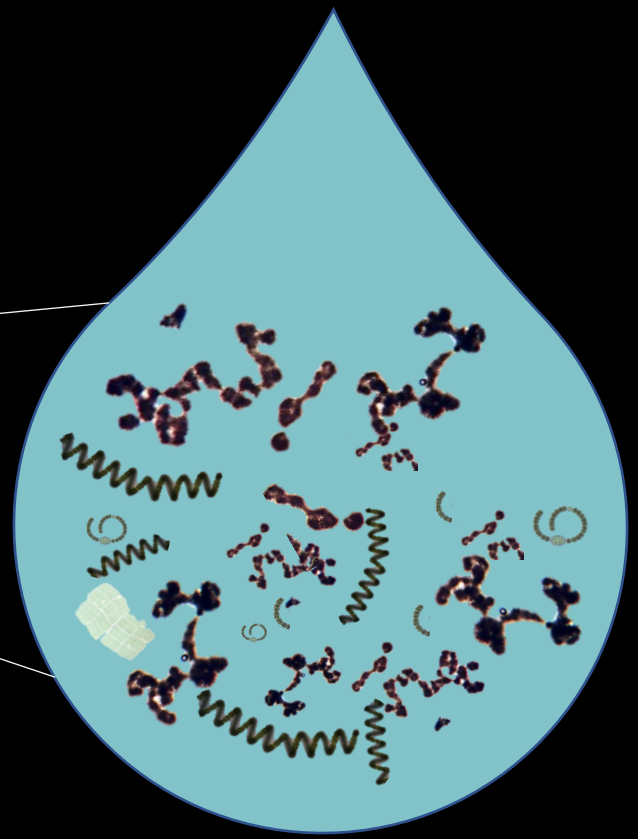


Photo by Michelle Jenkins, CSI HABs volunteer



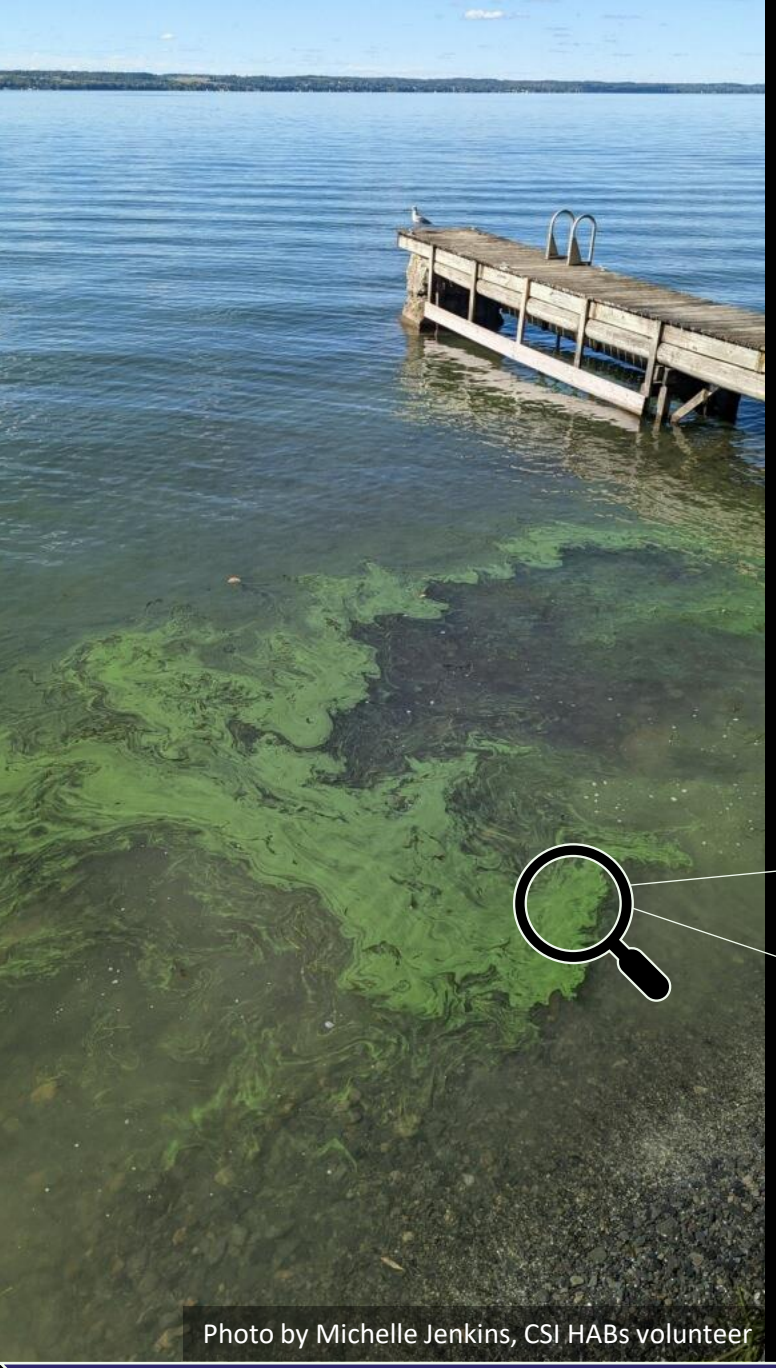


Photo by Michelle Jenkins, CSI HABs volunteer

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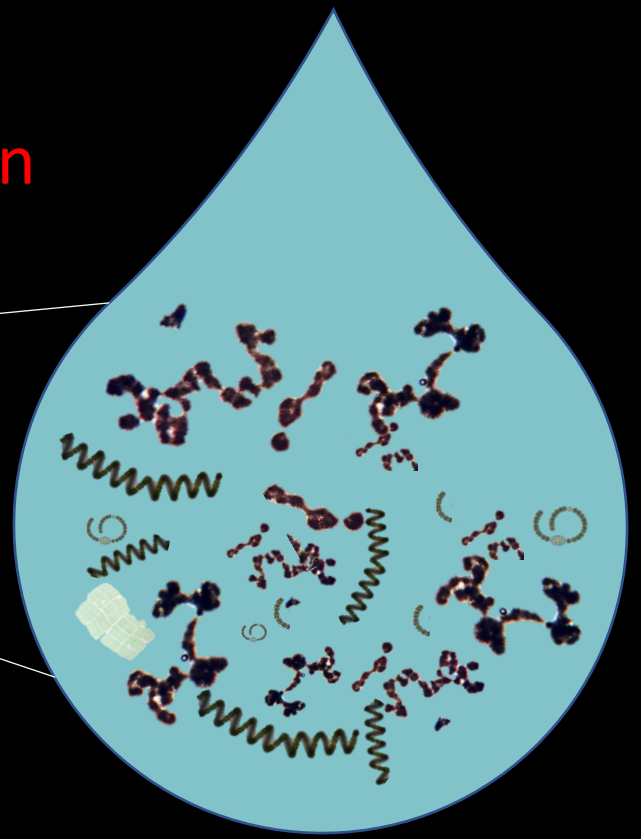
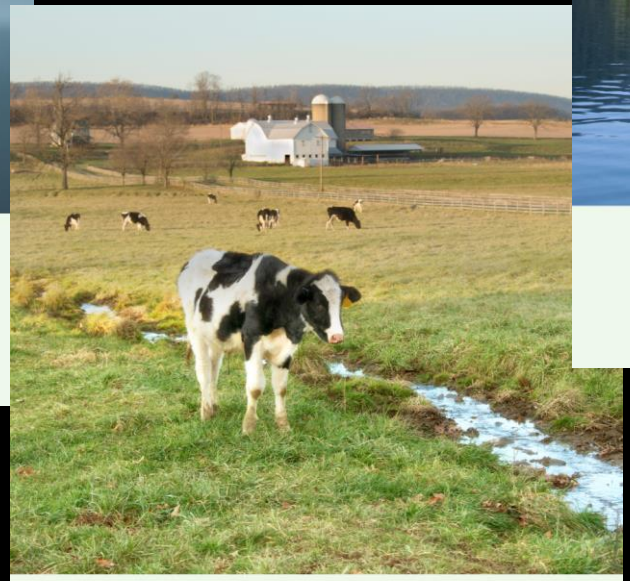
microcystin toxin



Impacts on humans

DRINKING WATER

CONTACT RECREATION
(swimming, fishing, kayaking)



LIVESTOCK

ECONOMICS

Impacts on the ecosystem

Anoxic conditions

the green frog

water fleas

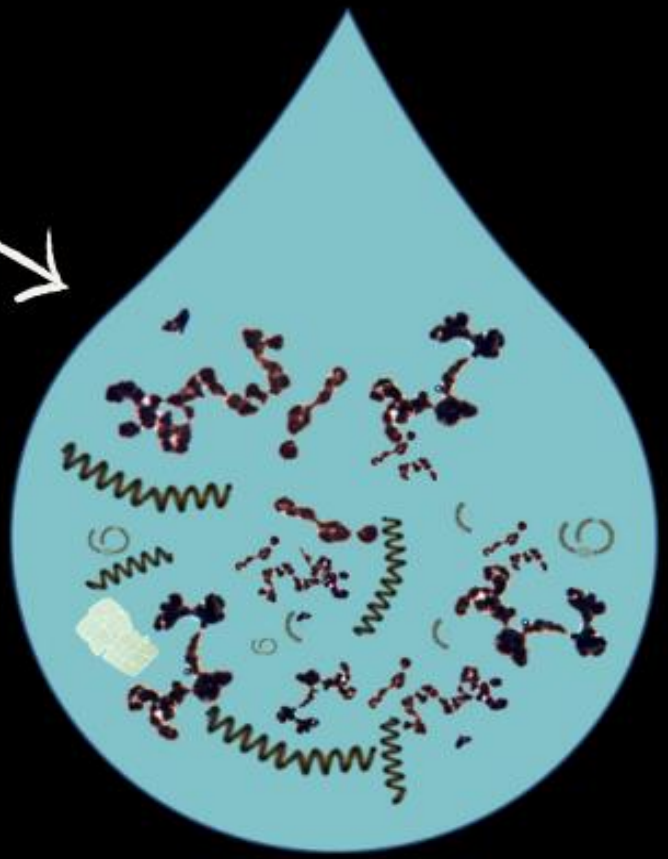
Rainbow trout

Toxin impacts on organisms

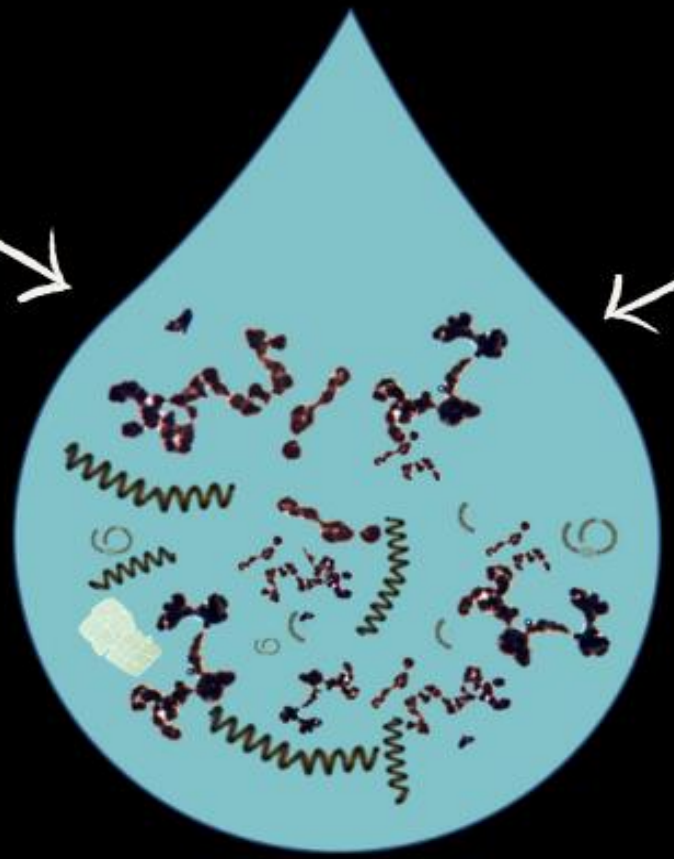
Carmichael and Boyer 2016, Bownik 2016, Babica et al. 2006 Buss et al. 2019, Mehinto et al. 2021, Best et al. 2001, Gélinas et al. 2012

What causes blooms?

sunlight

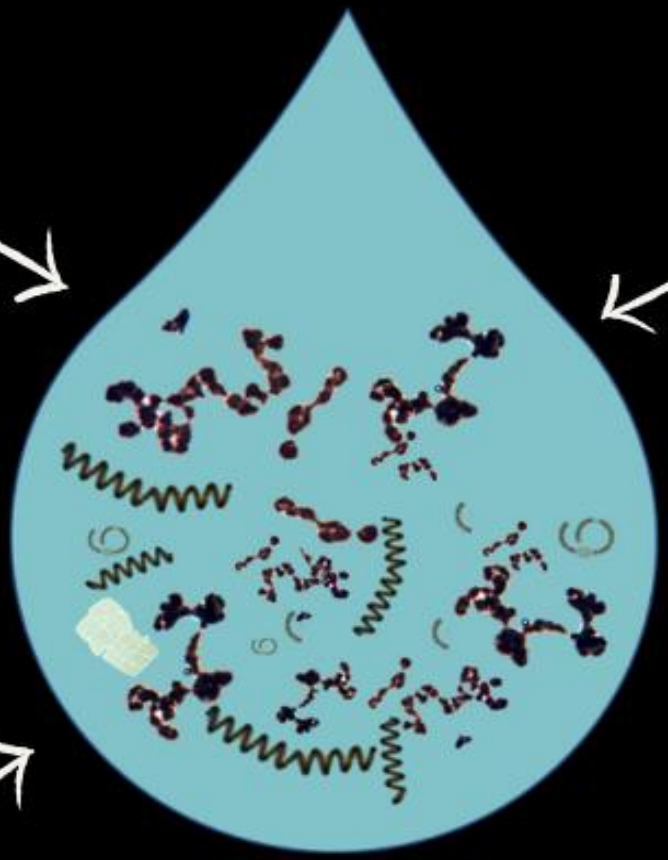


sunlight



still conditions

sunlight



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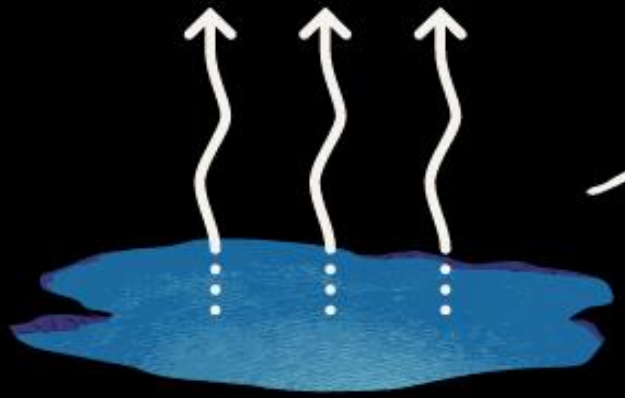
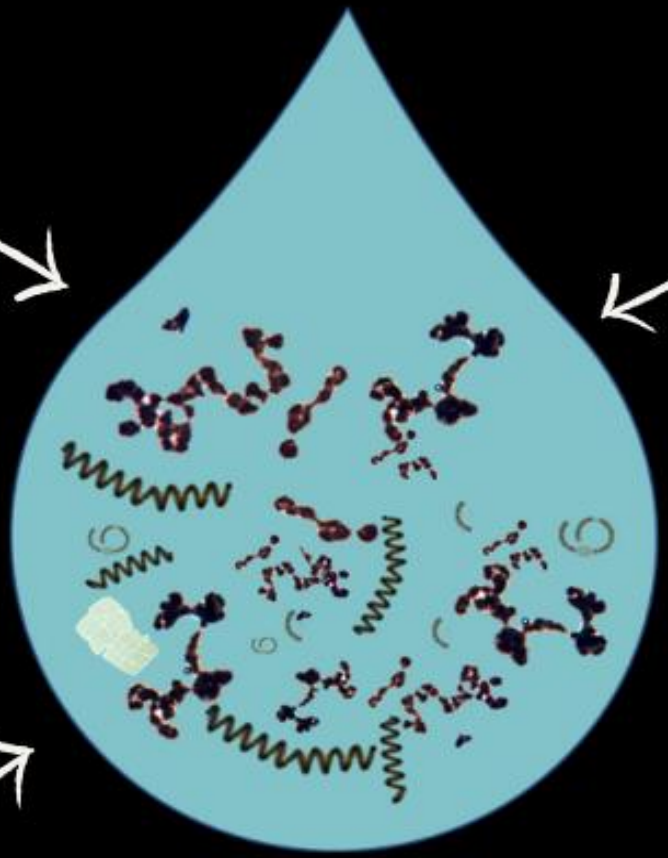
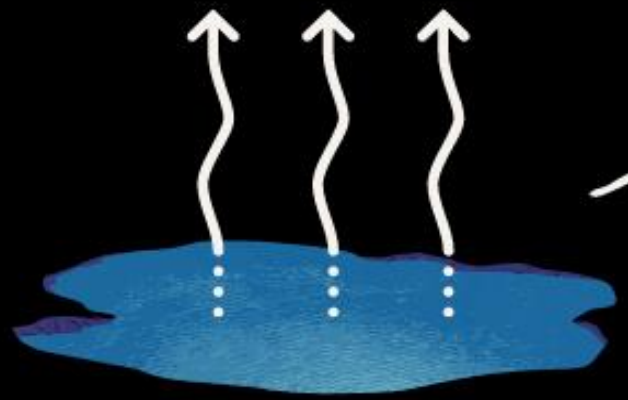


increased temperature

sunlight

still conditions





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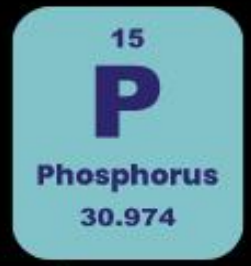
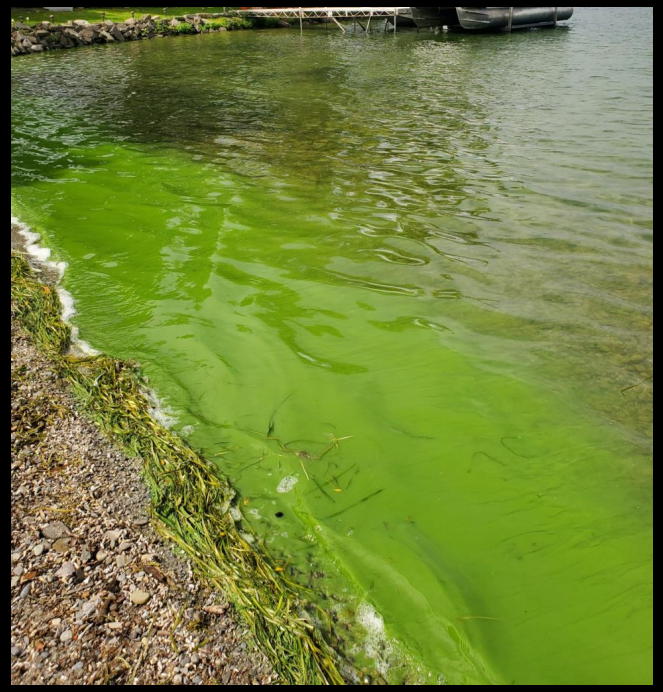


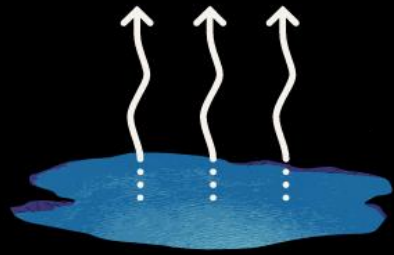
nutrients

Harmful Algal Blooms

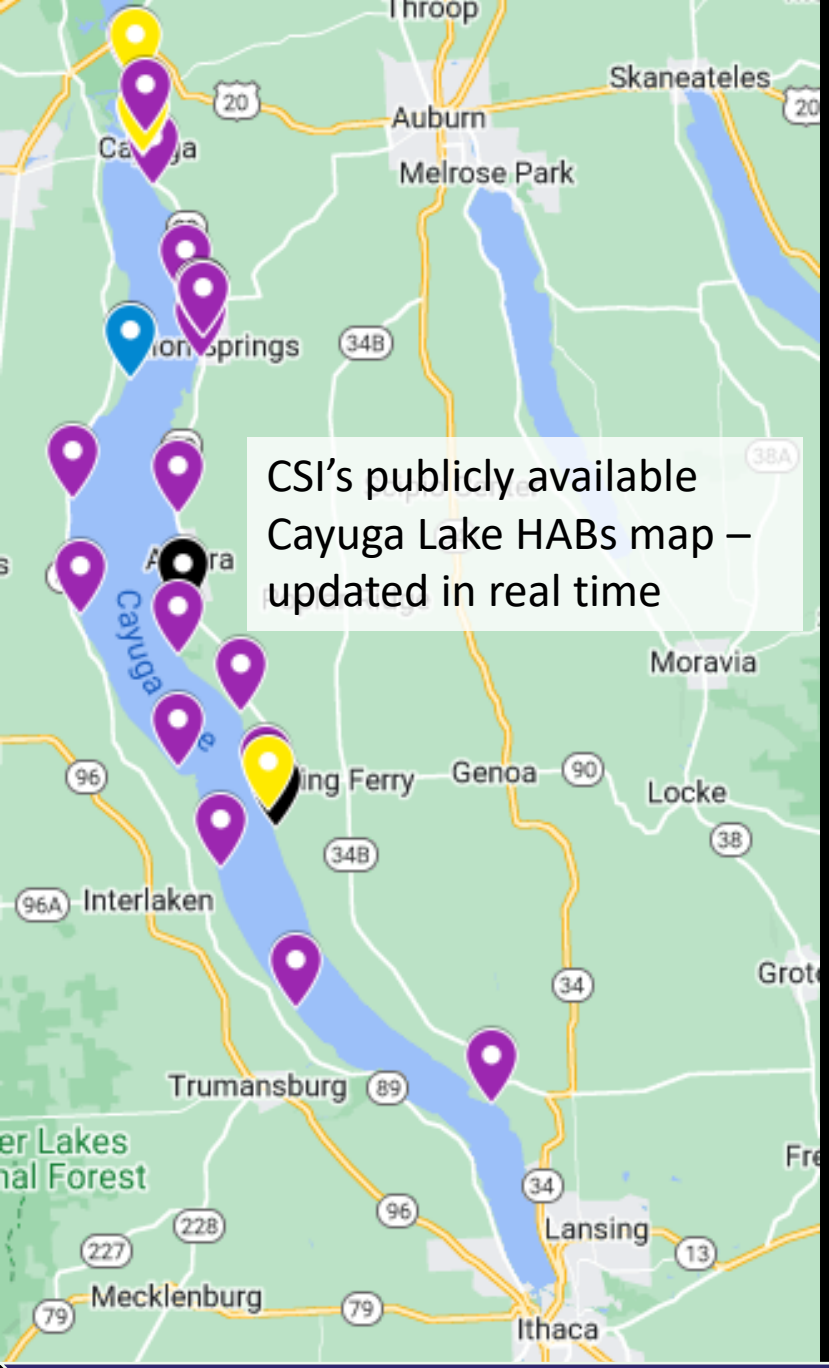


Cyanobacteria

Threats to humans and wildlife



Grow in certain conditions



CSI's publicly available Cayuga Lake HABs map – updated in real time

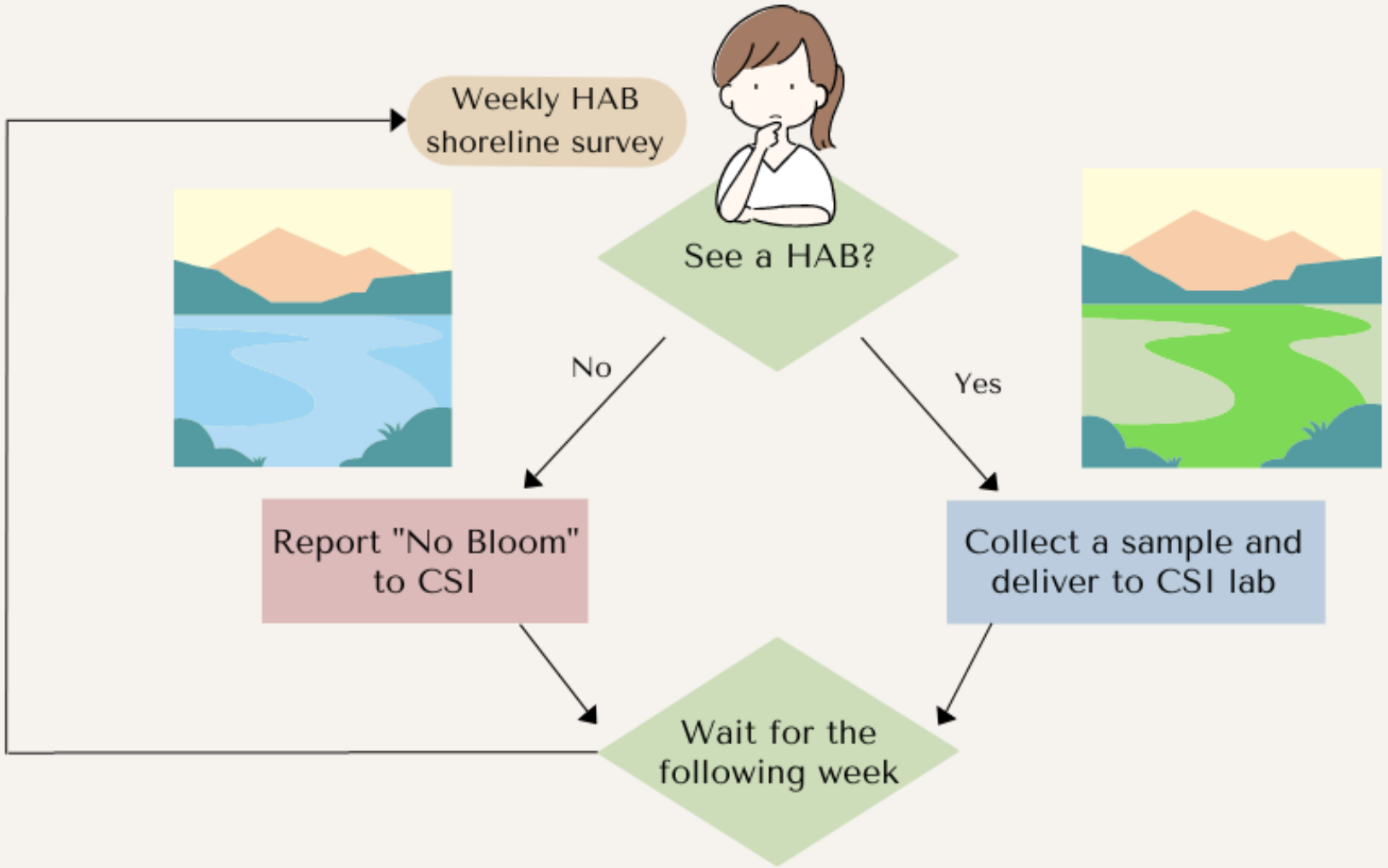
Cayuga Lake HABs Monitoring Program

This program has run for 5 years (and counting!)

It is the most thorough HABs monitoring program in New York State

Equally funded by Tompkins, Seneca, and Cayuga Counties

HAB "HARRIER" DUTIES



Note: “harrier” comes from the verb harry, to harass or attack repeatedly. As in “a harrier hawk attacks small game.” This term was applied to our HABs volunteers to describe their vigilance.

CSI LAB DUTIES

Receive potential HAB sample

Does cyanobacteria dominate the sample?

No

Remove pin from public HABs map

Yes

Report "cyanobacteria bloom" on public HABs map

Run lab analyses:

- Chlorophyll *a* ≈ bloom density*
- Microcystin ≈ bloom toxicity**

Report all results on public HABs map

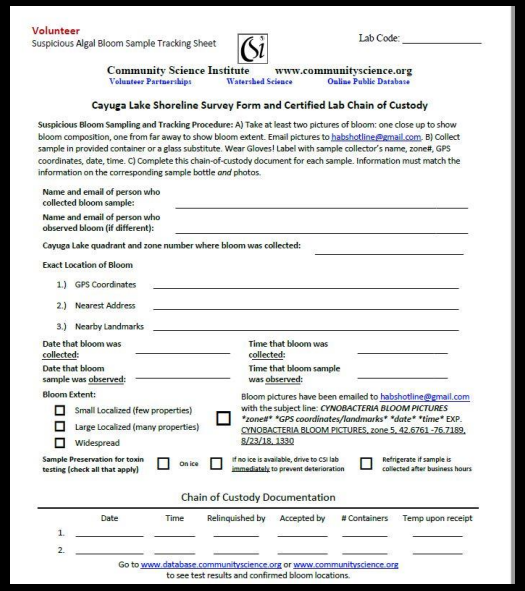
*Chlorophyll *a* can stem from organisms besides cyanobacteria, making this a *rough* estimate of bloom density

**Microcystin is only one of the possible cyanotoxins generated by cyanobacteria. It is a measure of toxicity *from microcystin toxin*, not of toxicity overall

HABs on Cayuga Lake: data collected

Data from volunteers:

- Location
- Time and date
- Photos
- Descriptions



Volunteer
Suspicious Algal Bloom Sample Tracking Sheet

Lab Code: _____

Community Science Institute www.communityscience.org
Volunteer Partnerships Watershed Science Online Public Database

Cayuga Lake Shoreline Survey Form and Certified Lab Chain of Custody

Suspicious Bloom Sampling and Tracking Procedure: A) Take at least two pictures of bloom: one close up to show bloom composition, one from far away to show bloom extent. Email pictures to habshotline@gmail.com. B) Collect sample in provided container or a glass substitute. Wear Gloves! Label with sample collector's name, zone#, GPS coordinates, date, time. C) Complete this chain-of-custody document for each sample. Information must match the information on the corresponding sample bottle *and* photos.

Name and email of person who collected bloom sample: _____

Name and email of person who observed bloom (if different): _____

Cayuga Lake quadrant and zone number where bloom was collected: _____

Exact Location of Bloom

1.) GPS Coordinates _____

2.) Nearest Address _____

3.) Nearby Landmarks _____

Date that bloom was collected: _____ Time that bloom was collected: _____

Date that bloom sample was observed: _____ Time that bloom sample was observed: _____

Bloom Extent:

☐ Small Localized (few properties)
☐ Large Localized (many properties)
☐ Widespread

Bloom pictures have been emailed to habshotline@gmail.com with the subject line: *CYNOBACTERIA BLOOM PICTURES *zone#* *GPS coordinates/landmarks* *date* *time* EXP.* CYNOBACTERIA BLOOM PICTURES, zone 5, 42.6761 -76.7189, 8/23/18, 1330

Sample Preservation for toxin testing (check all that apply) ☐ On ice ☐ If no ice is available, drive to CSI lab immediately to prevent deterioration ☐ Refrigerate if sample is collected after business hours

Chain of Custody Documentation

	Date	Time	Relinquished by	Accepted by	# Containers	Temp upon receipt
1.						
2.						

Go to www.database.communityscience.org or www.communityscience.org to see test results and confirmed bloom locations.

Data from CSI lab:

- Cyanobacteria composition
- Chlorophyll *a* concentration
- Microcystin toxin concentration

	Microscopy		Total Chlorophyll a		Microcystin	
Bloom Sample Code	Description	Analysis Date	Result in ug/L	Analysis Date	Result in ug/L	Analysis Date
22-3456-B1	sparse/moderate Dolichospermum	7/22/2022	117	7/26/2022	< 0.30	7/25/2022
22-3400-B1	sparse Microcystis	8/1/2022	10.12	8/3/2022	3.47	8/5/2022
22-3475-B3	sparse Microcystis, sparse Oscillotoria, sparse Merismopedia, Pseudoanabaena present	8/8/2022	21.8	8/8/2022	4.58	8/19/2022
22-3402-B3	dense Microcystis, sparse/moderate Dolichospermum, Pseudoanabaena present	8/7/2022	2448	8/8/2022	916.00	8/12/2022
22-3458-B4	dense Microcystis, sparse/moderate Dolichospermum, sparse Limnoraphis, Pseudoanabaena	8/11/2022	2805	8/12/2022	451.00	8/12/2022

A note about chlorophyll *a* and microcystin toxin

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22-3475-B3	sparse Microcystis, sparse Oscillotoria, sparse Merismopedia, Pseudoanabaena present	8/8/2022	21.8	8/8/2022		4.58	8/19/2022
22-3402-B3	dense Microcystis, sparse/moderate Dolichospermum, Pseudoanabaena present	8/7/2022	2448	8/8/2022		916.00	8/12/2022
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22-3402-B3	dense Microcystis, sparse/moderate Dolichospermum, Pseudoanabaena present	8/7/2022	2448	8/8/2022		916.00	8/12/2022
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Non-bloom chlorophyll *a* levels: ≤25 µg/L

A note about chlorophyll *a* and microcystin toxin

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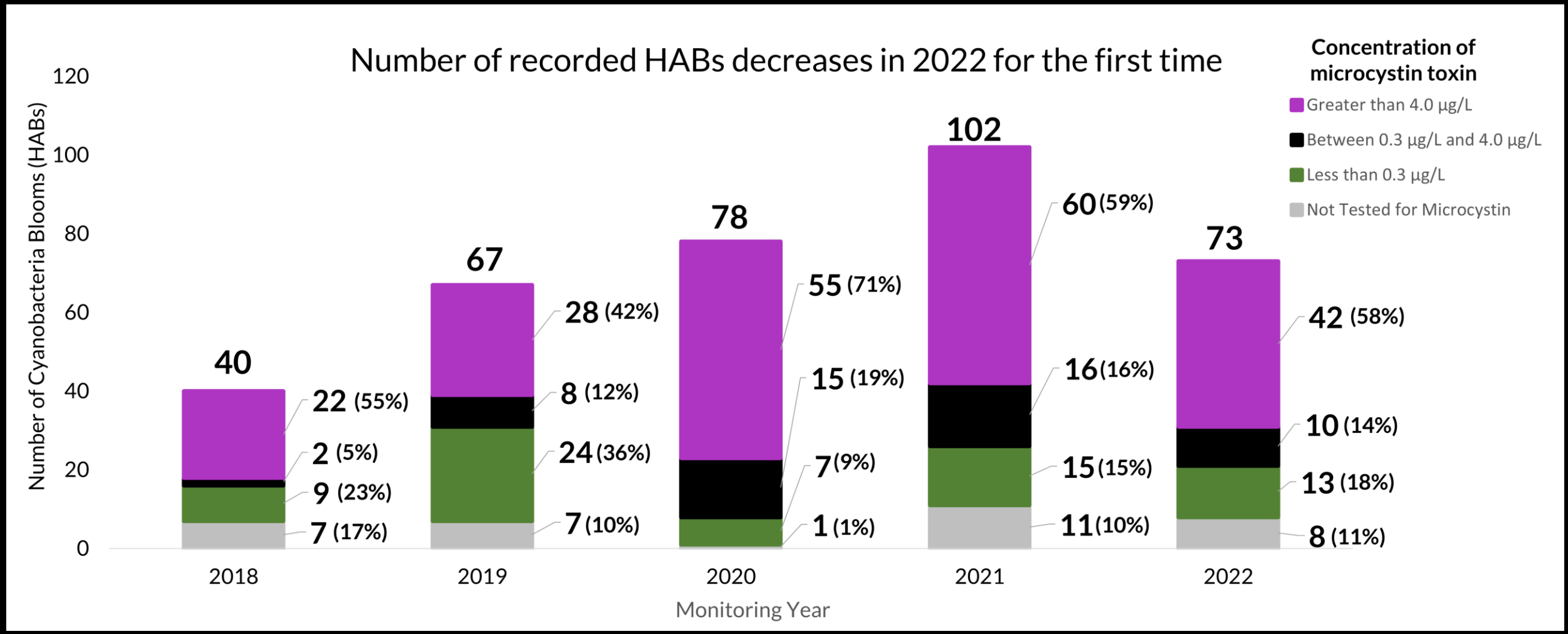
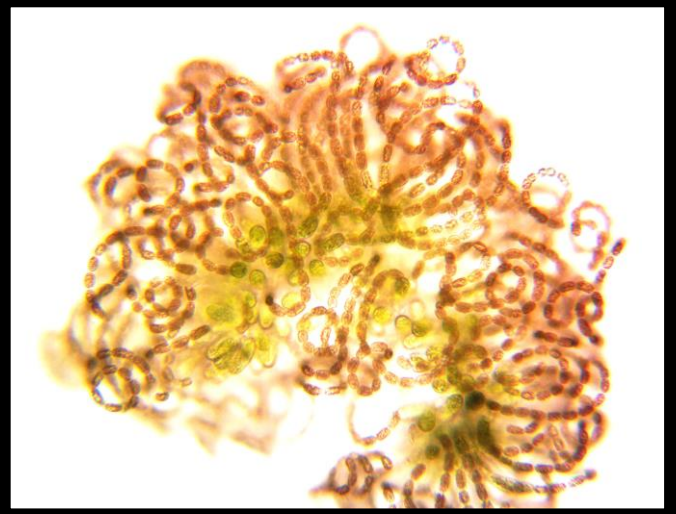
Microcystin limits
(set by NY State Dept. of Health):

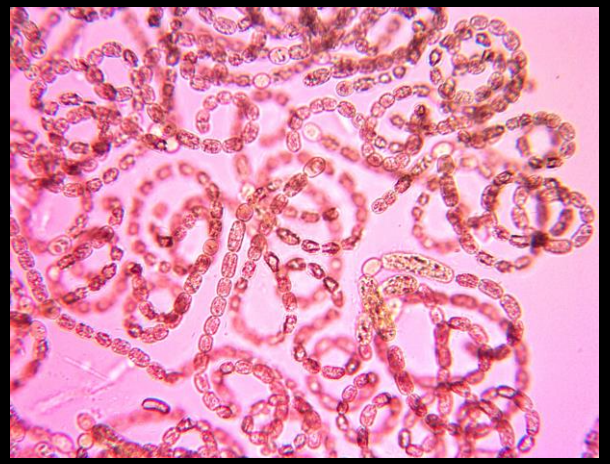
- Drinking water limit: ≤0.3 µg/L
- Contact recreation limit: ≤4 µg/L

It is NEVER safe to swim in a bloom! Always keep pets and children away from blooms!

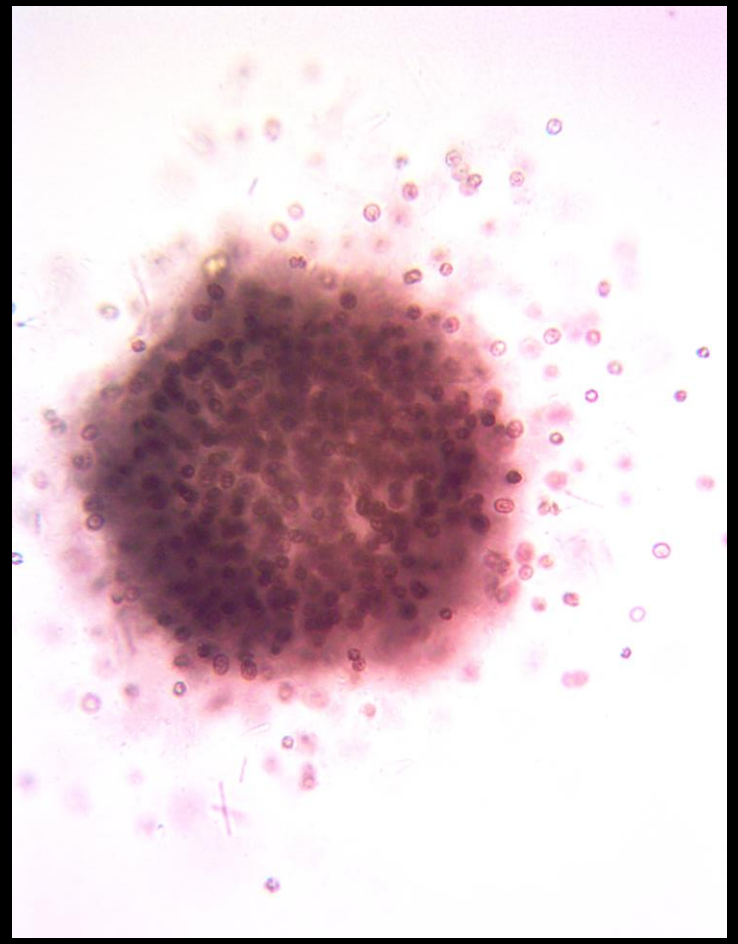

Number of recorded HABs decreases in 2022 for the first time
Concentration of microcystin toxin
Greater than 4.0 µg/L
Between 0.3 µg/L and 4.0 µg/L
Less than 0.3 µg/L
Not Tested for Microcystin
Number of Cyanobacteria Blooms (HABs)
120
100
80
60
40
20
0
2018
2019
2020
2021
2022
Monitoring Year
40
22 (55%)
2 (5%)
9 (23%)
7 (17%)
67
28 (42%)
8 (12%)
24 (36%)
7 (10%)
78
55 (71%)
15 (19%)
7 (9%)
1 (1%)
102
60 (59%)
16 (16%)
15 (15%)
11 (10%)
73
42 (58%)
10 (14%)
13 (18%)
8 (11%)

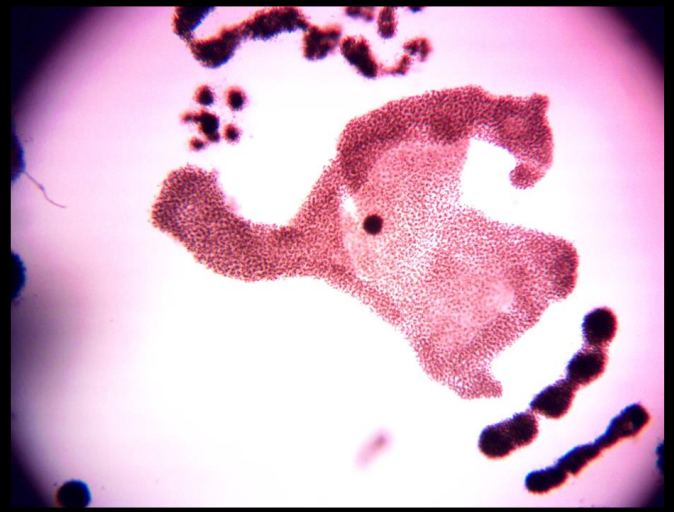
Dolichospermum sp.

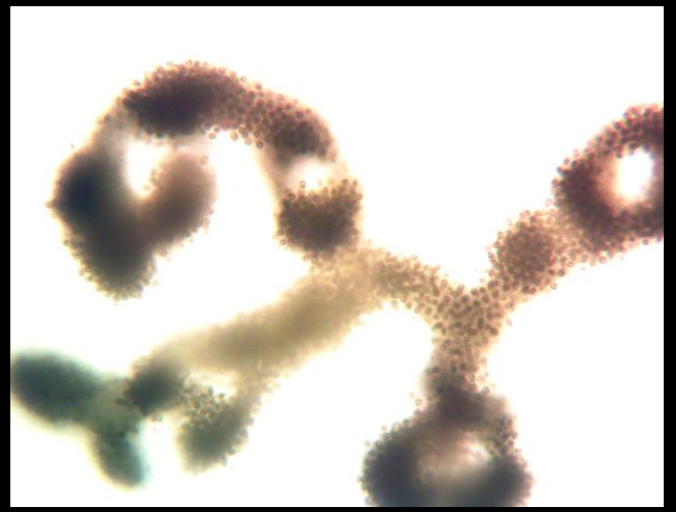




Microcystis sp.



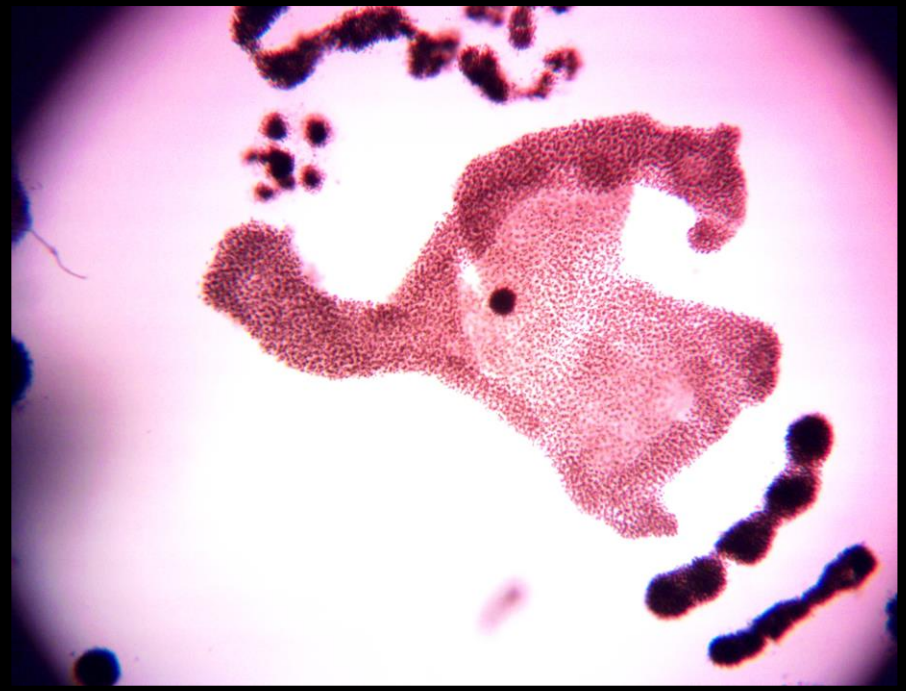




Cayuga Lake Cyanobacteria

Dolichospermum sp.

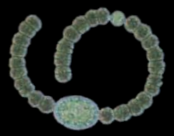
Microcystis sp.



Dolichospermum sp. and *Microcystis* sp. are Cayuga Lake's most common bloom-forming cyanobacteria

Cayuga Lake HABs – cyanobacteria

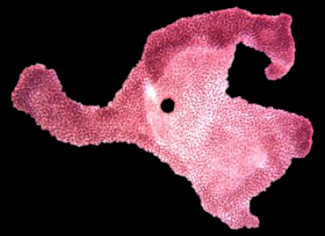
July



= *Dolichospermum* sp.

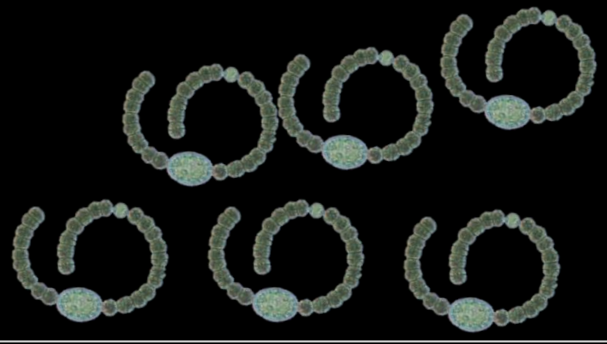
August

September

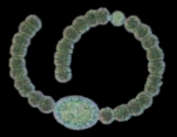


= *Microcystis* sp.

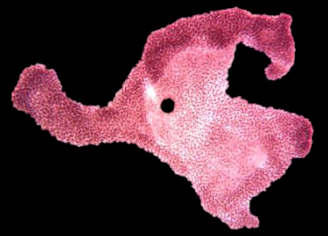
Cayuga Lake HABs – cyanobacteria



July | August | September

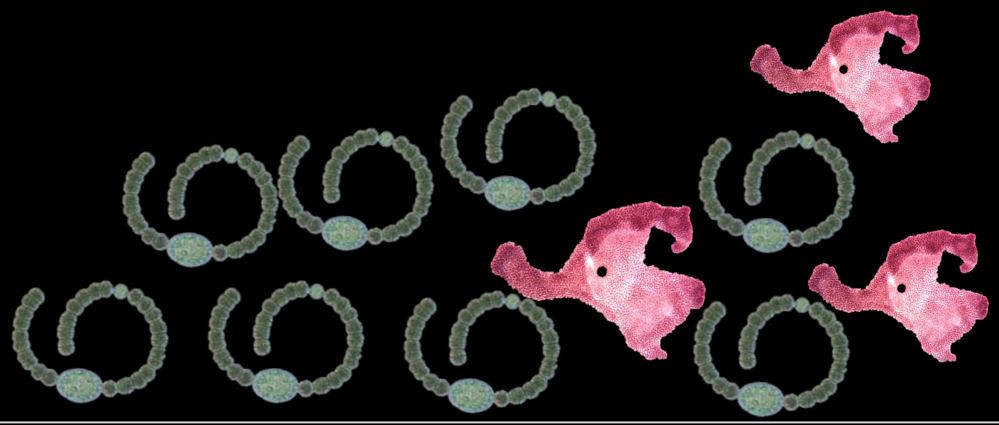


= *Dolichospermum* sp.



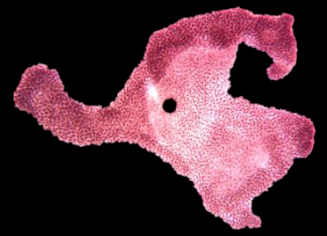
= *Microcystis* sp.

Cayuga Lake HABs – cyanobacteria



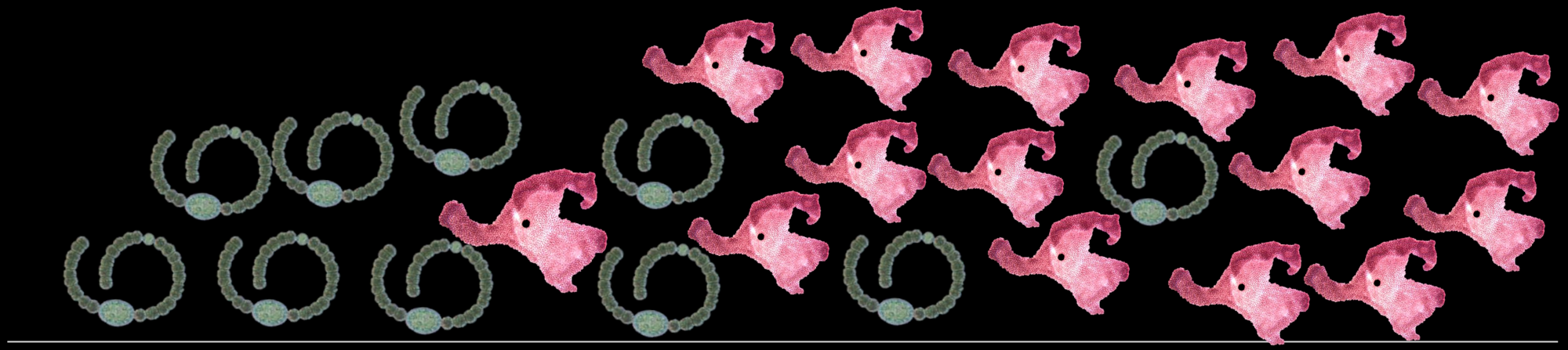
July August September

= *Dolichospermum* sp.



= *Microcystis* sp.

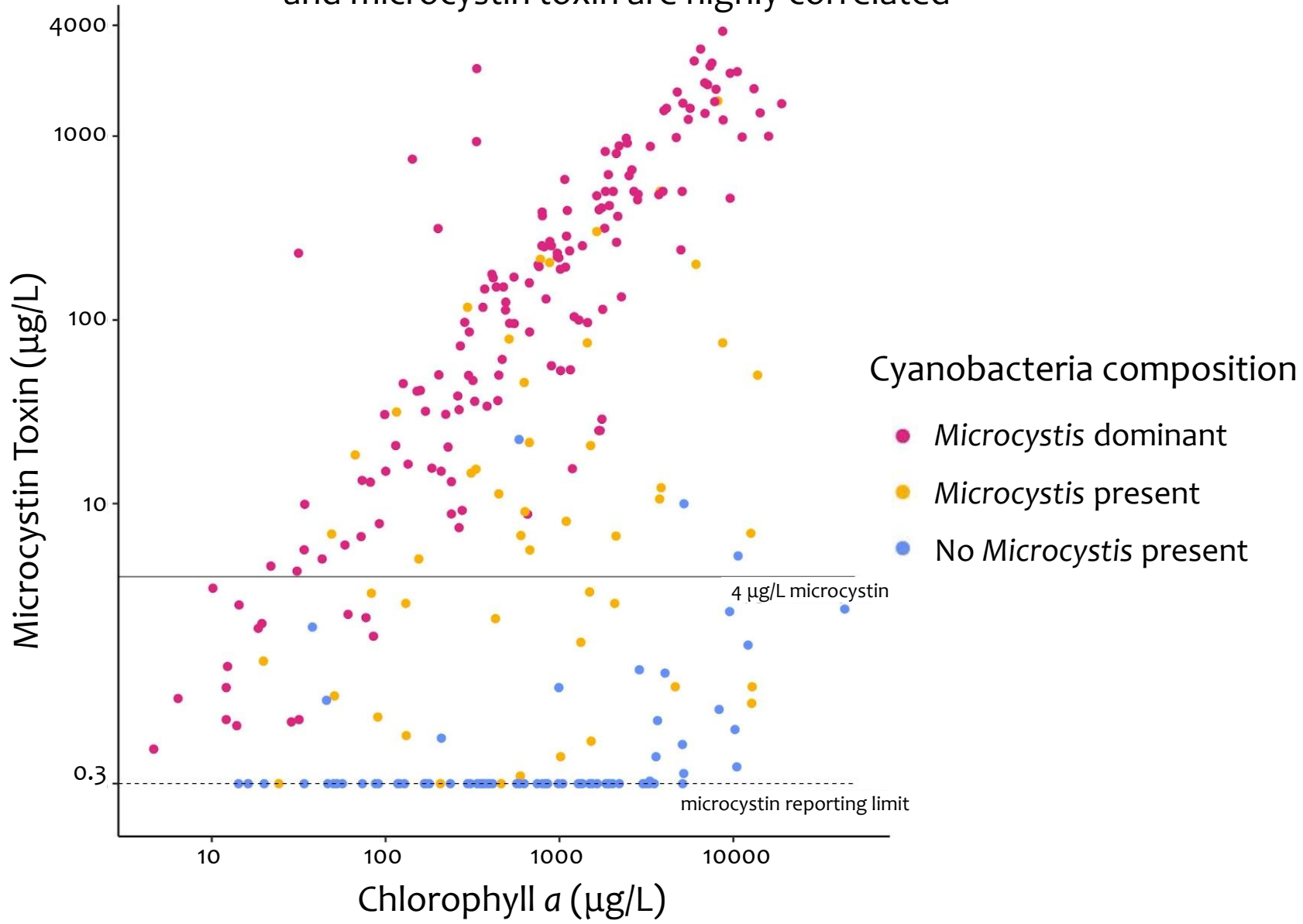
Cayuga Lake HABs – cyanobacteria



= *Dolichospermum* sp.

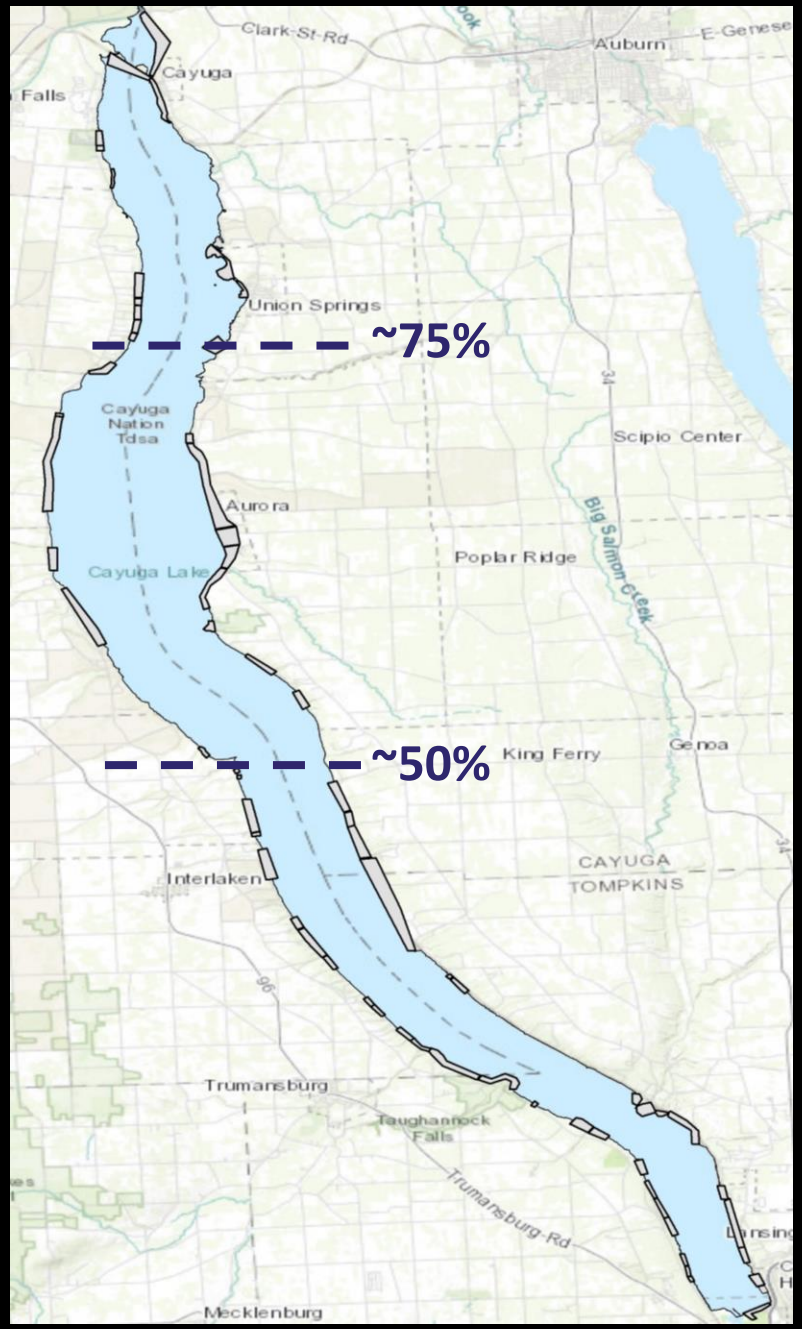
= *Microcystis* sp.

In *Microcystis*-dominated blooms, chlorophyll *a* and microcystin toxin are highly correlated



Spatial Patterns

microcystin toxin recreation limit: **≤4 µg/L**



Spatial Patterns

>4µg/L = high in microcystin toxin

62% of **all HABs** observed occur north of Sheldrake Point

80% of HABs high in microcystin toxin occurred north of Sheldrake Point

>4µg/L = high in microcystin toxin

44% of **all HABs** observed occur in the northern ¼ of Cayuga Lake

64% of HABs high in microcystin toxin occurred in the northern ¼ of Cayuga Lake

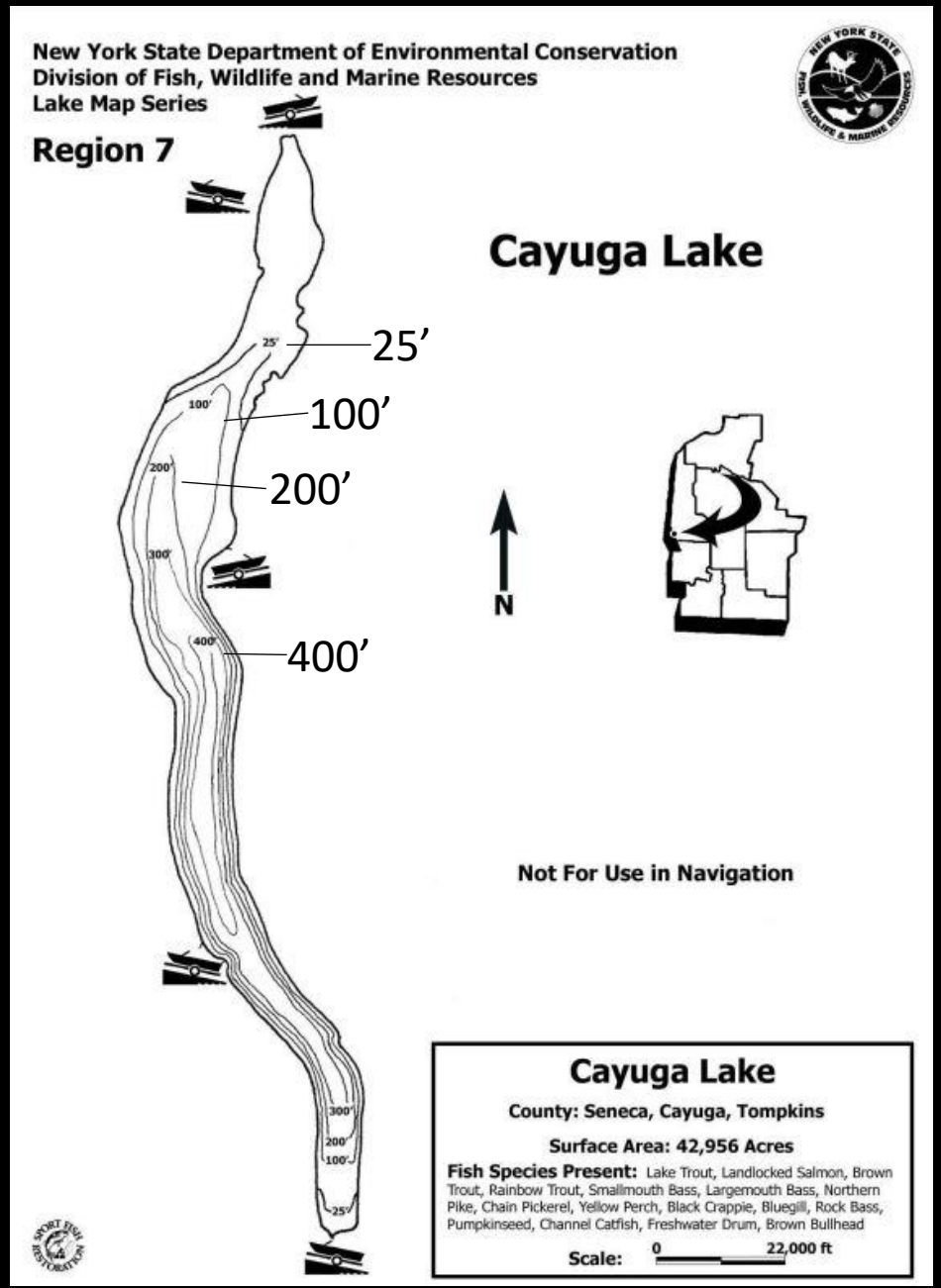
>4µg/L = high in microcystin toxin

Why are Cayuga Lake HABs different on the northern vs. southern end?

Potential explanations:

- Nutrients
- Shallow water
  - Warmer water
  - Higher density of *Microcystis*

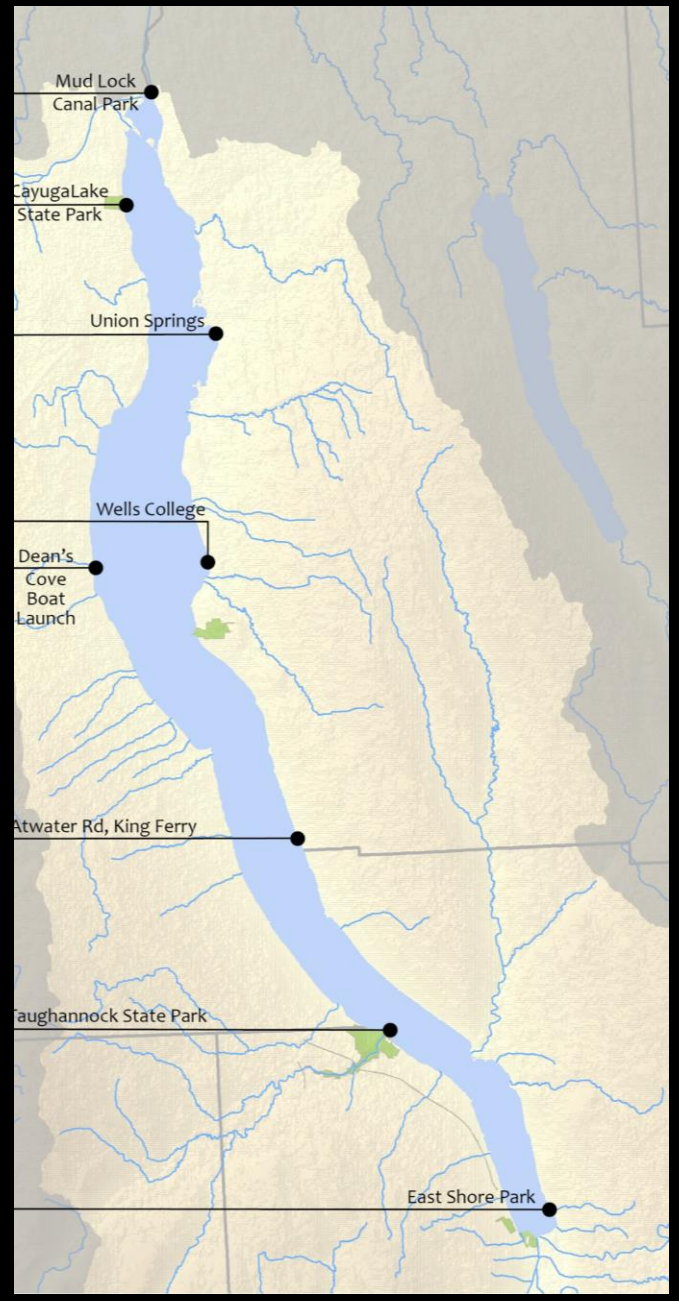
O'Leary et al. 2019



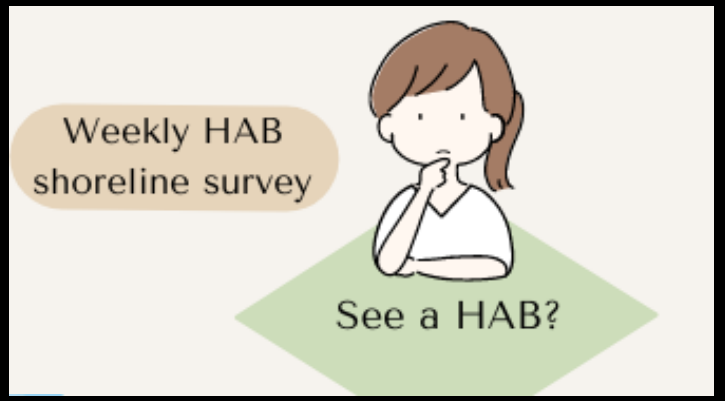
Plankton Net Surveys

8 locations are regularly surveyed during non-bloom conditions.

Surveys demonstrate denser populations of *Microcystis* sp. at the north end of the lake



HABs on Cayuga Lake

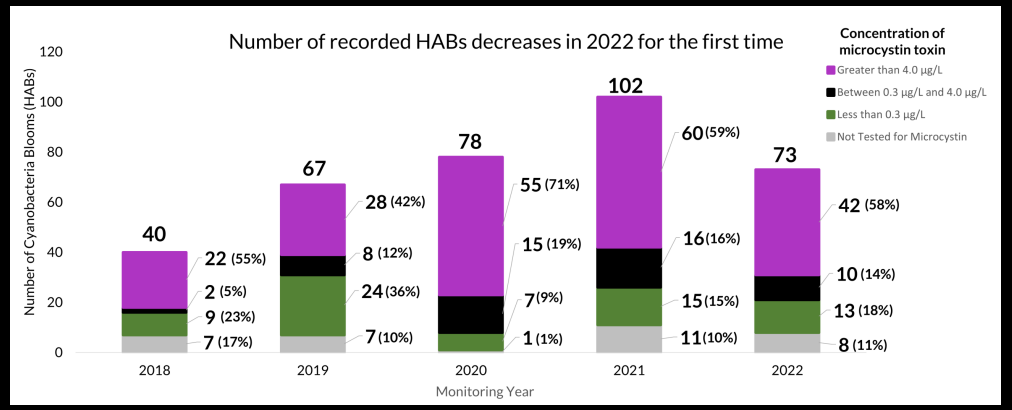


Amazing volunteers!

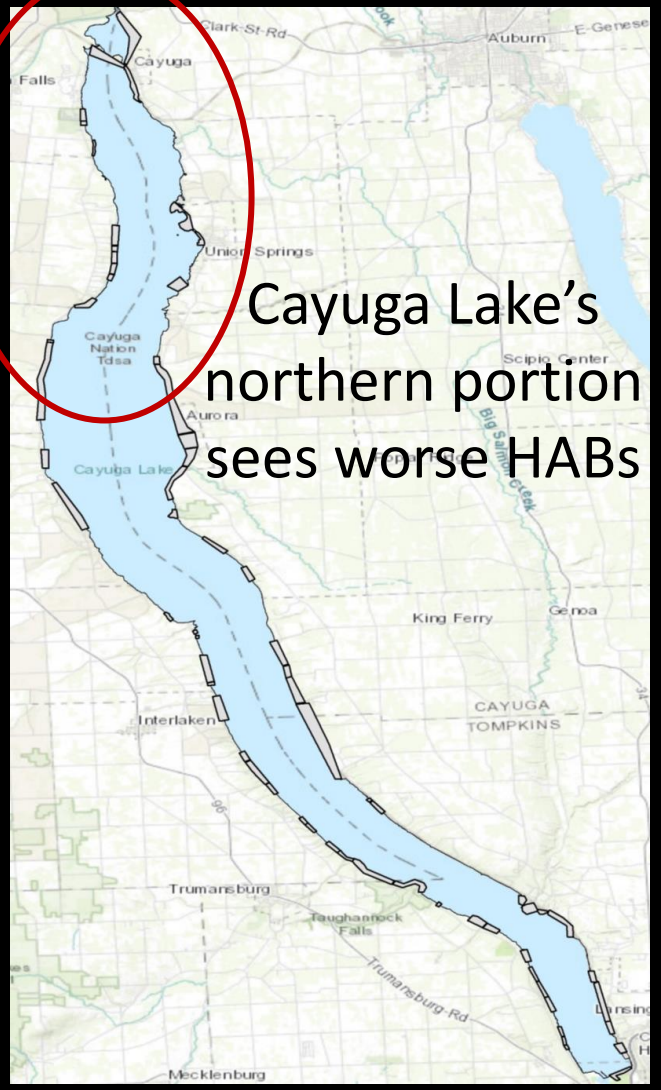
Microcystis spp.

Dolichospermum spp.

Main cyanobacteria



HABs are (mostly) increasing



Cayuga Lake's northern portion sees worse HABs

HABs Database

Coming soon…

Landing Page

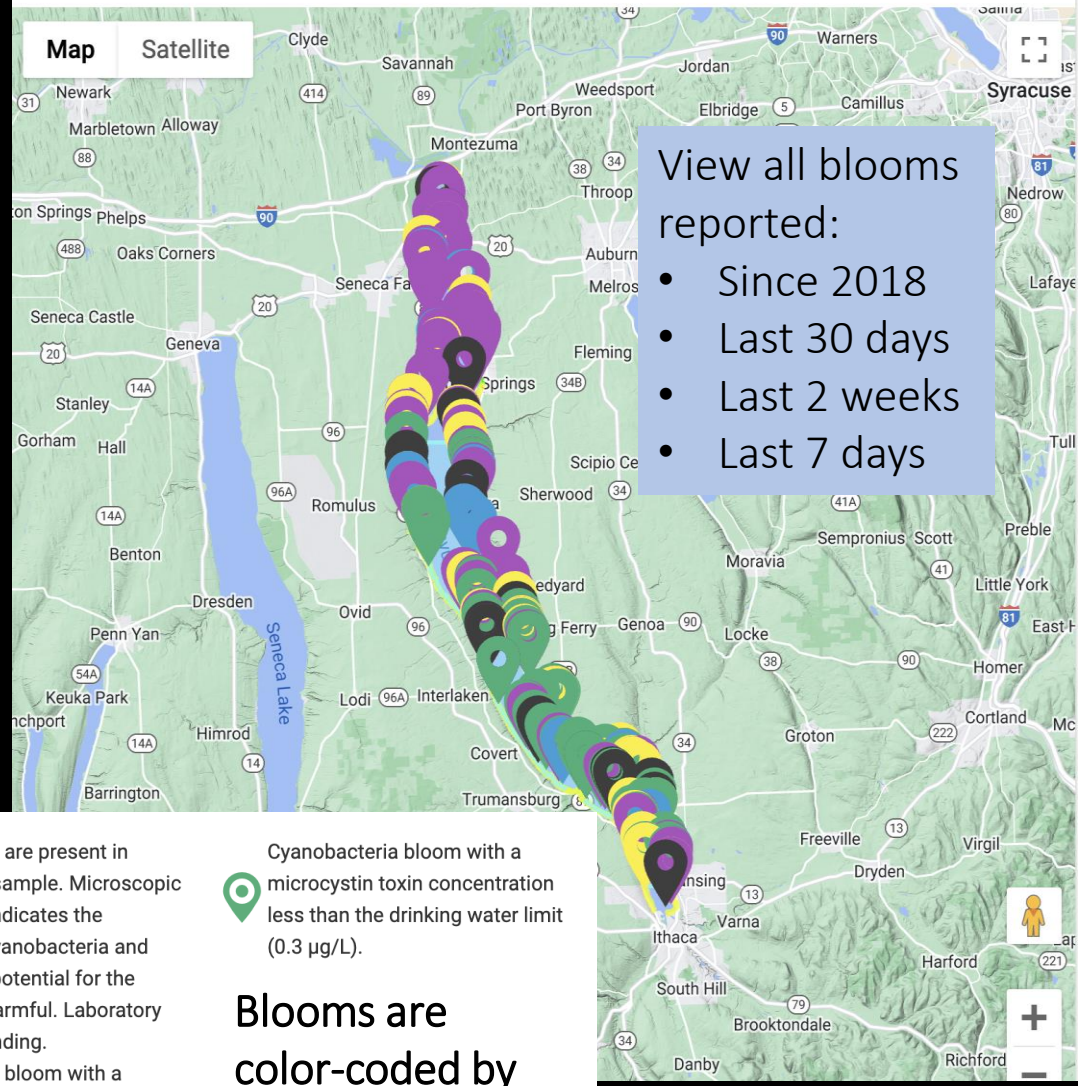
Events

	Bloom Code	Observed	Segment	Extent
1	22-3492-B2	October 05, 2022	Lakeshore Segment Southeast 1: Elmwood Point to Lake Ridge Point	Small Localized (few properties)
2	22-3458-B7	September 30, 2022	Lakeshore Segment Northeast 1: Northern Marshes to Harris Park	Large Localized
3	22-3492-B1	September 30, 2022	Lakeshore Segment Southeast 1: Elmwood Point to Lake Ridge Point	Large Localized
4	22-3414-B1	September 24, 2022	Lakeshore Segment Northeast 10: Long Point State Park to Elmwood Point	Small Localized (few properties)
5	22-3410-B1	September 24, 2022	Lakeshore Segment Northeast 9: Long Point State Park	Widespread
6	22-3478-B2	September 24, 2022	Lakeshore Segment Southeast 1: Elmwood Point to Lake Ridge Point	Large Localized

Table of HAB Events with links to lakeshore segments and blooms

Map defaults to display all HABs since 2018. Use drop-down menu to select recent bloom reports

All Blooms since 2018



View all blooms reported:

- Since 2018
- Last 30 days
- Last 2 weeks
- Last 7 days

378

HABS REPORTED SINCE 2018

Tally of the number of blooms reported since the start of our monitoring program

Suspicious Bloom. Photos indicate that the suspicious bloom is highly likely to be a harmful algal bloom (HAB). No laboratory results are yet available.

Cyanobacteria bloom with a microcystin toxin concentration that exceeds the limit for contact recreation (4.0 µg/ L).

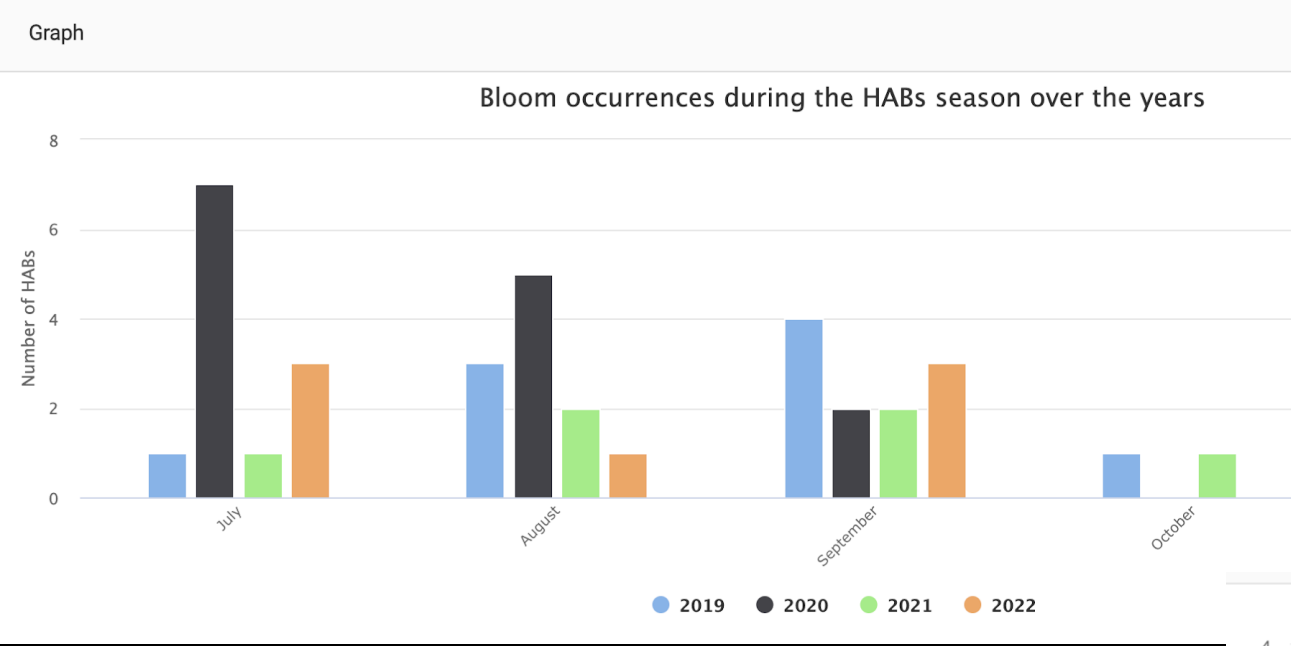
Cyanobacteria are present in bloom (HAB) sample. Microscopic examination indicates the presence of cyanobacteria and therefore the potential for the bloom to be harmful. Laboratory results are pending.

Cyanobacteria bloom with a microcystin toxin concentration in between the drinking water limit (0.3 µg/L) and the limit for contact recreation (4.0 µg/L).

Cyanobacteria bloom with a microcystin toxin concentration less than the drinking water limit (0.3 µg/L).

Blooms are color-coded by microcystin toxin concentration

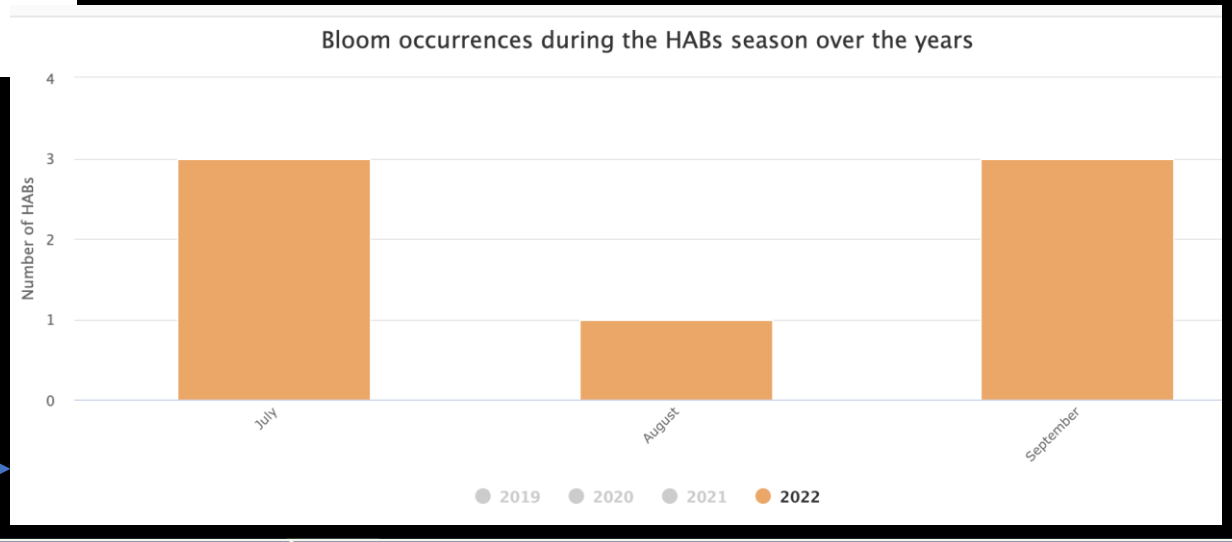
Segment Page



Map of all blooms reported in the given segment

Visualize monthly trends in HABs during each year of our monitoring program

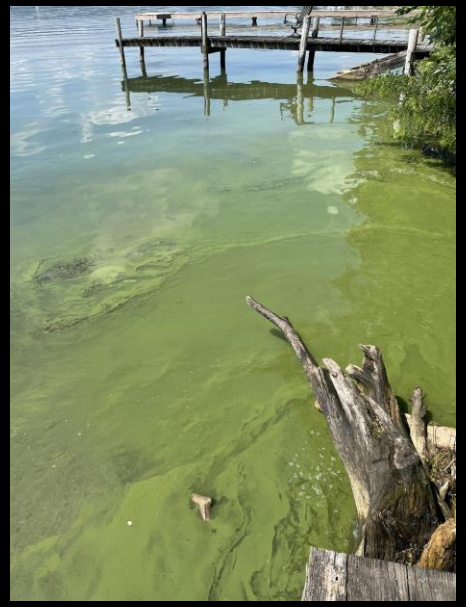
Graphs can be modified to include multiple years or just one year



Event Page

Where, When, and What details for a single bloom

Photo of bloom



Harmful Algal Bloom (HAB) Event Information

Bloom Code 22-3473-B2

Where

Water Body	Cayuga Lake
LatLong	42.63014, -76.68778
Segment	Lakeshore Segment Southwest 9: Frontenac Point to Lively Run
County	Seneca
Extent	Large Localized

When

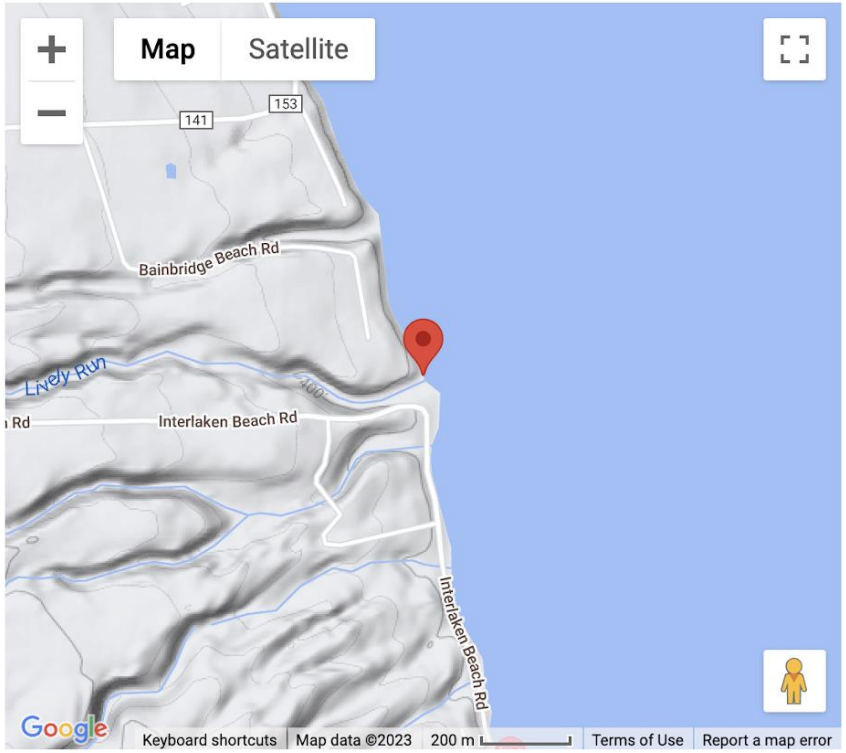
Bloom Reported	September 13, 2022
Bloom Sampled	September 13, 2022
Microscopic Examination	September 14, 2022

What

Bloom Genera [1]

Bloom Chemistry

Map



Bloom Description

shoreline along Interlaken Beach Rd, just east of Shepherdess Cellars

Become a HABs Harrier

Email us at
info@communityscience.org
to become a volunteer!

Community Science Institute

Partnering with Communities to Protect Water

Any questions?

Learn more at: **www.communityscience.org**

Email us at **info@communityscience.org** to become a volunteer!

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twitter.com/CSIwater