Harmful Algal Blooms (HABs) on Cayuga Lake: five years of monitoring

Grace Haynes
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.

Nonprofit 501(c)3 Organization

Certified Water Testing Lab ELAP #11790

Volunteer Water Monitoring Programs

- Synoptic Stream & Lake Monitoring
- Cayuga Lake HABs Monitoring
- Biomonitoring (BMI Monitoring)

Red Flag Monthly Stream Monitoring

Public Water Quality Database

Outreach and Education

Who is Community Science Institute?

What is a “HAB”?

Cayuga Lake HABs Monitoring Program
Community Science Institute’s Mission
To empower community members to protect water through volunteer stream and lake monitoring

- Nonprofit 501(c)3 Organization
- Certified Water Testing Lab ELAP #11790
- Volunteer Water Monitoring Programs
  - Synoptic Stream & Lake Monitoring
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  - Biomonitoring (BMI Monitoring)
  - Red Flag Monthly Stream Monitoring
- Public Water Quality Database
- Outreach and Education

Who is Community Science Institute? What is a “HAB”? Cayuga Lake HABs Monitoring Program
What is a “HAB”?

H = Harmful
A = Algal
B = Bloom
What is a “HAB”? 

H = Harmful  
A = Algal
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What is a “HAB”?

\[
\begin{align*}
H &= \text{Harmful} \\
A &= \text{Algal} \\
B &= \text{Bloom}
\end{align*}
\]
What is a “HAB”?

H = Harmful
A = Algal
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What is a “HAB”? 

H = Harmful
A = Algal
B = Bloom
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.
When do they become “harmful”?  

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

microcystin toxin
Impacts on humans

- CONTACT RECREATION (swimming, fishing, kayaking)
- DRINKING WATER
- LIVESTOCK
- ECONOMICS

Who is Community Science Institute?  What is a “HAB”?  Cayuga Lake HABs Monitoring Program
Impacts on the ecosystem

Anoxic conditions

Toxin impacts on organisms

What causes blooms?
sunlight

Who is Community Science Institute?  What is a “HAB”?  Cayuga Lake HABs Monitoring Program
Who is Community Science Institute?  
What is a “HAB”?  
Cayuga Lake HABs Monitoring Program
Harmful Algal Blooms

Cyanobacteria

Threats to humans and wildlife

Grow in certain conditions

Who is Community Science Institute? What is a “HAB”? Cayuga Lake HABs Monitoring Program
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
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.

Who is Community Science Institute? - What is a “HAB”? - Cayuga Lake HABs Monitoring Program
Chlorophyll $\alpha$ 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

Data from CSI lab:
• Cyanobacteria composition
• Chlorophyll \(a\) concentration
• Microcystin toxin concentration

<table>
<thead>
<tr>
<th>Bloom Sample Code</th>
<th>Microscopy Description</th>
<th>Analysis Date</th>
<th>Total Chlorophyll (a) Result</th>
<th>Analysis Date</th>
<th>Microcystin Result</th>
<th>Analysis Date</th>
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<tbody>
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<td>7/22/2022</td>
<td>117 ug/L</td>
<td>7/28/2022</td>
<td>6.30 ug/L</td>
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<td>2448 ug/L</td>
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<td>916.80 ug/L</td>
<td>8/12/2022</td>
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<td>22-3458-B44</td>
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<td>8/11/2022</td>
<td>2065 ug/L</td>
<td>8/12/2022</td>
<td>451.00 ug/L</td>
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A note about chlorophyll \( \alpha \) and microcystin toxin

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<td>0.30</td>
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<td>21.8</td>
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<td>8/12/2022</td>
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<td>8/12/2022</td>
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Non-bloom chlorophyll $a$ levels: ≤25 µg/L
A note about chlorophyll $a$ and microcystin toxin

Microcystin limits (set by NY State Dept. of Health):
- Drinking water limit: $\leq 0.3 \mu g/L$
- Contact recreation limit: $\leq 4 \mu g/L$

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

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Who is Community Science Institute?  
What is a “HAB”?  
Cayuga Lake HABs Monitoring Program
Dolichospermum sp.
Microcystis sp.
**Cayuga Lake Cyanobacteria**

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

*Who is Community Science Institute?*  
*What is a “HAB”?*  
*Cayuga Lake HABs Monitoring Program*
Cayuga Lake HABs – cyanobacteria

July

=$Dolichospermum$ sp.

August

$Microcystis$ sp.

September
Cayuga Lake HABs – cyanobacteria

Who is Community Science Institute?
What is a “HAB”?
Cayuga Lake HABs Monitoring Program

July

August

September

= Dolichospermum sp.

= Microcystis sp.
Cayuga Lake HABs – cyanobacteria

July

= Dolichospermum sp.

August

= Microcystis sp.

September
Cayuga Lake HABs – cyanobacteria

July

August

September

= Dolichospermum sp.

= Microcystis sp.
In Microcystis-dominated blooms, chlorophyll $a$ and microcystin toxin are highly correlated.
Spatial Patterns

microcystin toxin recreation limit: \( \leq 4 \mu g/L \)
Spatial Patterns

\[150% \text{ and } 75\%\]

\[>4\text{µg/L} = \text{high in microcystin toxin}\]
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!

HABs are (mostly) increasing

Main cyanobacteria

Dolichospermum spp.

Microcystis spp.

Cayuga Lake’s northern portion sees worse HABs

Weekly HAB shoreline survey

see a HAB?

Cayuga Lake HABs Monitoring Program

Who is Community Science Institute?

What is a “HAB”?
HABs Database

Coming soon...
Who is Community Science Institute?

What is a “HAB”?

Cayuga Lake HABs Monitoring Program

### Table of HAB Events

<table>
<thead>
<tr>
<th>Bloom Code</th>
<th>Observed</th>
<th>Segment</th>
<th>Extent</th>
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<tbody>
<tr>
<td>1</td>
<td>22-3492-82</td>
<td>October 05, 2022</td>
<td>Lakeshore Segment Southeast 1: Elmwood Point to Lake Ridge Point</td>
</tr>
<tr>
<td>2</td>
<td>22-3458-87</td>
<td>September 30, 2022</td>
<td>Lakeshore Segment Northeast 1: Northern Marshes to Harris Park</td>
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<tr>
<td>3</td>
<td>22-3492-81</td>
<td>September 30, 2022</td>
<td>Lakeshore Segment Southeast 1: Elmwood Point to Lake Ridge Point</td>
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<tr>
<td>4</td>
<td>22-3414-81</td>
<td>September 24, 2022</td>
<td>Lakeshore Segment Northeast 10: Long Point State Park to Elmwood Point</td>
</tr>
<tr>
<td>5</td>
<td>22-3410-81</td>
<td>September 24, 2022</td>
<td>Lakeshore Segment Northeast 9: Long Point State Park</td>
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<td>6</td>
<td>22-3478-82</td>
<td>September 24, 2022</td>
<td>Lakeshore Segment Southeast 1: Elmwood Point to Lake Ridge Point</td>
</tr>
</tbody>
</table>

**378**

HABS REPORTED SINCE 2018

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

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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 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 that exceeds the limit for contact recreation (4.0 μg/L).

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).

Blooms are color-coded by microcystin toxin concentration

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View all blooms reported:
- Since 2018
- Last 30 days
- Last 2 weeks
- Last 7 days

---

Who is Community Science Institute?  What is a “HAB”?  Cayuga Lake HABs Monitoring Program
Who is Community Science Institute?

What is a “HAB”?

Cayuga Lake HABs Monitoring Program

Segment Page

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

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

Map of all blooms reported in the given segment.
### Where, When, and What
details for a single bloom

#### Photo of bloom

![Photo of bloom](image)

<table>
<thead>
<tr>
<th>What</th>
<th>Bloom Genera</th>
<th>Bloom Chemistry</th>
</tr>
</thead>
<tbody>
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#### Harmful Algal Bloom (HAB) Event Information

<table>
<thead>
<tr>
<th>Where</th>
<th>Water Body</th>
<th>LatLong</th>
<th>Segment</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Cayuga Lake</td>
<td>42.63014, -76.68778</td>
<td>Lakeshore Segment Southwest 9: Frontenac Point to Lively Run</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>County</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seneca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Extent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Large Localized</td>
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<table>
<thead>
<tr>
<th>When</th>
<th>Bloom Reported</th>
<th>Bloom Sampled</th>
<th>Microscopic Examination</th>
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<tbody>
<tr>
<td></td>
<td>September 13, 2022</td>
<td>September 13, 2022</td>
<td>September 14, 2022</td>
</tr>
</tbody>
</table>

#### Bloom Description

shoreline along Interlaken Beach Rd, just east of Shepherdess Cellars

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Where is Community Science Institute?

What is a “HAB”?

Cayuga Lake HABs Monitoring Program
Become a HABs Harrier

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

Learn more at: www.communityscience.org

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