

HABs in New York State Current status and mitigation efforts

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Introduction to Harmful Algae Blooms

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What is a HAB?

- H: Harmful** (toxins, other harmful compounds, economic aesthetics, ecological)
- A: Algal** (freshwater HABs refer to cyanobacteria, not truly algae)
- B: Bloom** (proliferation of cells, dense concentrations)

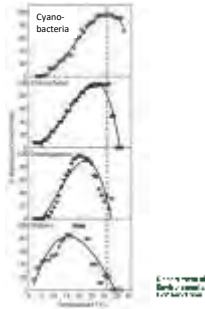


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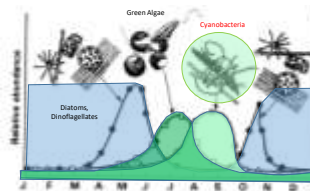
Cyanobacteria

- Highly specialized and competitive ancient bacteria
- Some types can regulate buoyancy or fix nitrogen
- Typically grow best in
 - high temperature
 - high light
 - high nutrient conditions
- Causes well understood, but hard to predict



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Seasonal Changes in Algae



- Peak HAB season is August – September
- But exactly when a bloom will appear is harder to say

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Common types of Cyanobacteria

Dolichospermum



- Fixes Nitrogen
- Produces anatoxin (nerve toxin) and others

Aphanizomenon



Microcystis



- Adjusts buoyancy
- Produces microcystin (liver toxin)



Cyanotoxins

Microcystins (liver toxins)

- Most common toxin in New York

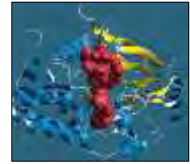
Anatoxins (nerve toxins)

- Potentially fatal to dogs

Lipopolysaccharides (endotoxins)

- Skin irritants and allergens
- Produced by most cyanobacteria

Other Toxins (Cylindrospermopsin, Saxitoxin, BMAA, etc.)



**No visual cues that toxins are present
Toxin production not well understood**



Visual Based Response: Why?

- Symptoms possible with or without toxins
- Sampling and analysis takes time
- Toxin production is extremely variable
- Not all toxins analyzed
- Blooms are dynamic:
 - Spatial, temporal & toxin gene expression
- Not practical to sample all waters at all times
 - **Know it, Avoid it, Report it!**



HAB Monitoring



National Interest in HABs



New York – high awareness & concern

At least 100,000 fish die from toxic algae bloom in Ontario Lake

Skaneateles Lake algae outbreak could be toxic, state DEC says

Harmful algae found in nearly 100 water bodies in New York



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DEC HABs Reporting System - NYHABS



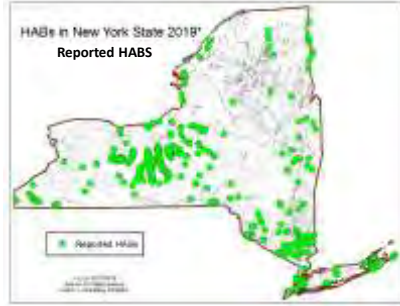
- The public reporting for HABs in NYS
- User friendly
- Upload photos
- Real reports

on.ny.gov/nyhabs



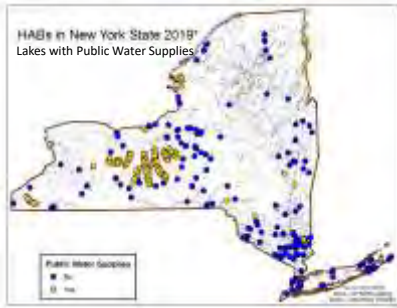
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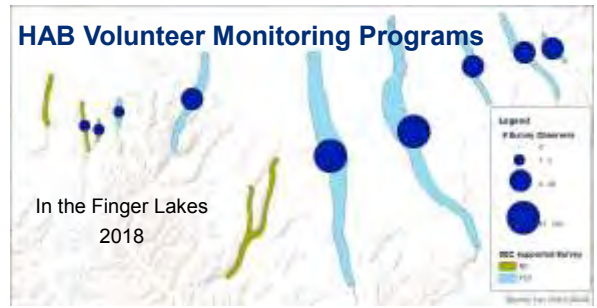
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HAB Volunteer Monitoring Programs



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Shoreline Surveillance



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Shoreline Surveillance



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Shoreline Surveillance



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Shoreline Surveillance



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Shoreline Surveillance



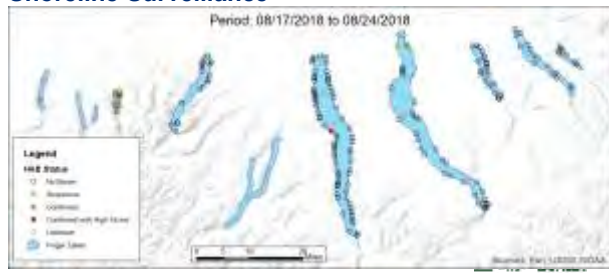
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Shoreline Surveillance



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Shoreline Surveillance



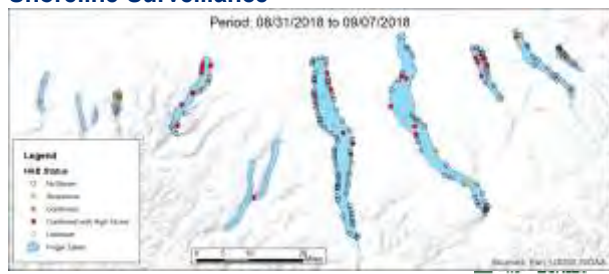
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Shoreline Surveillance



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Shoreline Surveillance



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Shoreline Surveillance



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Shoreline Surveillance



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The Governor's HABs Initiatives

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Combatting HABs in NYS

December 2017: Governor Cuomo announced a 4-point initiative Part of the \$2.5B Clean Water Infrastructure Act of 2017:

1. Regional HABs summits
2. Completion of Action Plans
3. Advanced HAB monitoring
4. Pilot treatment technologies



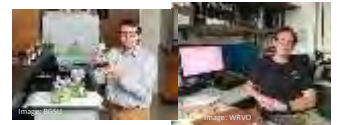
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HABs Summits

Open to the Public
12 lakes divided into 4 regions
Took place in Feb/March 2018

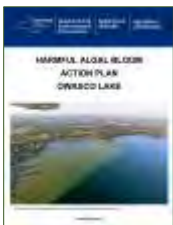
Presentations and discussions on:

- Sources of nutrients
- Nutrient Reduction Strategies
- Algal ecology
- HABs treatment
- Other



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HAB Action Plans



- View: <https://www.dec.ny.gov/chemical/113733.html>
- There are few common themes – lakes are very different, but
 - Agricultural Best Management Practices (BMPs)
 - Non-point source BMPs
 - Ditches – short circuit for nutrients and sediment
 - Internal Sources of nutrients
 - Watershed Management Plans – 9E especially
 - Funding available but
 - Requires match
 - Lack of institutional capacity
 - All takes time and effort



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HAB Advanced Monitoring Pilot

DEC and USGS piloting use of advanced monitoring platforms

- Innovative HAB sensors
- Meteorological stations
- Real time reporting
- Public facing webpage: <https://ny.water.usgs.gov/maps/habs/>



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In-lake & Fixed monitoring systems

Discrete samples collected at 12 locations at each of the 3 depths:

- Nutrients
- DOC, TOC
- Chl A and
- Phytoplankton
- Pteridoprotein
- Cyanobacteria
- Cyanobacteria
- Cyanobacteria genes (qPCR)
- SRA/Ts

A meteorological station measuring air temperature, solar radiation, wind speed, wind direction, and humidity

At the lake surface:

- optical inline analyzer
- multi-band nephelometer analyzer
- multi-band W. algae multi-chlorophyll fluorometer for algae differentiation
- ADCP to measure water column structure

Three multiparameter inline monitoring:

- temperature
- specific conductance
- dissolved oxygen
- pH
- dissolved oxygen content
- turbidity and chlorophyll and phytoplankton fluorescence

A web camera live-streams photography to record algal scum formation, which can be operational with water-quality data.

String of water temperature and light sensors every 10m.

Source: Guy Foster, USGS

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Intensive Lake Characterization



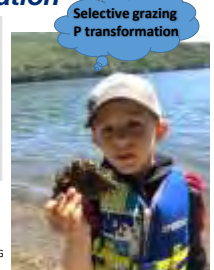
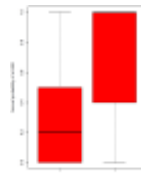
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Controlling the Causes

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Factors affecting bloom formation

- Temperature, Light
- At the New York State level:
 - Total Phosphorus (nutrients)
 - Polymixis
 - *Dreissenid* mussels
 - Orientation [NW+]
 - Fetch length
- At Lake / incident specific level:
 - Temperature
 - Increased rainfall / wind, followed by
 - Dry / Calm conditions



Source: Tony Eallonardo, OBG

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What can be controlled?

- Manageable (to some degree)
 - Nutrients
 - Climate change
 - Lake circulation
 - Human behaviors
 - Not manageable
 - Lake morphology
 - Short-term weather phenomena
 - Invasive species fit into both categories
- Implement nutrient control and reduction strategies through:
- Non-point source BMP implementation
 - Septic system improvements
 - Riparian Buffer establishment
 - Created wetlands & Habitats
 - Land Acquisition

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Mitigating Blooms

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Many possible strategies...



Many of these mitigation measures would require NYS DEC regulatory permits
 Permit process can be lengthy
 Potential pre- and post- mitigation monitoring requirement
 Image Source: Paerl et al, 2016, Harmful Algae, 54, 213-222

HABs Mitigation Pilots



Initiated in summer 2018
 Evaluation of innovative HABS mitigation actions
 • Nutrient inactivants
 • Hydrogen peroxide
 • Ultrasonic devices
 • Dissolved air flotation
 Fieldwork completed in 2019
 Environmental review under way

Lessons learned

Hydrogen Peroxide

- Apply more frequently, earlier, higher doses, larger treatment area
- No residual, dissociates within minutes
- Treatment plan not sufficient to cause change
- Monitoring plan (1 week later) not sufficient to capture changes
- Multi-formulation approach: Granular & Liquid
- Treat at depths where highest chlorophyll/DO concentrations present
- Surface application or sub-surface depth specific injection
- Screen waterbodies phytoplankton, zooplankton communities to evaluate potential impact

Ultrasonic

- Transmission of soundwaves may be impacted by organic matter and suspended solids
- Smaller zone of influence than advertised
- More units or larger units, possibly feasible for drinking water

Lessons learned

Nutrient Inactivation

- 1) Properly assess dosing, frequency, area, timing
 - May require waterbody specific designs
 - Allow for flexibility in permitting
- 2) Gauge extent to which external sources can or have been addressed if implications for treatment type
- 3) Well designed monitoring plan for pre and post treatment essential to determine effectiveness
- 4) Consider collecting additional data prior to treatments
 - Phytoplankton-Zooplankton biomass and community
- 5) Consider innovative administration of existing treatment options
 - Compliant with label or manufacturers recommendations
- 6) Can these strategies ultimately be scaled to larger waterbodies effectively and efficiently
 - Cost, permits, access, footprint, waste disposal, personnel

To be continued... Nutrient Inactivant Evaluation



HABS Mitigation 2.0

“The State will work with Clarkson University, SUNY ESF, and other experts to design and build emergency response equipment that can mitigate or eliminate HABS in waterways across the State.”



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Federal HAB mitigation efforts

- Dissolved air flotation & harvesting technology
- Pilot project on shore Downstate in 2019 with AECOM
- Boat-mounted pilot Upstate in 2020 with US Army Corps of Engineers



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Summary

- HABs affect all parts of NY
- NYS monitoring efforts now lead the nation
- Governor very active on protecting water quality
- Much work has already been done on *preventing* blooms
- *Mitigating* Blooms is a new area of focus



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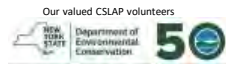
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Thanks!

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