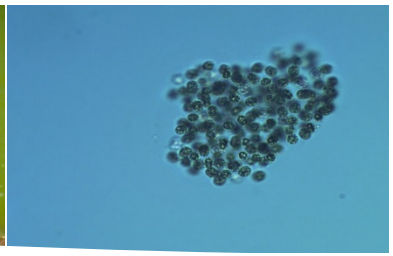
U.S. Environmental Protection Agency, Office of Research and Development

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM




Overview of HABs Research Program

Blake Schaeffer PhD & Nicholas Dugan PE

Presentation to the National Institute of Water Resources Directors

May 29, 2018

HABs: Overall Problems

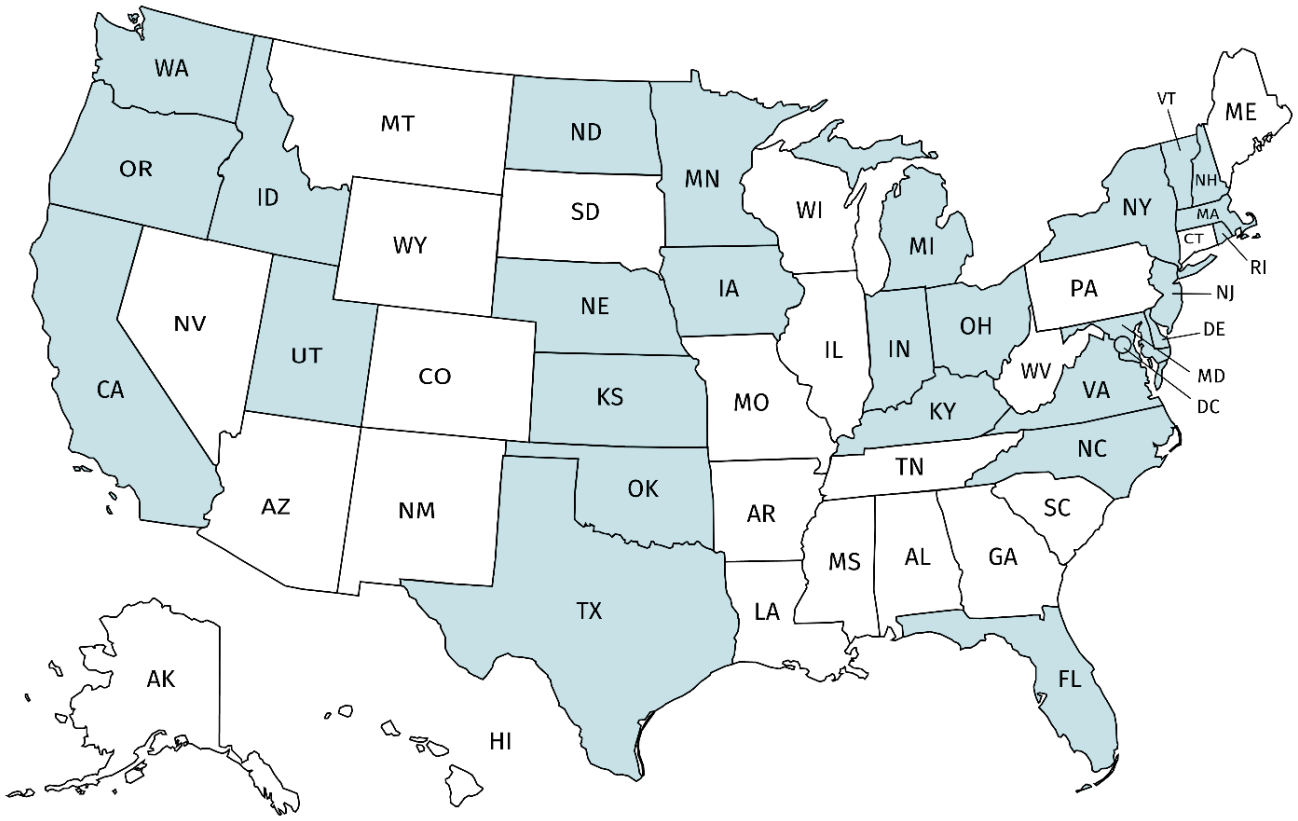
HABs have the potential to generate adverse health, ecosystem and economic impacts.

- Many different types of toxins.
- Pure toxins in laboratory studies exert toxic effects on liver and nervous system.
- Exposure through ingestion.
- Exposure though recreational activity body contact—associated with gastrointestinal effects, breathing difficulty, skin irritation, and animal deaths.

- Water treatment facilities may need to alter operational practices and/or invest in new equipment → economic burden
- Health effects → beach closures → loss of recreational/aesthetic value → economic burden
- Large blooms upset water chemistry (pH, dissolved oxygen) and limit the penetration of sunlight → declines in fish populations → loss of recreational/aesthetic value → economic burden, long term ecosystem damage
- Large blooms are odorous and unsightly → reluctance to swim → economic burden

HABs: Overall Problems

During the 2017 bloom season, USE PA was aware of blooms, beach closures and/or health advisories in 27 states and DC.

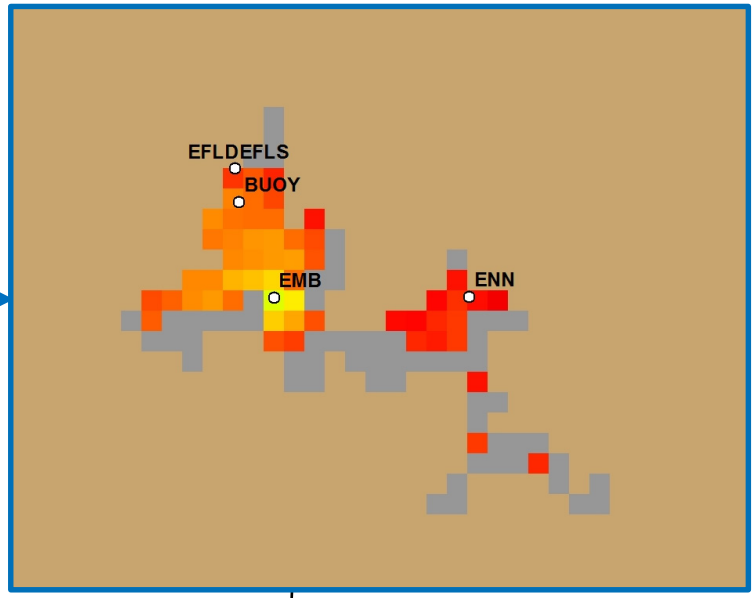


Actions: Research Approach

- Monitoring lakes and reservoirs
- Investigating drinking water treatment options
- Investigating health effects
- Developing analytical methods
- Utilizing remote sensing

Actions:
Monitoring and Remote Sensing

Overlay Satellite Data

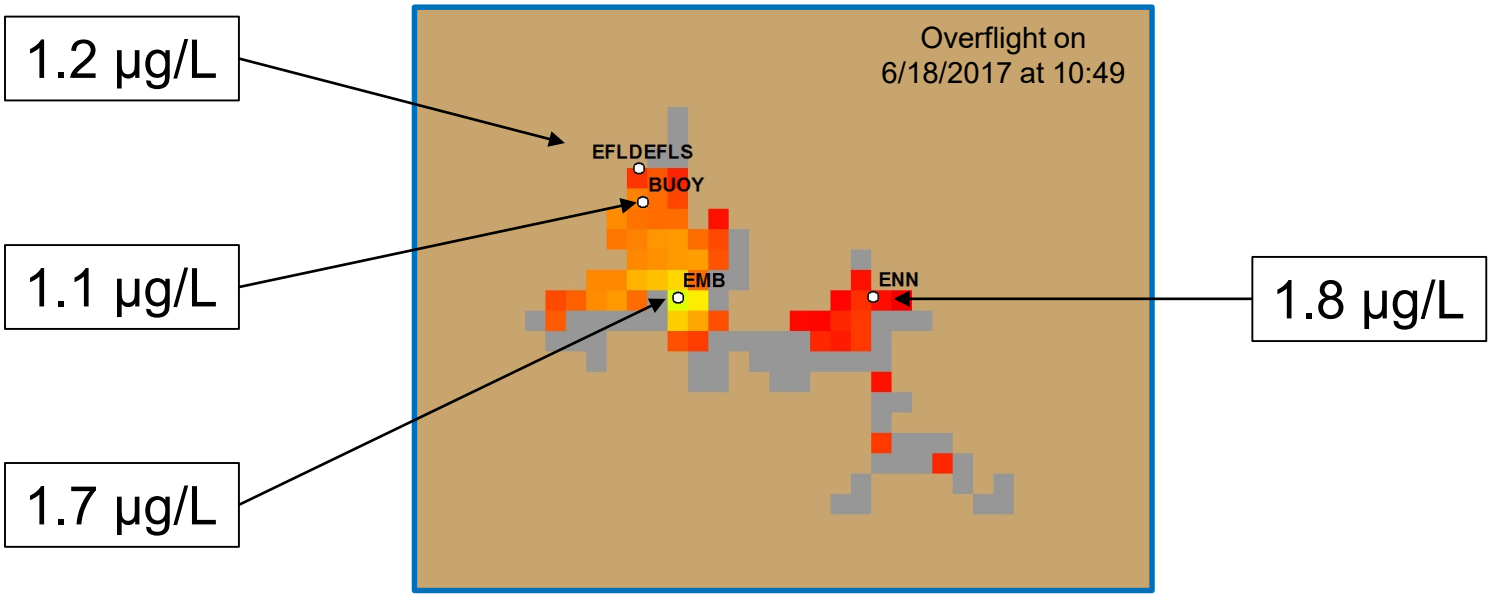


Optical signature of cyanobacterial pigments:

- = Low Concentration
- = High Concentration
- = No Data

Actions:
Monitoring and Remote Sensing

Integrate satellite data with “on the lake” sampling results for toxins (microcystins)



EPA health advisory concentration =
0.3 µg/L for pre-school aged children

Impact:
Monitoring and Remote Sensing

Monitoring and Remote Sensing

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Ultimate goal is to combine satellite, buoy-deployed sensor and grab sampling data for pigments, nutrients, toxins, microbial species, water quality and weather.

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Better Guidance Information

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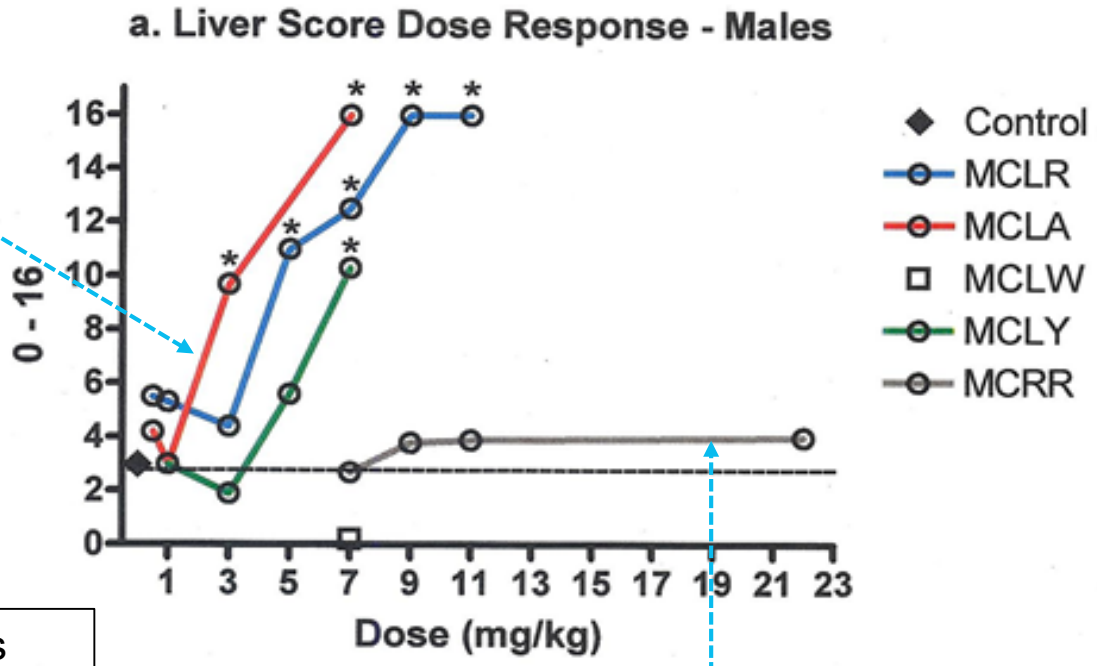
- *Beach closure decisions*
- *Forecasting bloom peaks and toxin production*
- *Response to reports of human and animal illnesses*

Actions: Health Effects

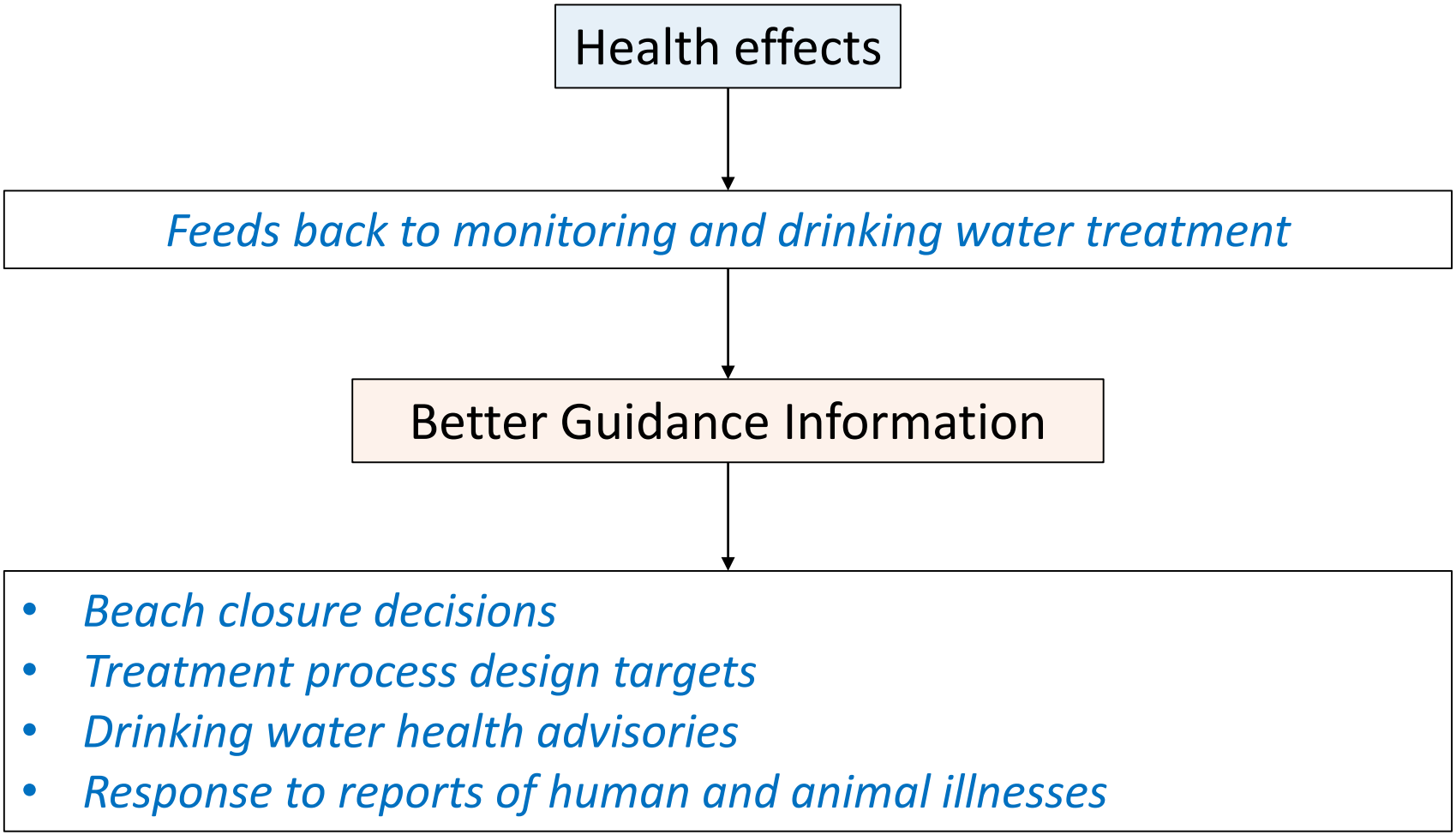
Investigate oral toxicities of different microcystin congeners in mice

Microcystin-LA exhibits toxicity at doses > 1 mg/kg



Microcystin-RR does not exhibit toxicity at doses up to 22 mg/kg

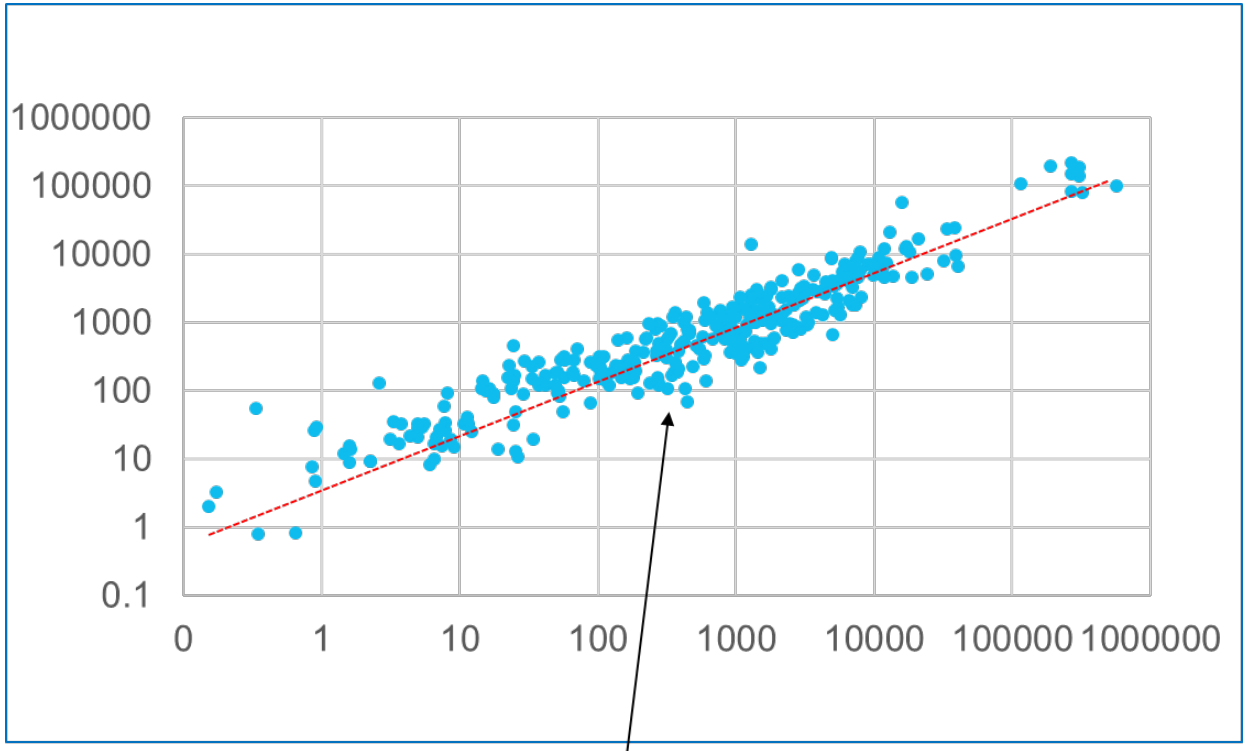
Impact: Health Effects



Actions: Analytical Methods

Collaboration with Ohio EPA to validate quantitative PCR method

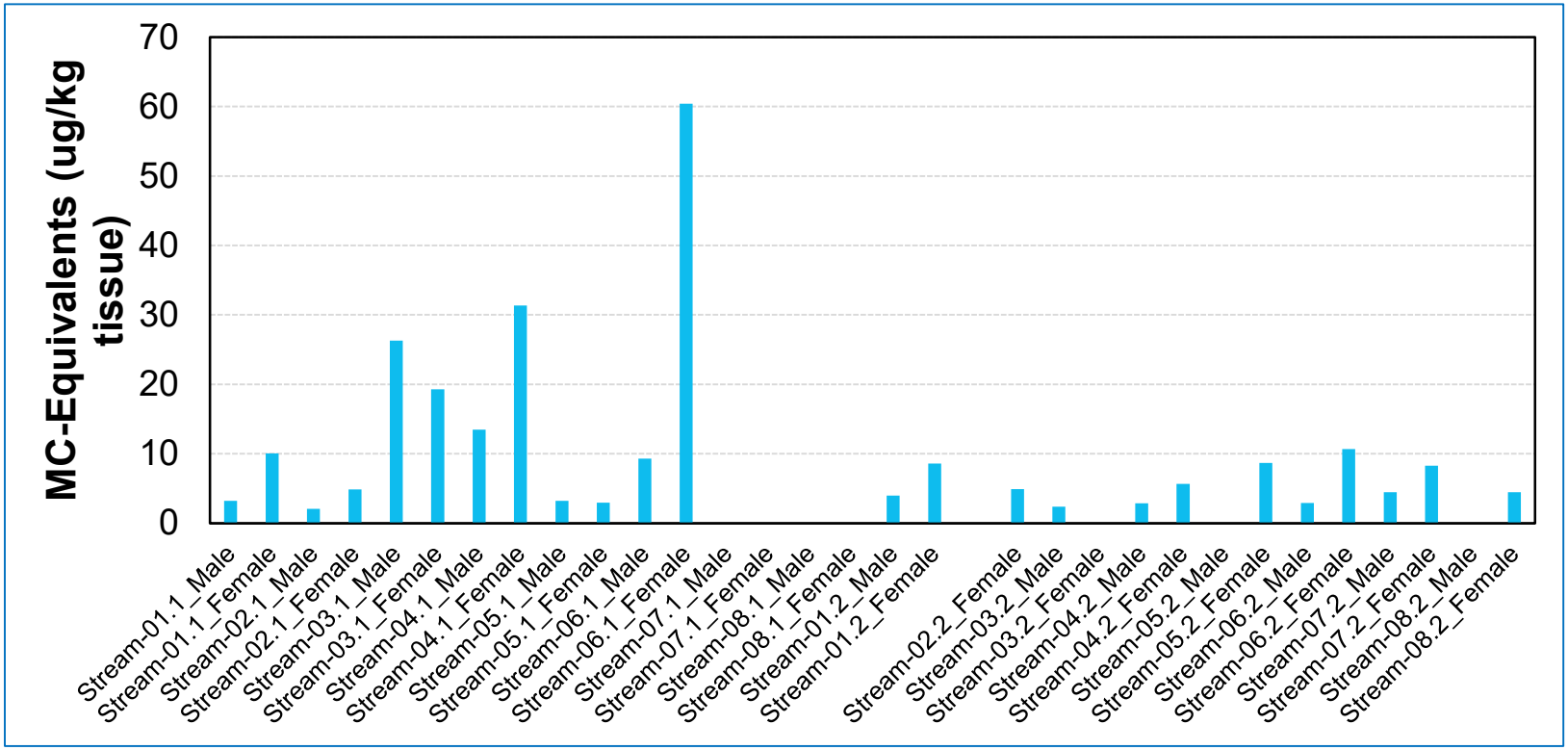
(Rapid detection of genetic material from toxin-producing cyanobacteria)



Agreement for samples split between Ohio and federal EPA laboratories

Actions: Analytical Methods

Toxin Analysis in Fish Tissues



Fathead minnows exposed to toxins in artificial streams

→ toxins successfully recovered from whole-fish tissue samples

Impact: Analytical Methods

Analytical Methods

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Feeds back to the monitoring component.

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Better Guidance Information

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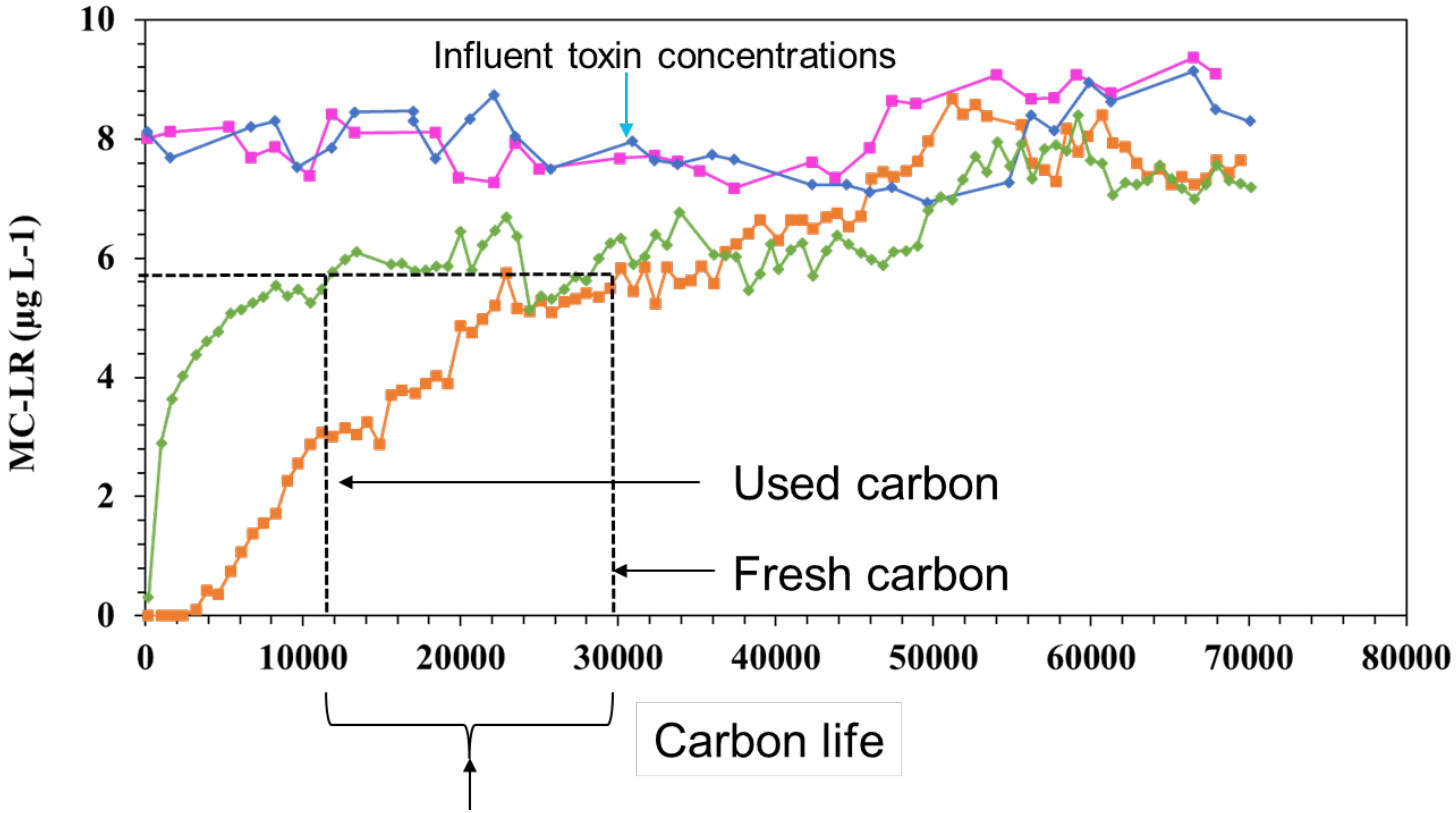
- *Beach closure decisions*
- *Forecasting bloom peaks and toxin production*
- *Response to reports of human and animal illnesses*
- *Response to concerns from fishermen*

Actions:
Drinking Water Treatment

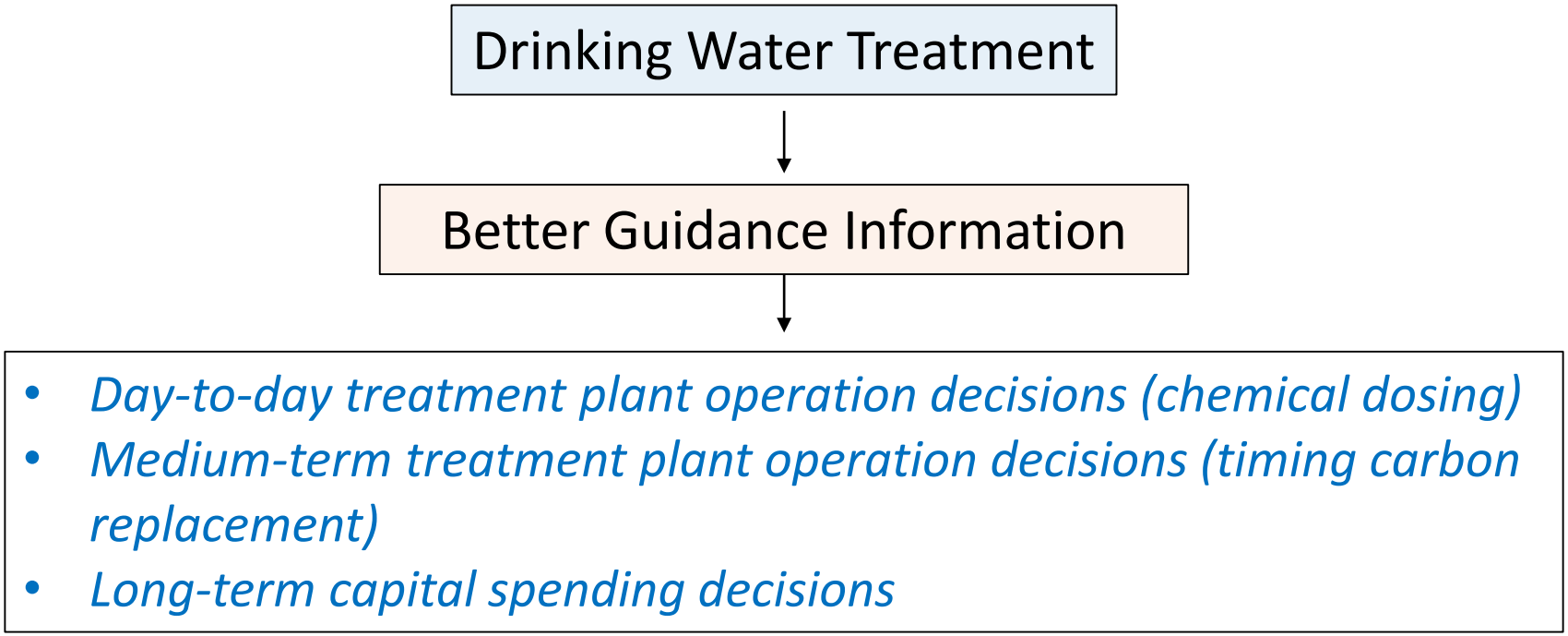
Toxin Removal through Granular Activated Carbon (GAC)

Impact of prior GAC use



Prior use decreases the ability of GAC to remove toxins

Impact:
Drinking Water Treatment

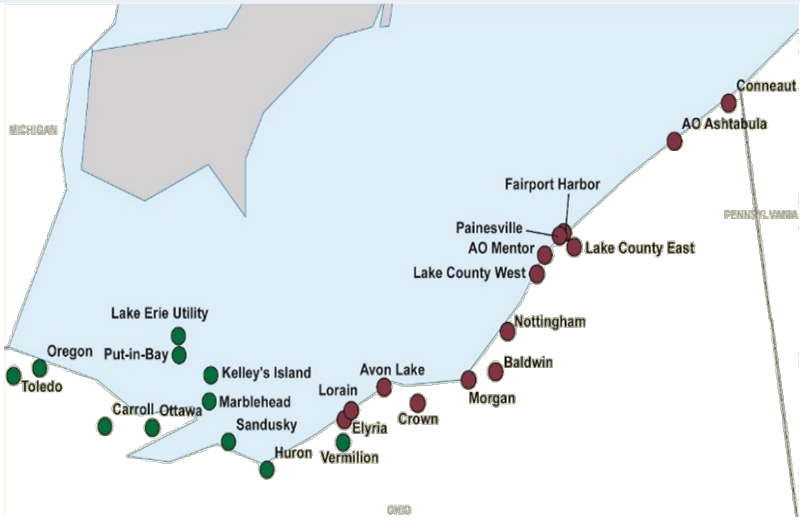


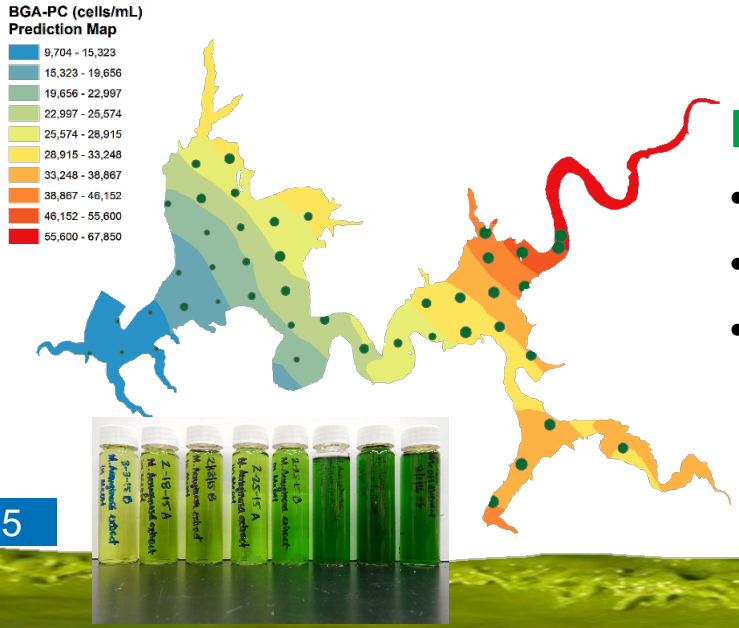
Actions and Impact: Ohio Lakes

Providing Technical Assistance to States

Lake Erie

- Monitoring cyanobacteria toxins through multiple years in numerous treatment plants.
- Conducting bench- and pilot-testing.
- Satellite monitoring program.





Harsha Lake

- Nutrient and HAB bloom dynamics.
- Treatment performance at local water utility.
- Nutrient trading program: reduce nutrient loadings at lowest cost by expanding the number of participants that have incentives to purchase credits

Contact

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