

Monitoring for Algal Toxins in Falls Lake

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Lakes & Algal Blooms



Nutrient management controls?

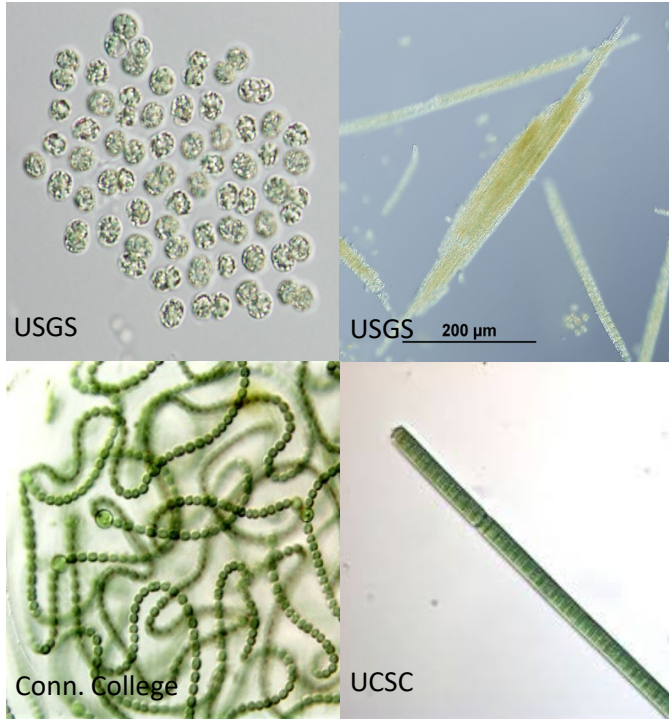
Low Productivity
Crater Lake, OR

Moderate Productivity
Falls Lake, NC

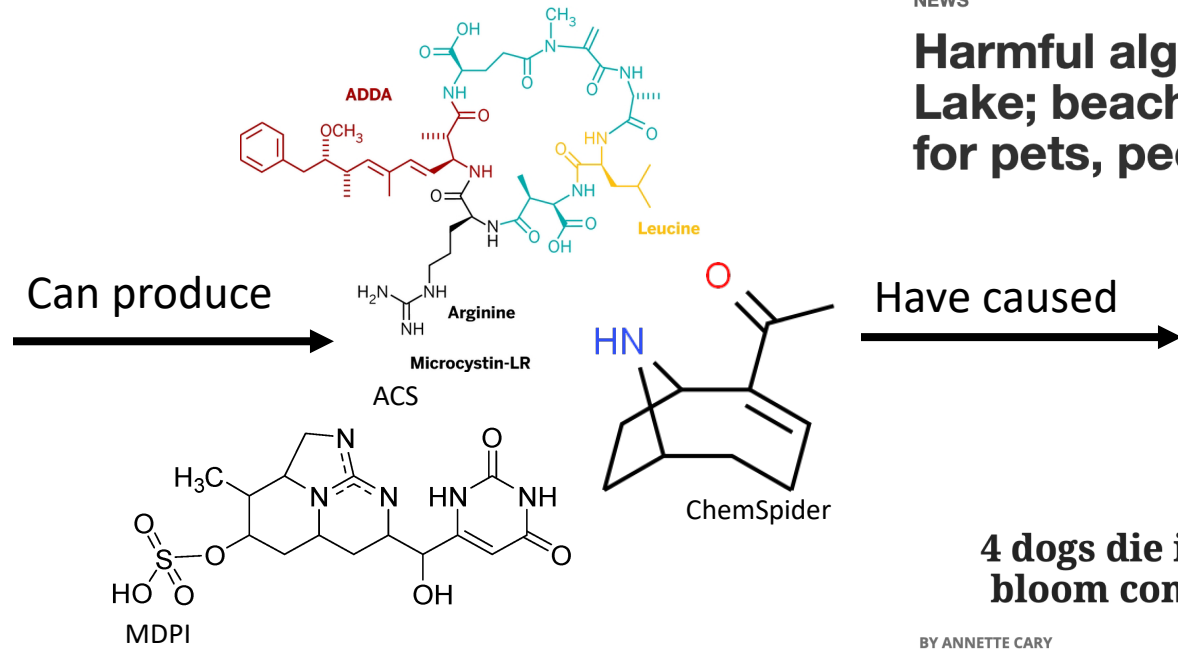
High Productivity
Lake Erie, MI

Why we care about algal toxins

Algae



Algal Toxins



Severe Consequences

NEWS
Harmful algae found at Silverwood Lake; beaches closed, warning issued for pets, people
Victorville Daily Press



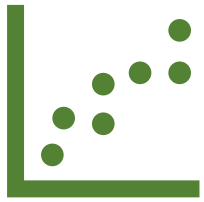
4 dogs die in Eastern WA after toxic algae bloom contaminates water. 7 lakes close

BY ANNETTE CARY
UPDATED AUGUST 27, 2021 9:01 AM

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Tri-city Herald

Research Questions

Which algal toxins are present in Falls Lake?



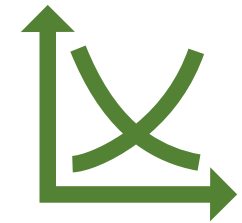
At **what concentrations** are they present?



When are they present?

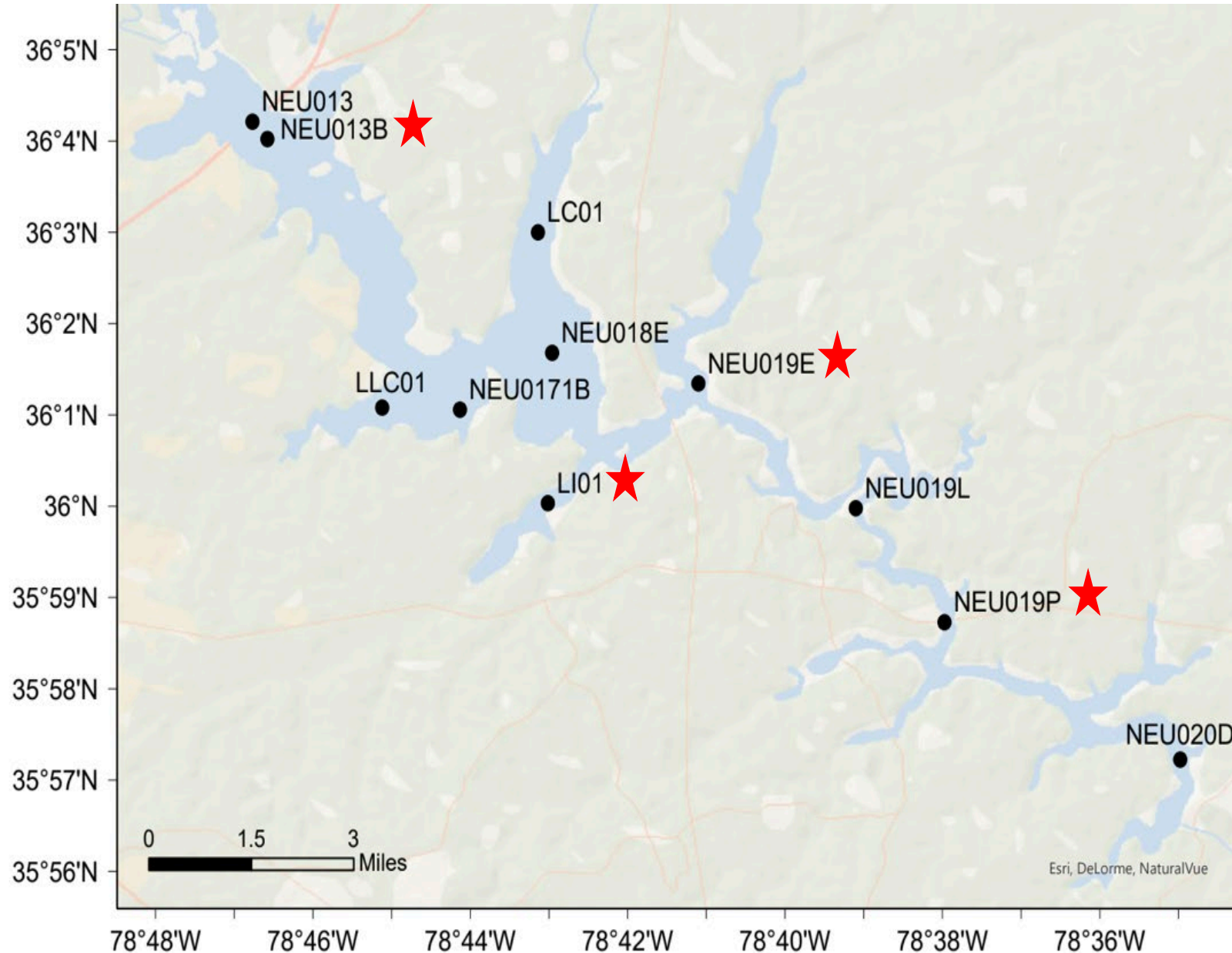


Where are they present within the lake?



What patterns exist between toxins & environmental data?

How can we improve monitoring approaches for algal toxins in the system?



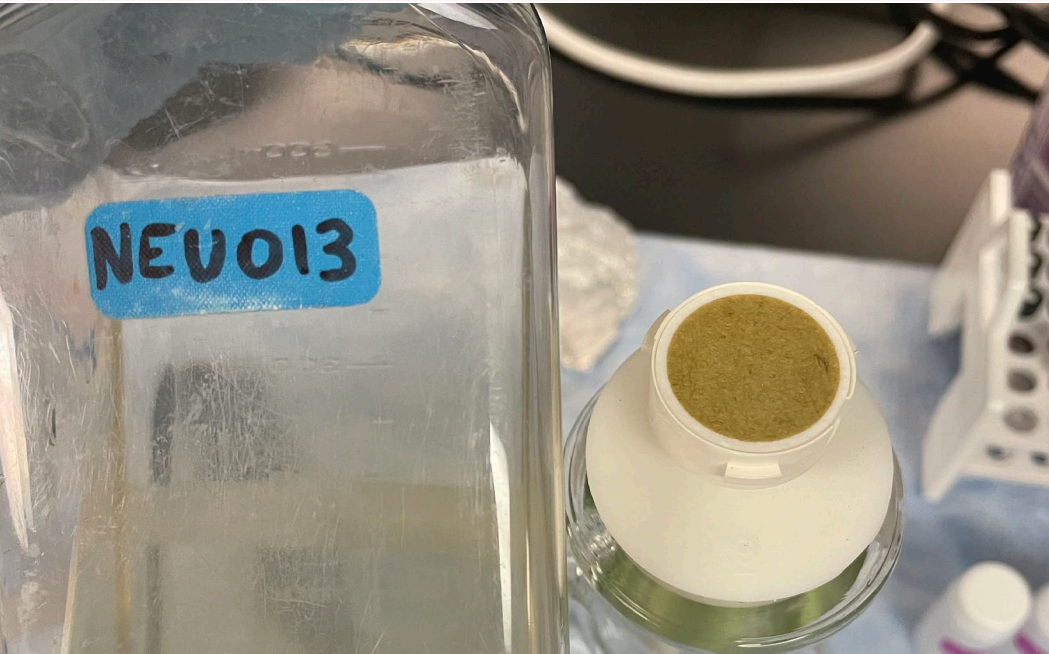
Data Collection

- Monthly Sampling at 11 stations

- Sampled algal biomass, toxin concentrations and species composition (underway)

- Stars denote sites for accumulated toxin measurements





Toxin Sampling

Discrete sampling: 'snapshot' of toxin concentrations on one specific day

- **Particulate:** bound within the cell
- **Dissolved:** released in the water column

Accumulated sampling: Measurement of toxin concentration build-up over a monthly period

*semi-quantitative approach

Toxins Measured

Toxin	Toxin Class	Human health concerns
Microcystin (MCY)	Hepatotoxin	Abdominal pain, vomiting, diarrhea, pneumonia
Cylindrospermopsin (CYL)	Hepatotoxin	Gastrointestinal effects including diarrhea and vomiting
Anatoxin-a (ANA)	Neurotoxin	numbness, drowsiness, respiratory paralysis leading to death
Beta-Methylamino-L-alanine (BMAA)	Neurotoxin	Potential link to neurodegenerative effects
Saxitoxin (SXT)	Neurotoxin	Vomiting, headache, weakness, respiratory paralysis leading to death

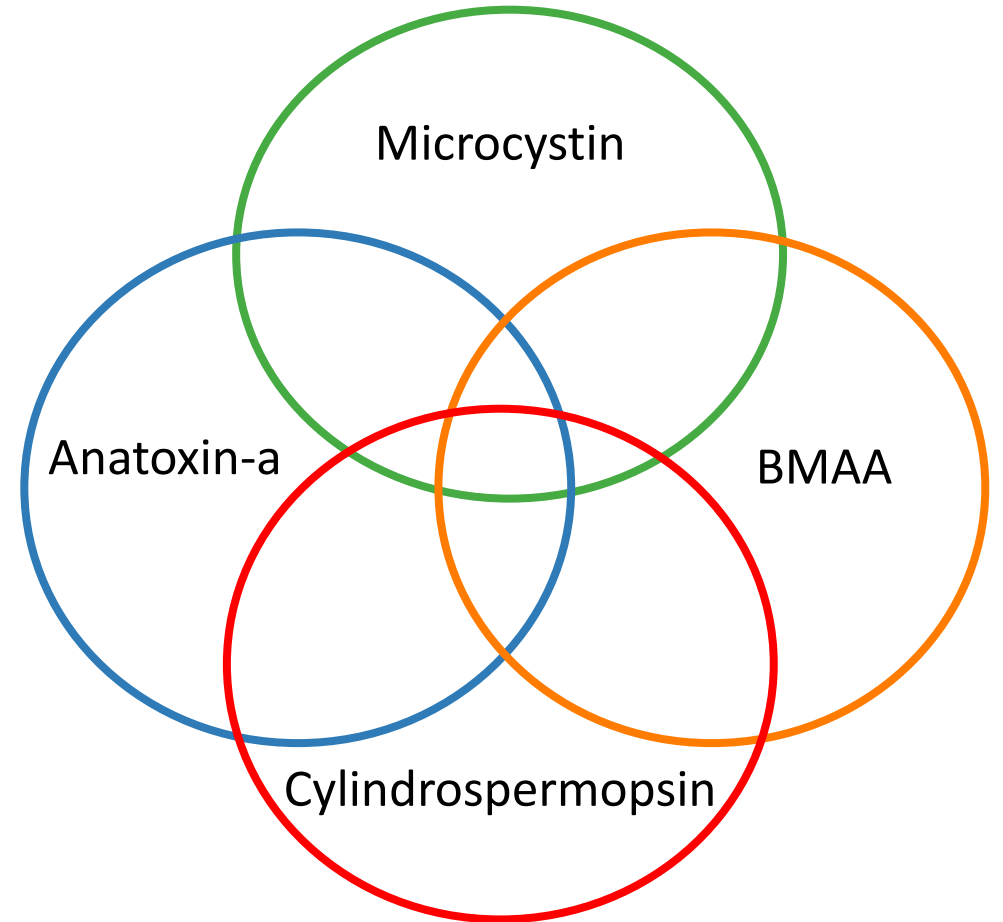
Toxin Occurrence

	MCY		CYL		ANA		BMAA		SXT	
	n	%	n	%	n	%	n	%	n	%
Particulate	295	49	115	2	142	70	81	57	43	0
Dissolved	294	55	121	14	81	6	80	6	45	0
Accumulated Dissolved	94	89	94	48	68	2	-	-	-	-

- No toxin exceeds WHO regulatory limits for drinking or recreation
- Two patterns for additional monitoring emerge: co-occurrence & accumulation

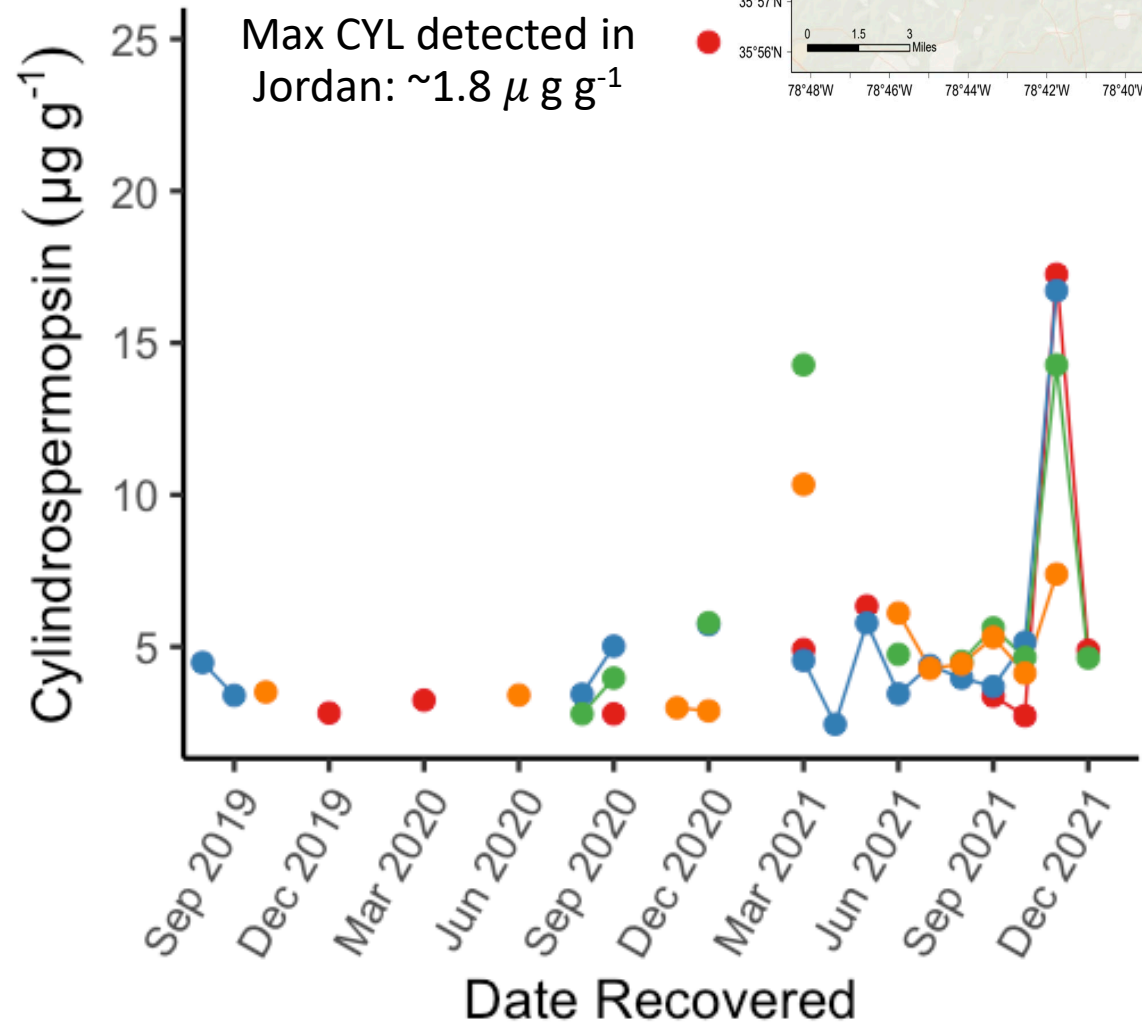
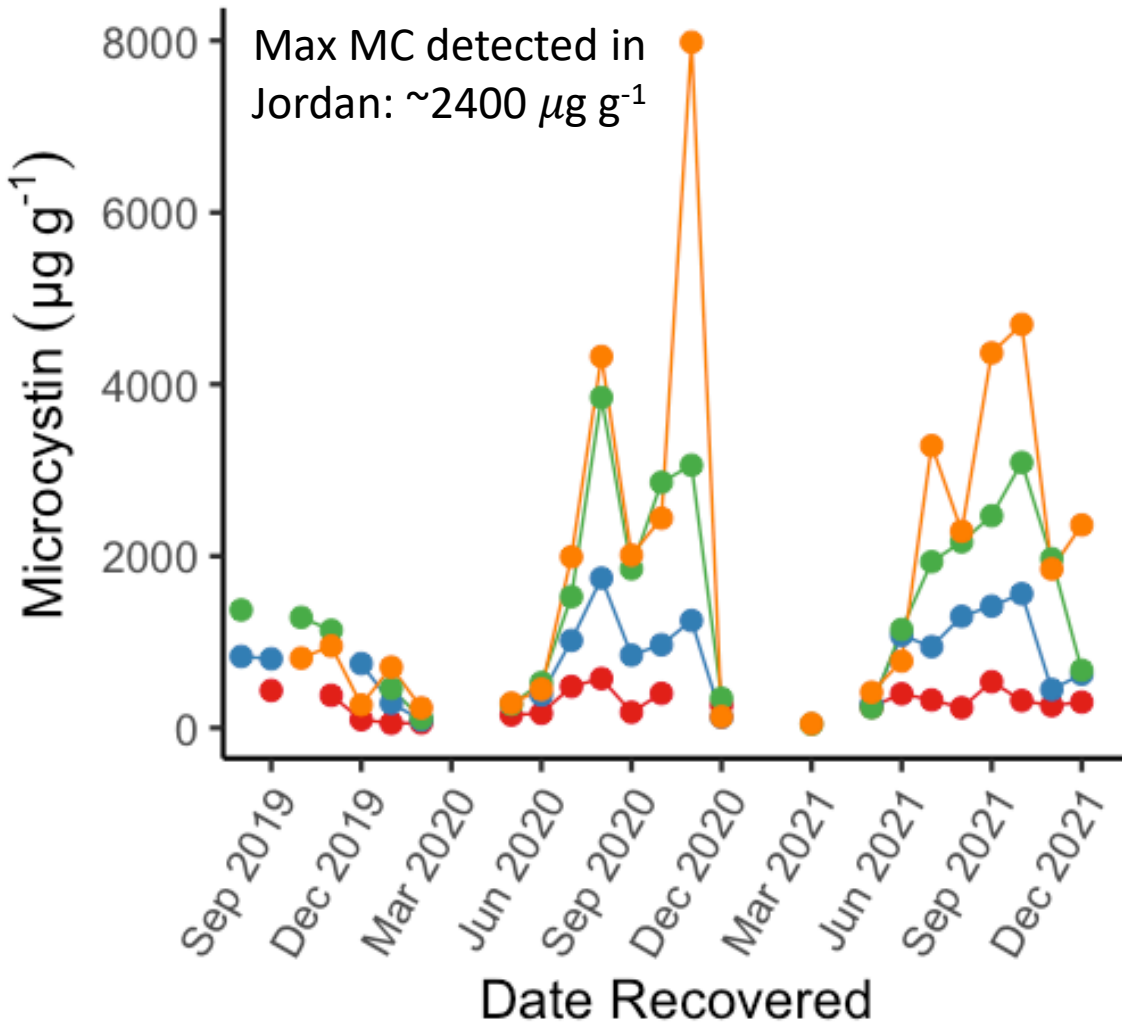
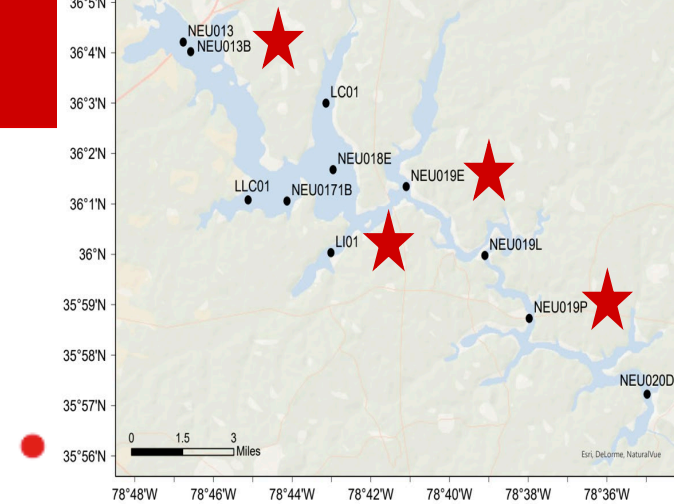
Co-occurrence Patterns

	2 or more toxins
Particulate	36%
Dissolved	14%
Accumulated Dissolved	43%

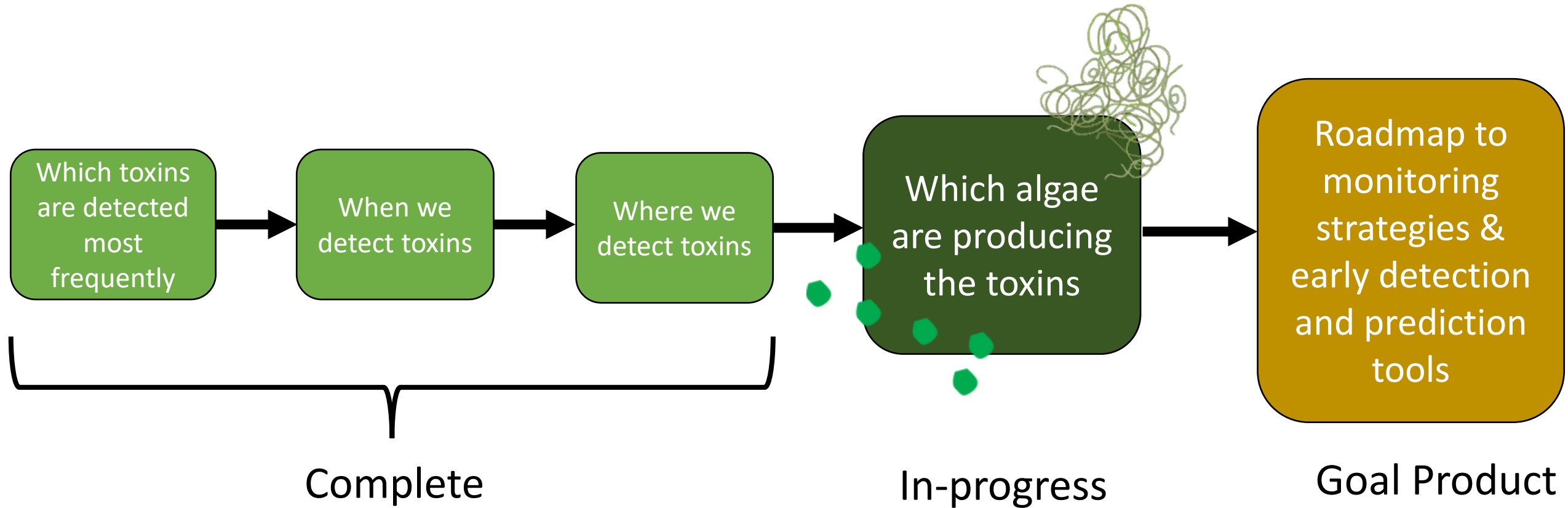


Accumulated Toxin

Station ● NEU013B ● LI01 ● NEU019E ● NEU019P



Next Steps



Acknowledgments

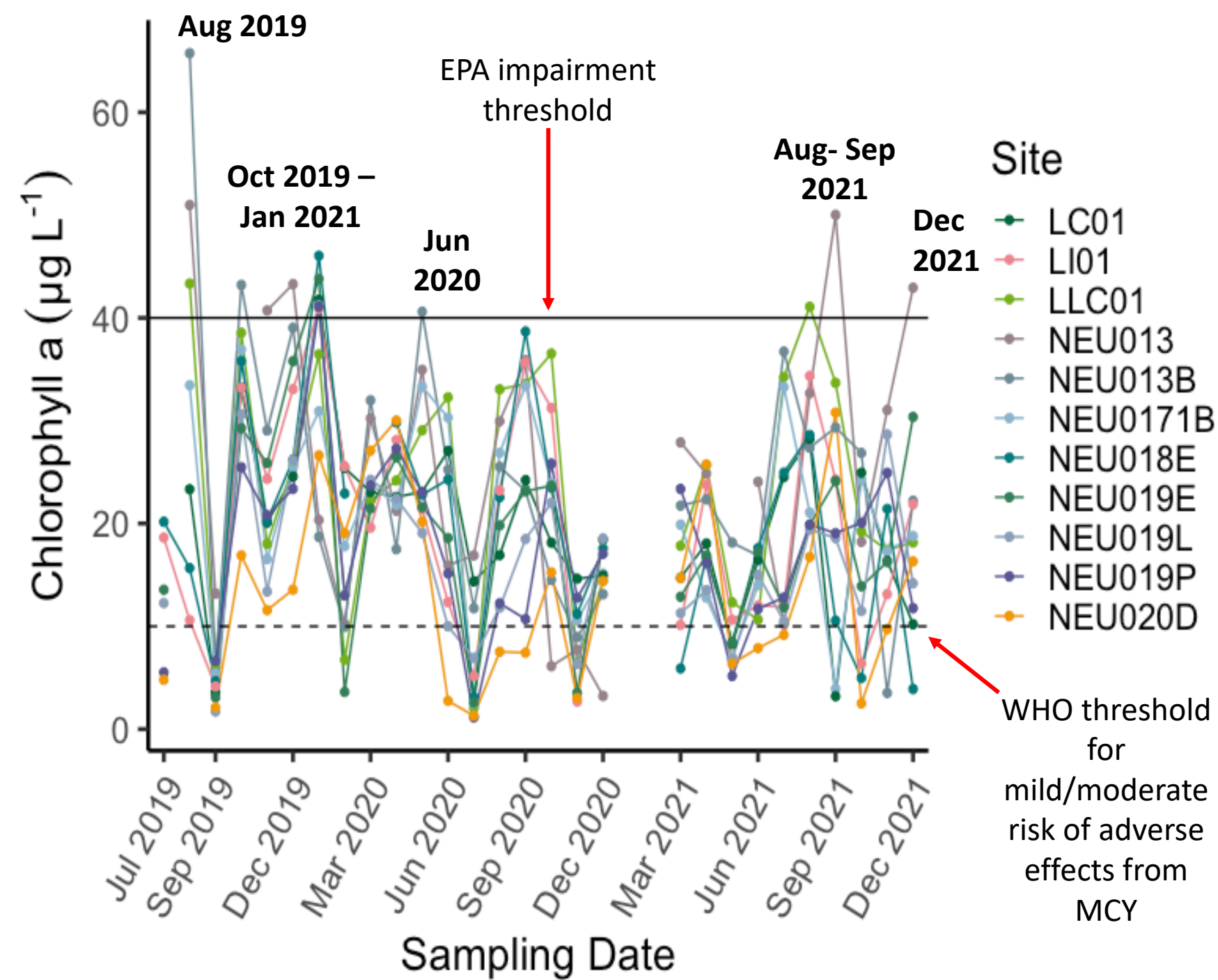
NC DEQ Water Resources Office especially the Intensive Survey Branch Team for sample collection.

Plankton ecology lab team for assistance with sample processing.

NC Policy Collaboratory for funding and research support.



Algal Biomass



- Algal biomass has exceeded impairment levels based on algal growth (EPA)
- Changes in **conductivity, total P and total N** explain ~20% of variation in algal biomass
- **With potentially toxic algae present**, biomass values between 10 and 50 $\mu\text{g L}^{-1}$ can be **indicative of moderate toxin exposure risks (WHO)**