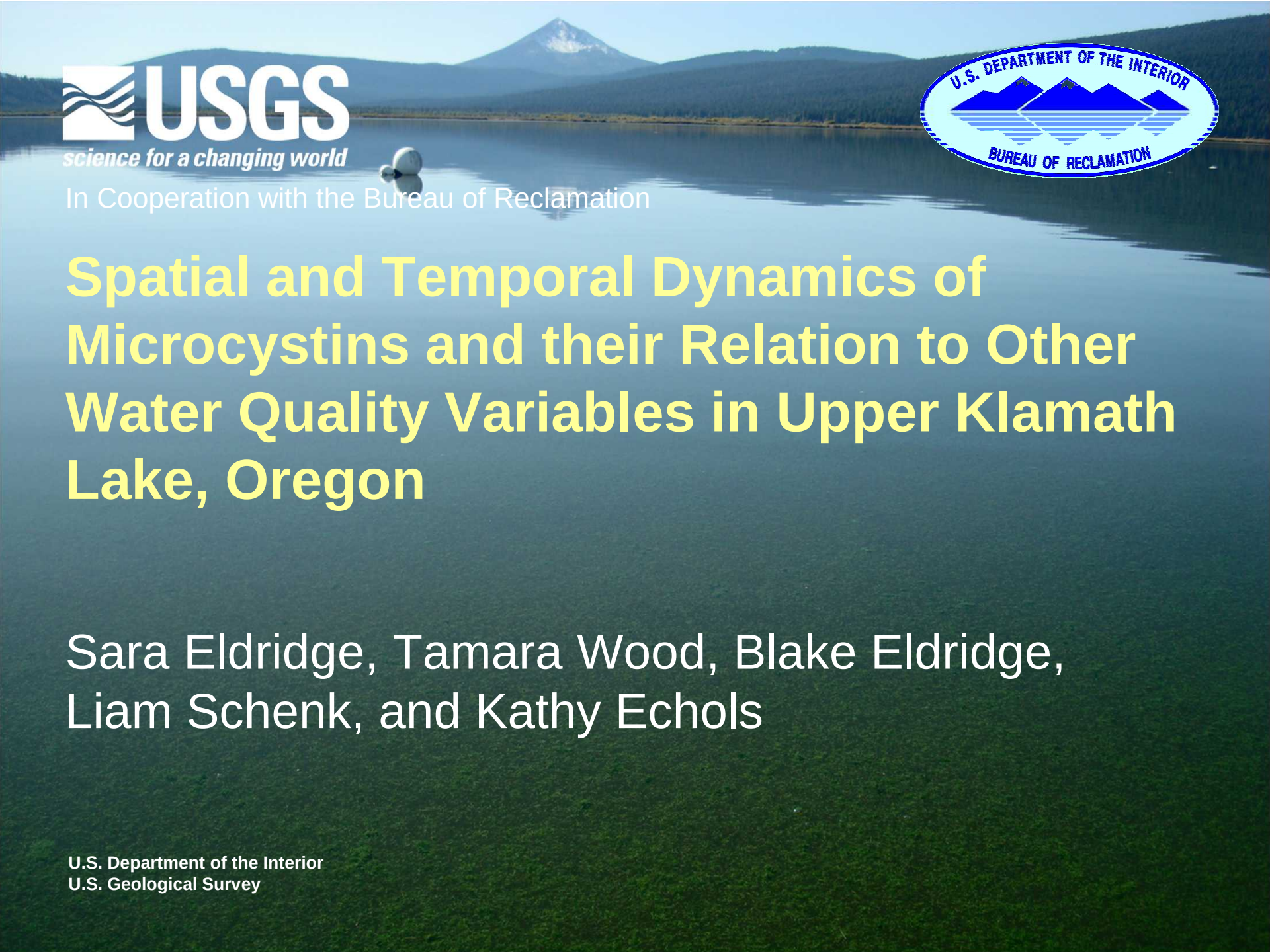


In Cooperation with the Bureau of Reclamation

Spatial and Temporal Dynamics of Microcystins and their Relation to Other Water Quality Variables in Upper Klamath Lake, Oregon

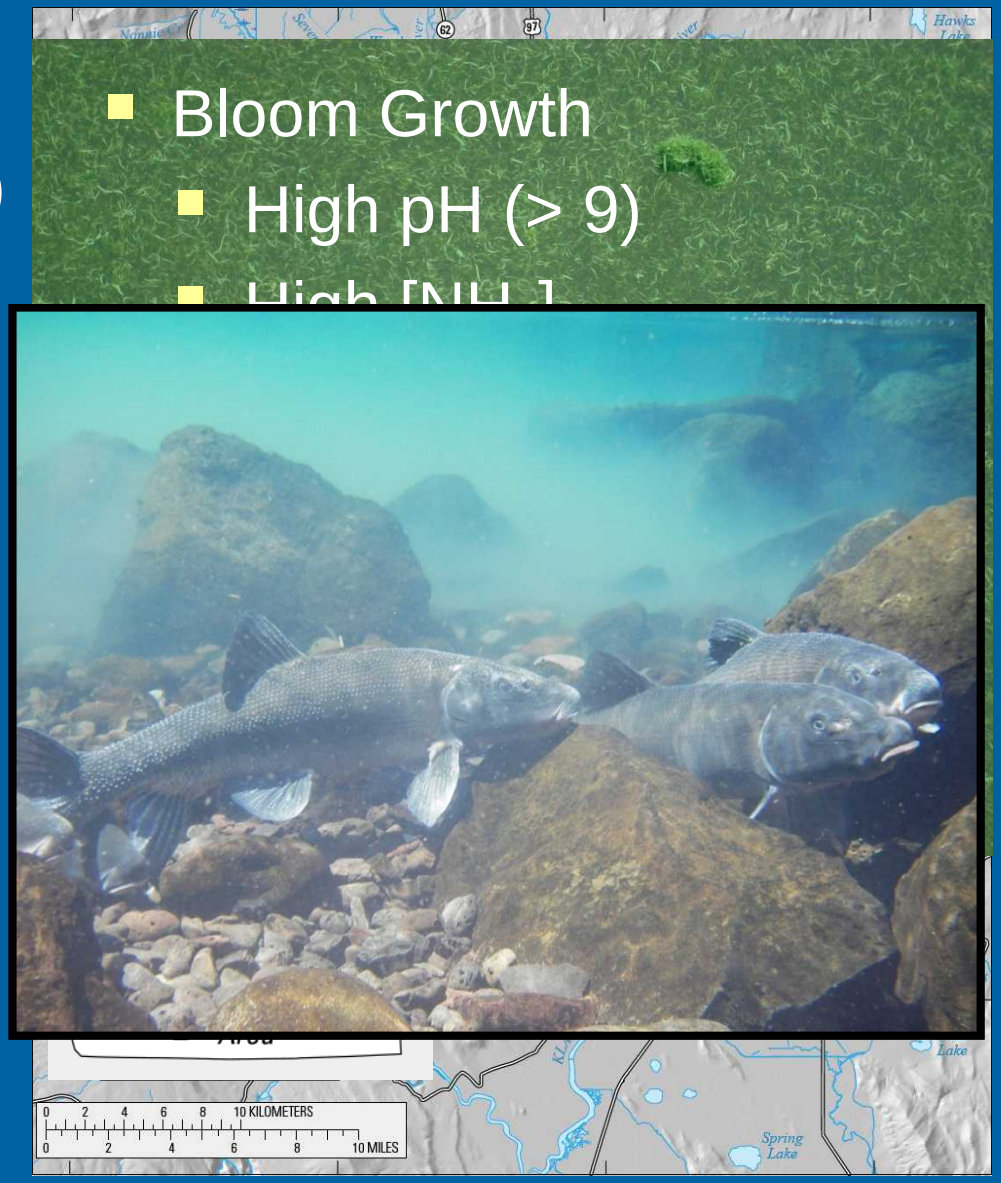
Sara Eldridge, Tamara Wood, Blake Eldridge, Liam Schenk, and Kathy Echols

U.S. Department of the Interior
U.S. Geological Survey

Background: Upper Klamath Lake (UKL)

- Large (232 km^2), shallow (2.8 m, average)
- Hypereutrophic
- Seasonal blooms of *Aphanizomenon flos-aquae* (AFA; > 90 %)
- Endangered Lost River and shortnose suckers

http://or.water.usgs.gov/klamath/



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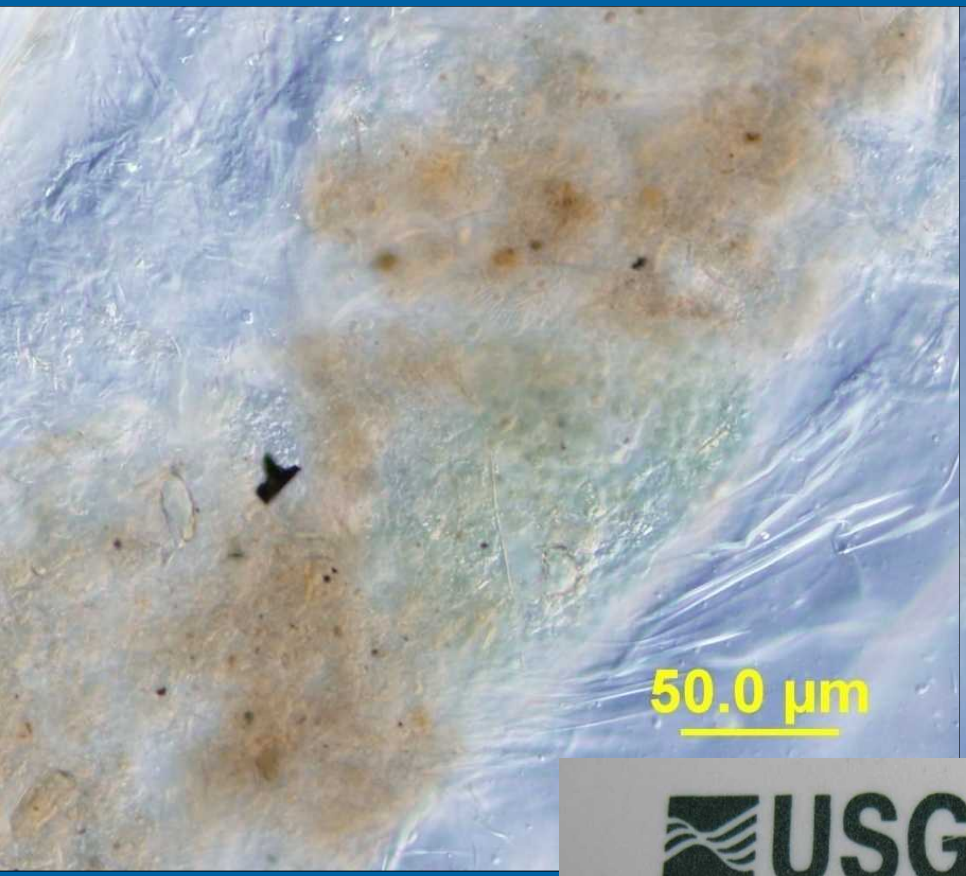

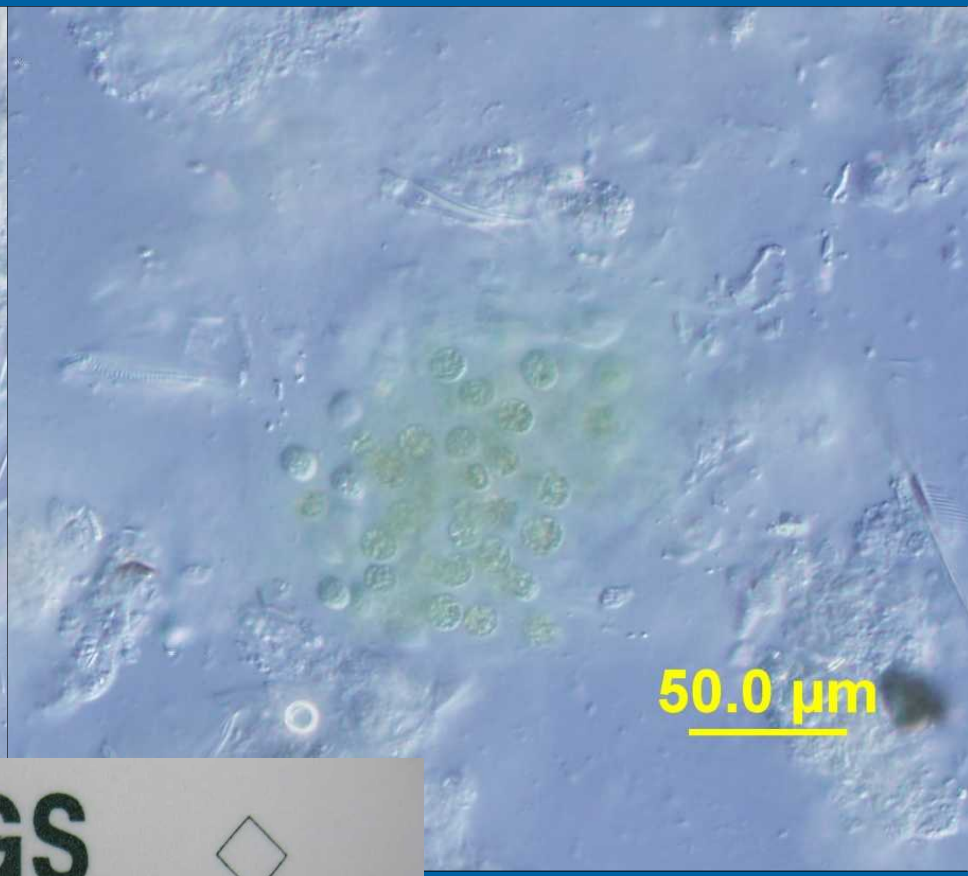

- VanderKoo

- Microscopic *eruginosa* ingested du
  - B. Rosen,

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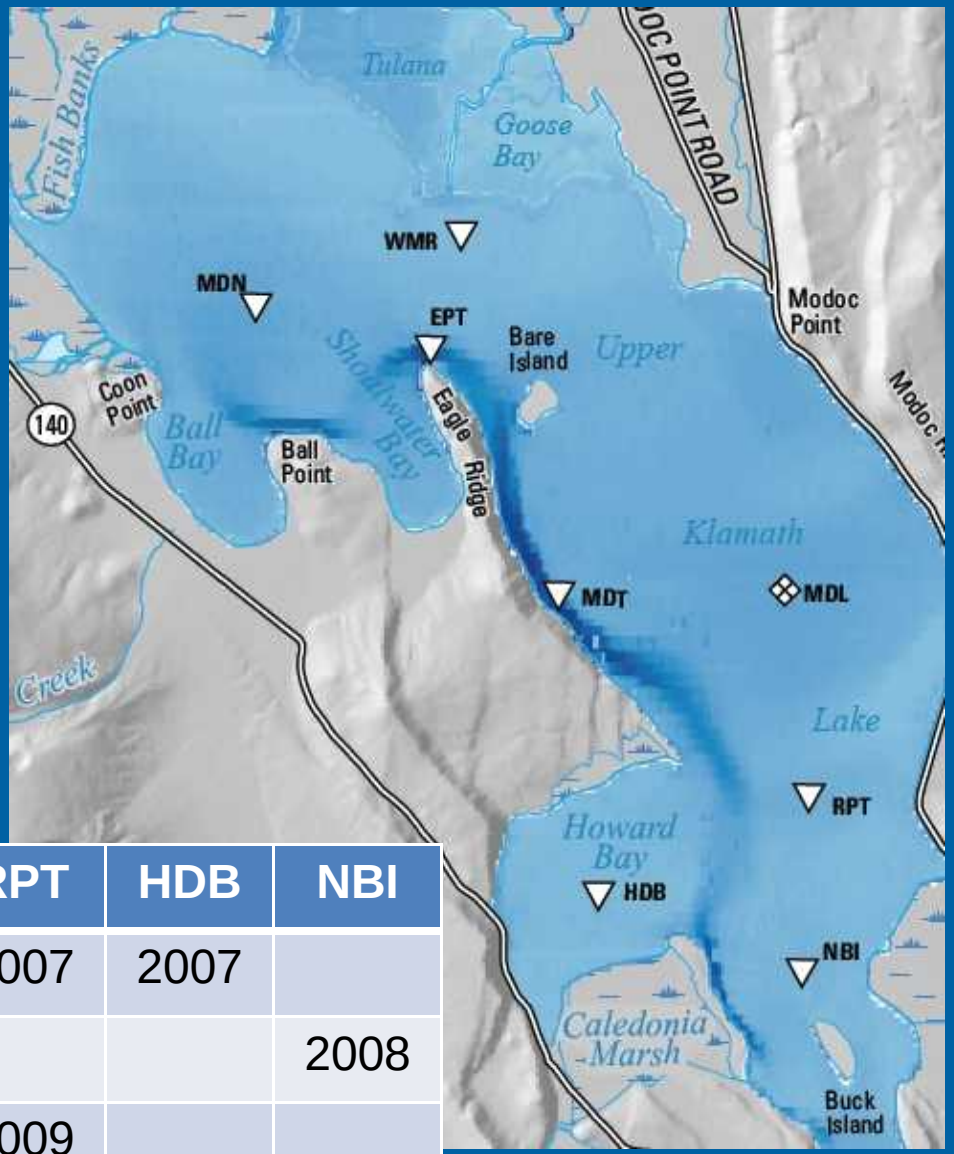
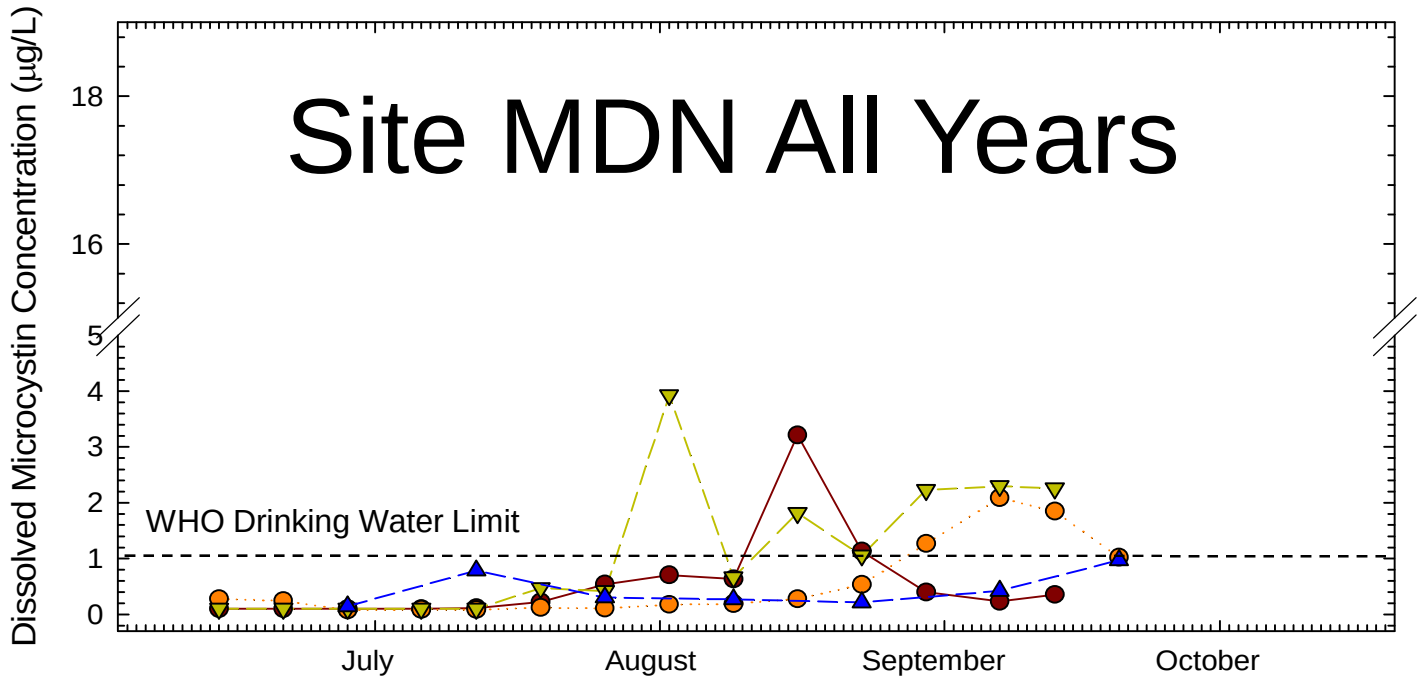
Sample Collection 2007-2011

- All years: Water column
- 2009: Sediment cores and sediment traps
- 2010: Chironomid larvae
- 2011: qPCR (MDN, MDT)

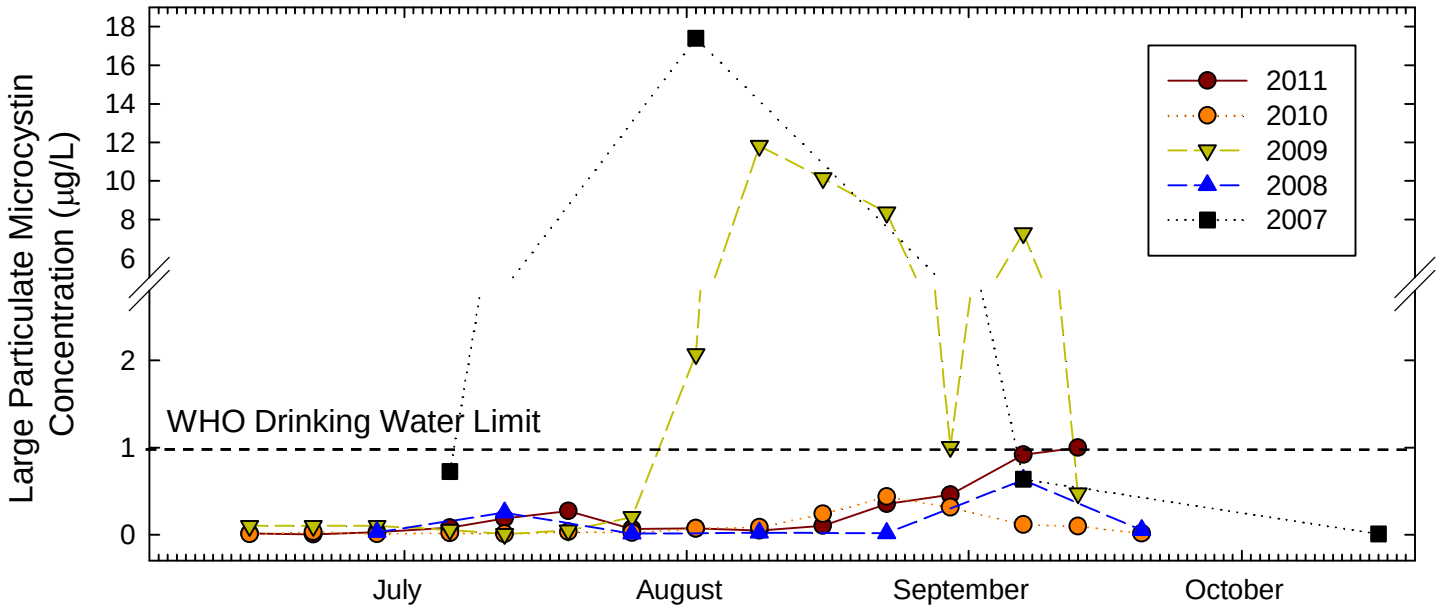


MDN	WMR	EPT	MDT	MDL	RPT	HDB	NBI
2007	2007	2007	2007		2007	2007	
2008	2008			2008			2008
2009	2009	2009	2009		2009		
2010							
2011	2011		2011		2011		

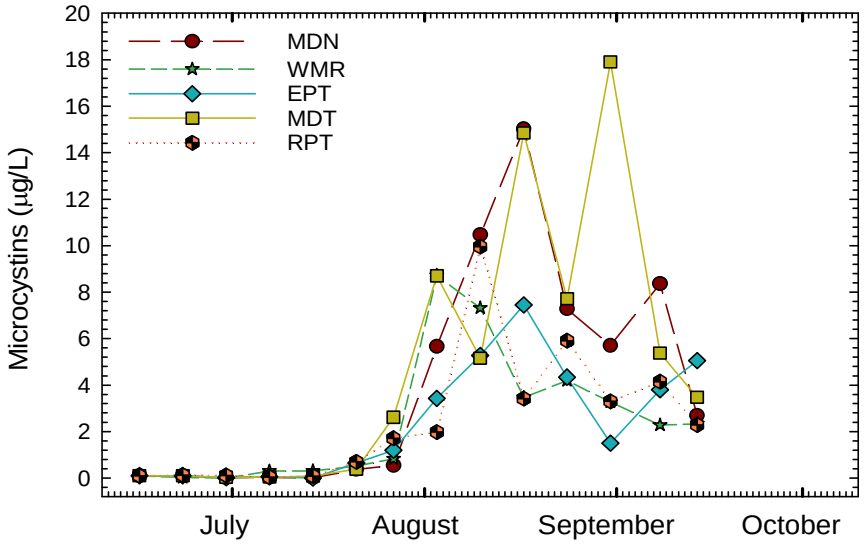
Dissolved, 2008-2011

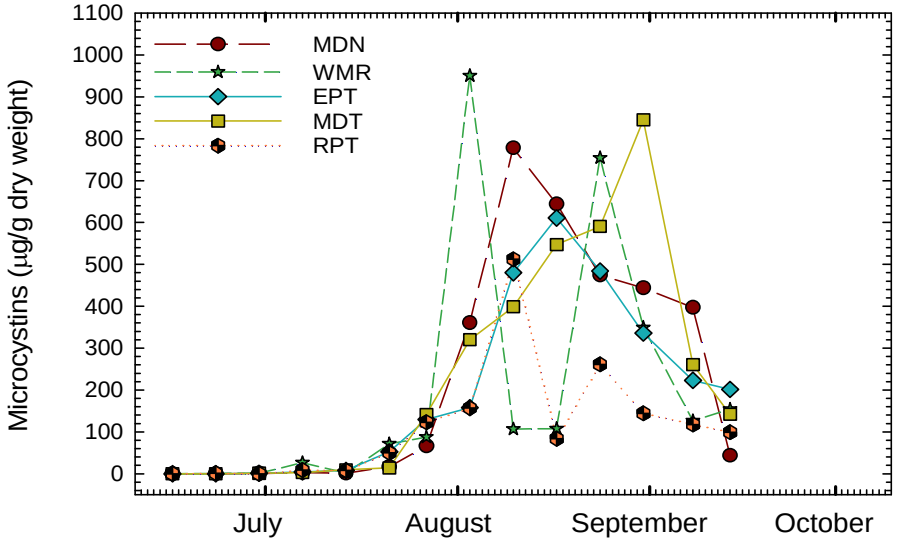


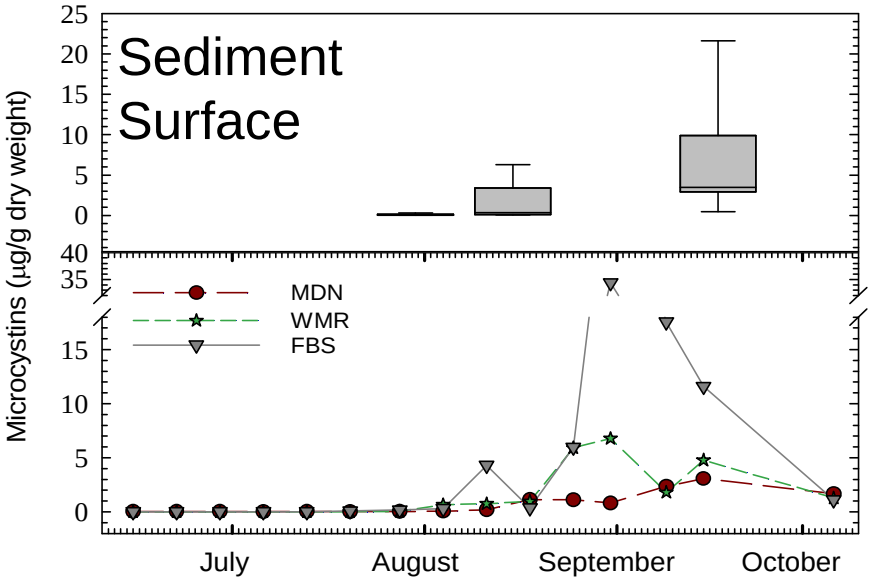
Large Particulate Fraction, 2007-2011

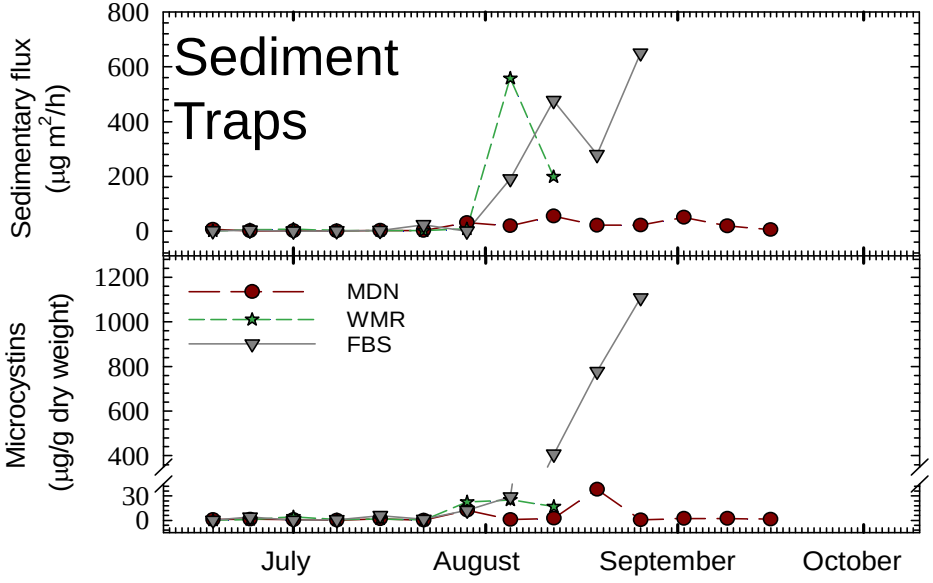


Sediment Surface, Traps 2009



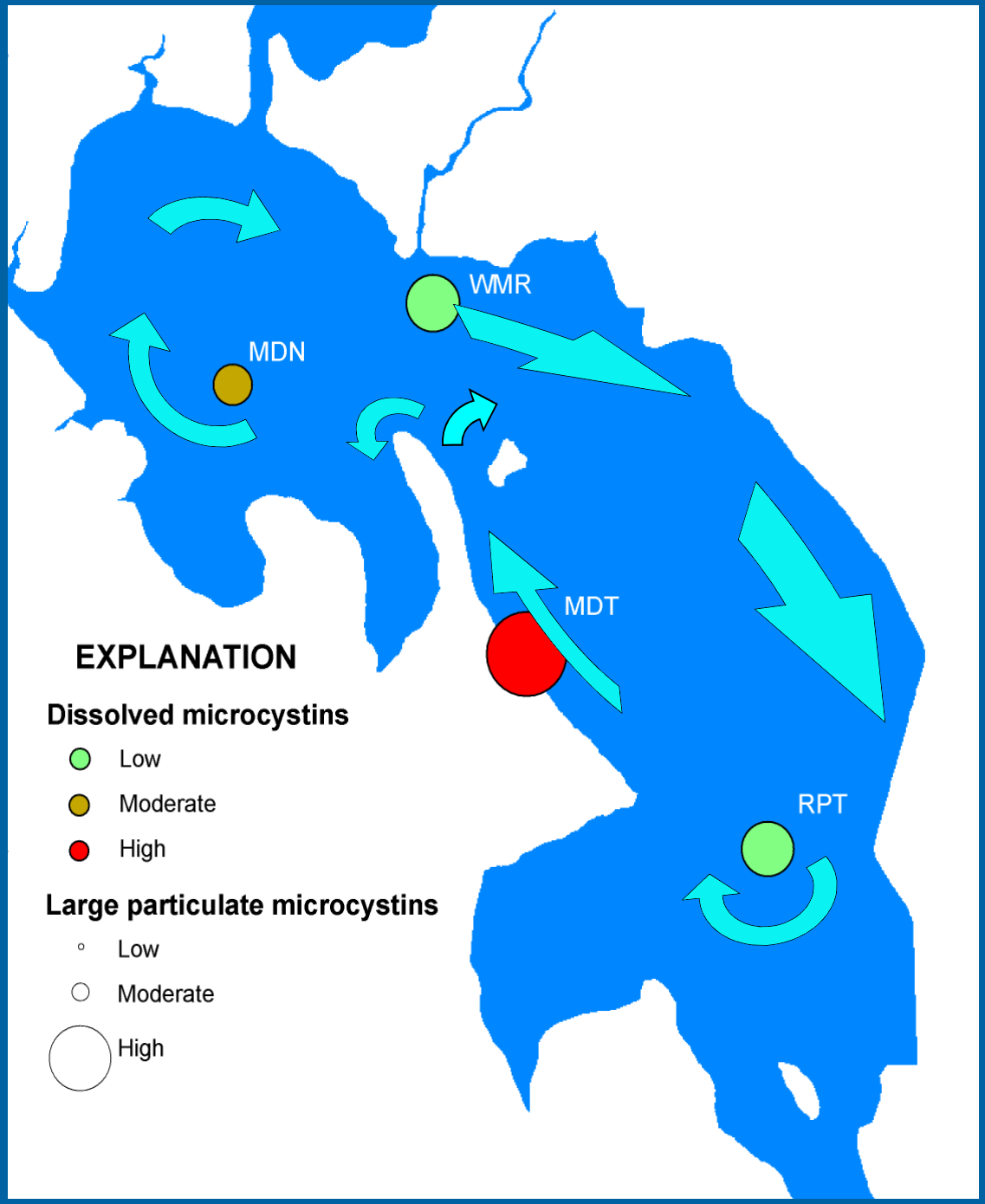






Spatial Variation 2009, 2011

Based on 2-year median values



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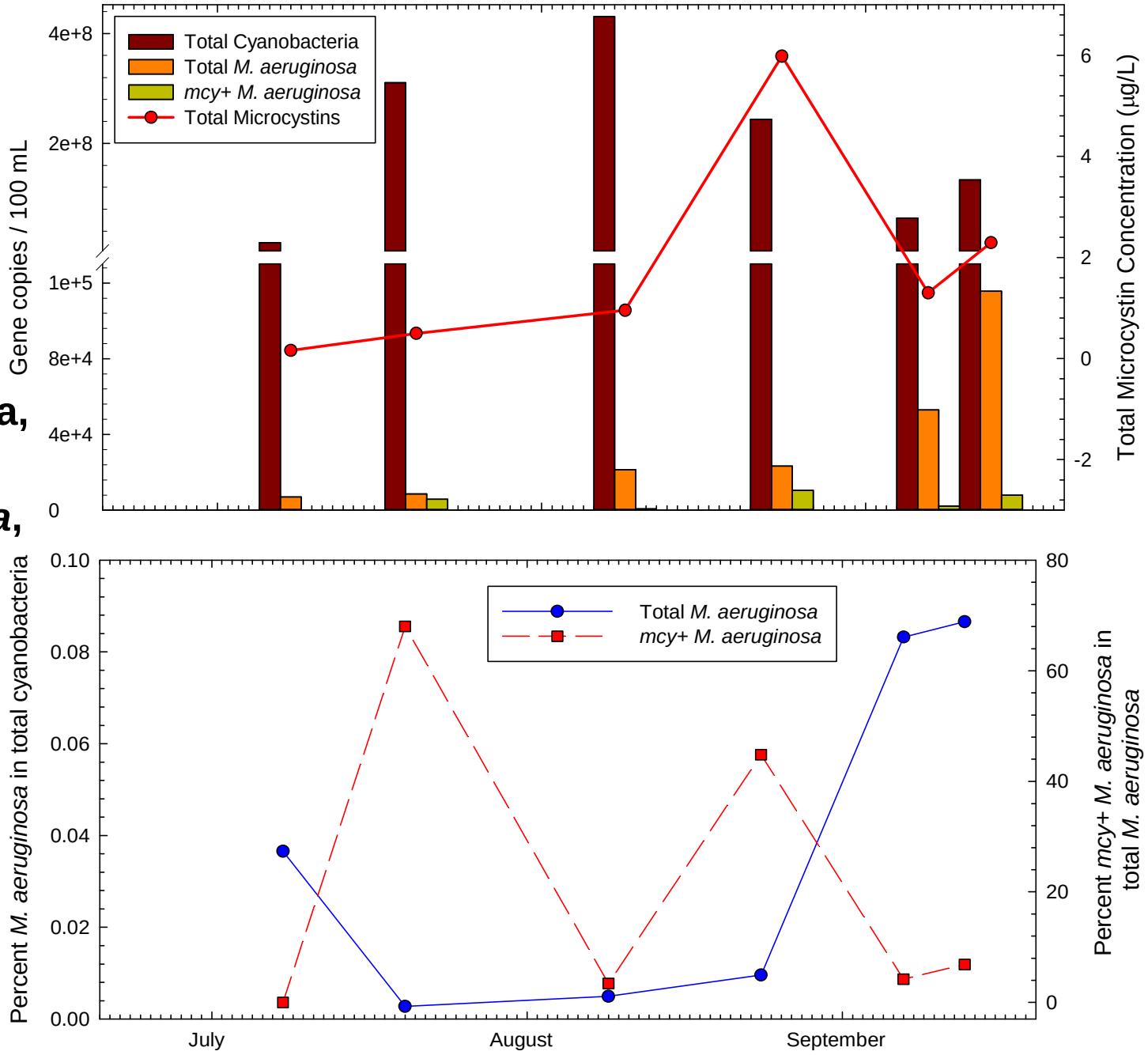
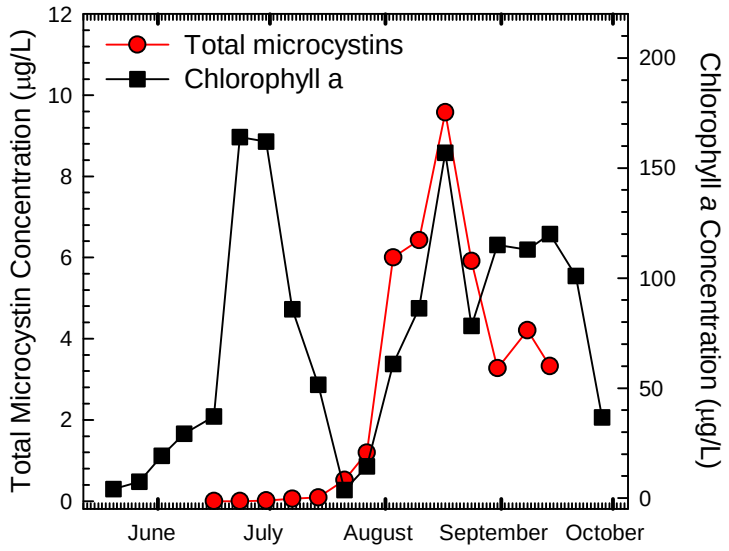
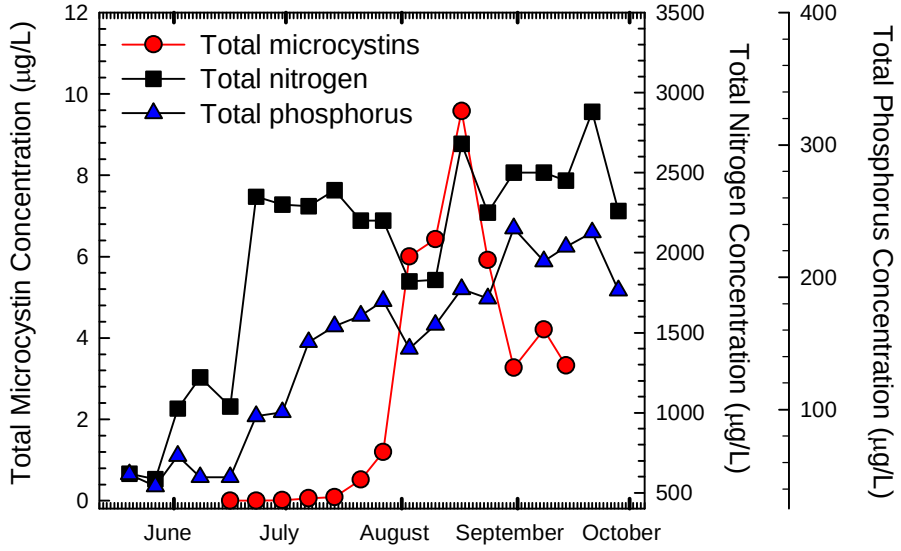
qPCR Analysis, 2011

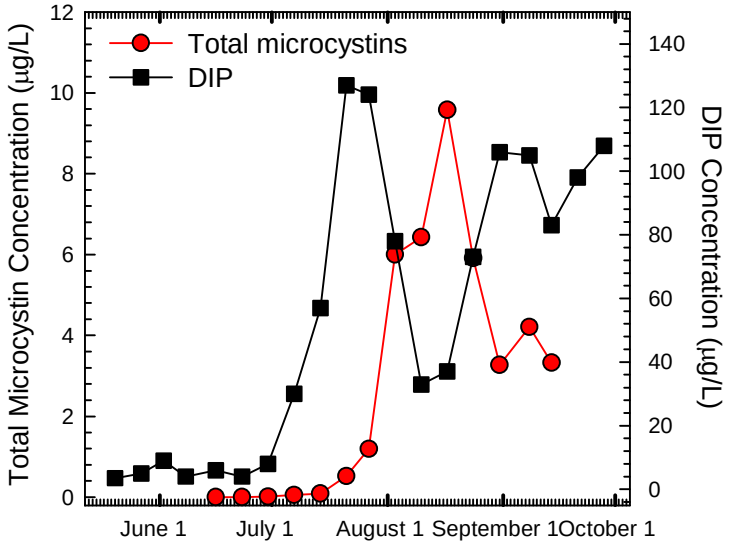
- **Cyanobacteria, 16S rRNA**
- ***M. aeruginosa*, 16S rRNA**
- **Microcystin production, *mcy*E**

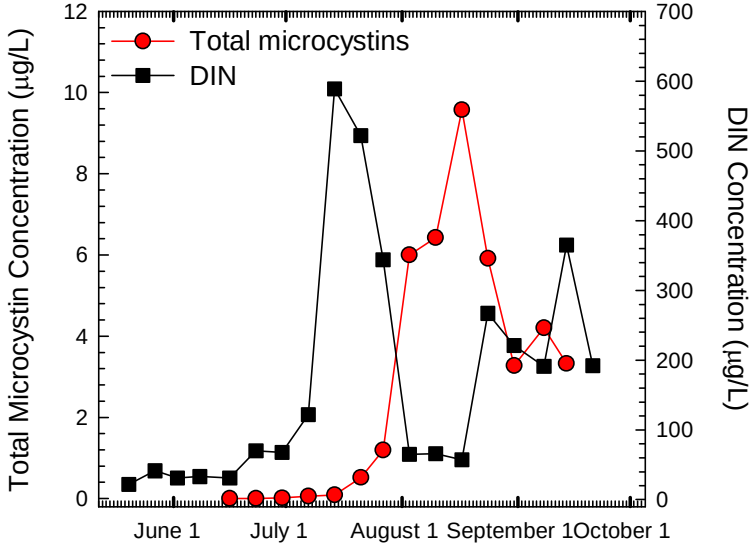


Total Microcystins vs. Chlorophyll *a*, Total and Dissolved Nutrients, 2009









A. flos-aquae vs. *M. aeruginosa*

- Microcystin occurrence and toxigenic *M. aeruginosa* associated with the second *A. flos-aquae*-dominated bloom
- N_2 fixation in *A. flos-aquae*, not *M. aeruginosa*
- Hypothesis: Toxigenic *M. aeruginosa* growth stimulated by DIN during *A. flos-aquae*-dominated bloom decline, but dependent on DIP to regulate *A. flos-aquae* growth and decline
- Impact of nutrient reduction (management) on microcystin occurrence

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Summary

- High inter-annual variability; large particulate microcystin concentrations highest in 2007 and 2009
- Concentrations highest at MDT (trench)
- Toxin concentrations increase after recovery of first lakewide bloom, with increasing chlorophyll *a*, TN and TP
- Relation between *A. flos-aquae* and *M. aeruginosa* based on nutrient dynamics
  - *M. aeruginosa* dependent on *A. flos-aquae* to supply DIN directly, DIP indirectly through bloom cycle

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