What Environmental Factors Impact the Concentration of Microcystin in an Inland Reservoir?

Mia Varner[1,2], Dr. Dion Dionysiou[1], Dr. Joel Allen[2]

1. University of Cincinnati – Department of Biomedical, Chemical, and Environmental Engineering
2. U.S. EPA – Office of Research and Development

Background

- Cyanobacteria are naturally occurring phytoplankton in aquatic environments
- Increased nutrient inputs and temperatures, among others, have been identified as contributing factors in the proliferation of harmful algal blooms (HABs)
- CyanoHABs potentially produce toxic compounds which threaten public health and the environment
- Source water quality monitoring tools can provide temporally dense data sets for exploring relationships between CyanoHABs and environmental factors

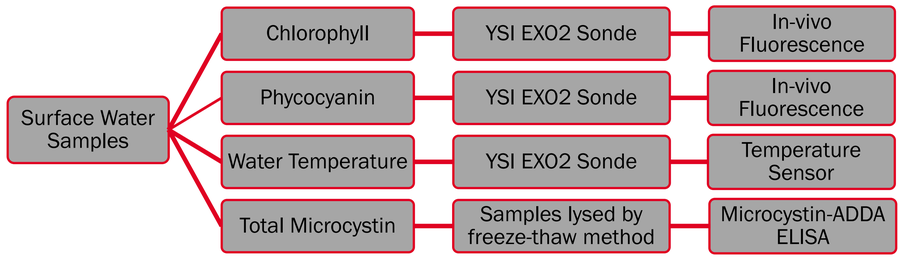
Objective

The objective of this project is to investigate relationships between water quality parameters and microcystin concentration in a multiple-use reservoir with a history of cyanoHABs. Significant correlations will aid in predictive modeling of these potentially toxic algal blooms.

Sampling Locations

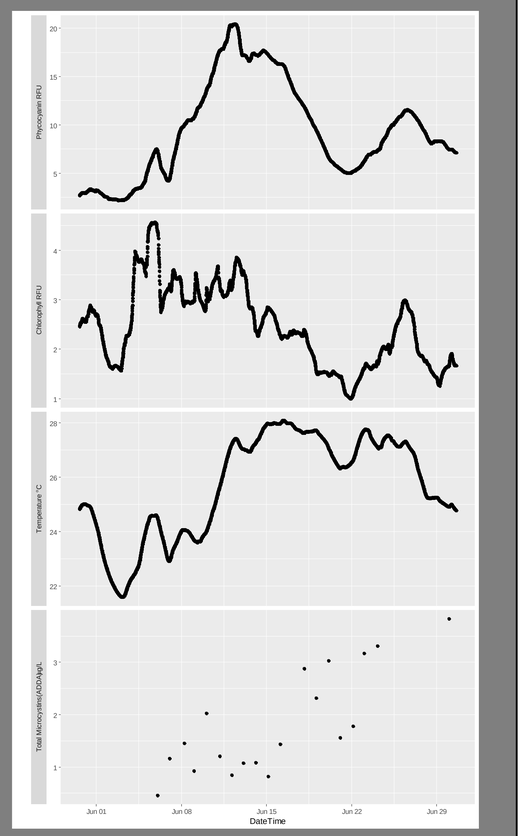
William H. Harsha Lake, Clermont County, Ohio

Methods

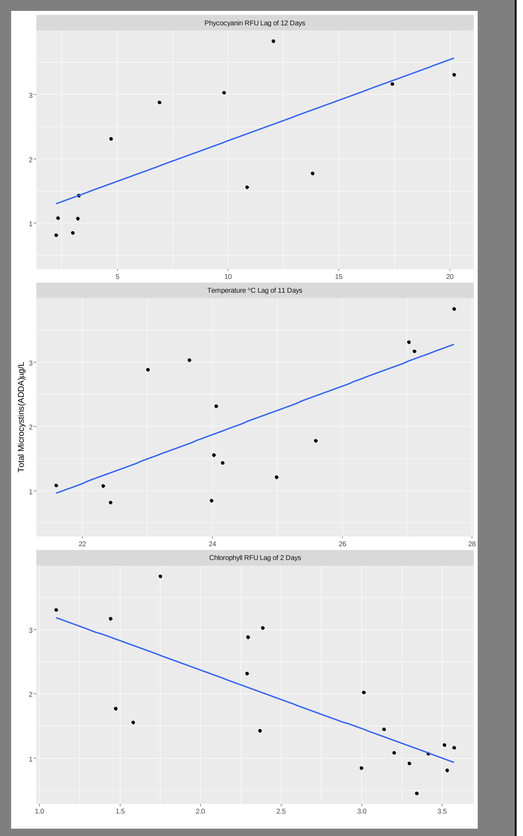


Results

2015 Summary of Water Quality Parameters



Observed Relationships at the Buoy Location



Parameter	Spearman's Rho	P value	Lag (days)
Phycocyanin	0.85	<0.001	12
Temperature	0.67	0.01	11
Chlorophyll a	-0.77	<0.001	2

Table 1. Results of spearman rank correlation. Data were filtered using a 24 hour moving average. Lag represents the time in days of optimal comparison.

Discussion

- Analysis was done using the statistical program, R
  - Spearman's Rank Correlation was used to determine the significance and strength of the relationships studied
  - Optimal time lag correlations were found using lags of 1 to 14 days, for each parameter
- Significant correlations were observed between each of the water quality parameters and microcystin, as seen in Table 1
- All parameters show strong correlations:
  - Phycocyanin and Temperature have potential as predictors of MC risk
  - Chlorophyll a is not a good predictor even though its relationship was highly significant

Further Research

- Additional insight on the interaction between environmental factors and their effect on toxic producing blooms is necessary
- Further research needs to be done regarding the presence of the toxin producing gene or genes, toxin production, and release, of all the cyanobacteria genera.
- Specifically for this project, multiple parameters will be investigated in the future, in combination with a similar time series approach shown, in order to develop correlations and relationships that can be used for predictive monitoring.

References

Are harmful algal blooms becoming the greatest inland water quality threat to public health and aquatic ecosystems? *Environmental Toxicology and Chemistry*, *35*(1), 6–13.

Paerl, H. W., & Paul, V. J. (2012). Climate change: Links to global expansion of harmful cyanobacteria. *Water Research*, *46*(5), 1349–1363. http://doi.org/10.1016/j.watres.2011.08.002

Arar, E. J. (1997). Method 446.0 In Vitro Determination of Chlorophylls a, b, c+ c and Pheopigments in. Retrieved from http://florida.eregulations.us/gateway/refpdf/62/62/Ref-02923/m446_0%5B1%5D.pdf

Abraxis. (2014). Microcystins Tube Kit. Abraxis. Retrieved from http://www.abraxiskits.com/wp-content/uploads/2014/10/Microcystins-Tube-Insert-Rev100814.pdf

Mia Varner: Varnerme@mail.uc.edu

UNIVERSITY OF Cincinnati