

WATER@MICHIGAN 2017

Presentation Summary

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Local government views on drinking water infrastructure

Lake Erie is an important source of drinking water for 11.6 million people. Annual cyanobacterial harmful algae blooms threaten this drinking water source. The dominant bloom-forming cyanobacteria, *Microcystis*, has the potential to produce microcystin, which functions as a hepatotoxin in mammals. Strain variants of *Microcystis* can have or lack the genes for microcystin production and coexist in the same bloom with variable abundance through the progression of the bloom. A growing body of literature suggests that microcystin serves to protect cyanobacteria cells from oxidative stress and elevated concentrations of hydrogen peroxide (H_2O_2) in the environment select for toxic strains of *Microcystis*. However, the dynamics of H_2O_2 during cyanobacteria blooms have not been previously studied. Weekly sampling during the 2014 cyanobacteria bloom in western Lake Erie revealed that the proportion of toxic *Microcystis* cells was highest when H_2O_2 was highest. Furthermore, microcystin and algal pigment concentrations peaked following peak H_2O_2 concentrations. Expression of genes encoding bacterial catalase-peroxidase enzymes is highest after peak hydrogen peroxide concentrations, suggesting that the microbial community is responding to and decreasing H_2O_2 concentrations. *Microcystis* was found to lack genes encoding catalase-peroxidase, suggesting that it depends on toxin production or catalase expression from "helper" bacteria for mitigating oxidative damage caused by H_2O_2 .

Additional Resources

- Zilliges et al. 2011, "The Cyanobacterial Hepatotoxin Microcystin Binds to Proteins and Increases the Fitness of *Microcystis* under Oxidative Stress Conditions," *PLoS ONE*.
- Cory et al. 2016, "Seasonal Dynamics in Dissolved Organic Matter, Hydrogen Peroxide, and Cyanobacterial Blooms in Lake Erie," *Frontiers in Marine Science*.
- Morris et al. 2011, "Dependence of the Cyanobacterium *Prochlorococcus* on Hydrogen Peroxide Scavenging Microbes for Growth at the Ocean's Surface," *PLoS ONE*.
- Great Lakes HABs and Hypoxia webpage:
https://www.glerl.noaa.gov/res/HABs_and_Hypoxia/
- EPA Harmful Algal Blooms & Cyanobacteria webpage:
<https://www.epa.gov/water-research/harmful-algal-blooms-cyanobacteria>