**Understanding the effects of grazing on cyanoHAB toxicity**

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*Figure 1: Remote Sensing Image of Lake Erie Bloom during Toledo Water Crisis in 2014.*

Freshwater ecosystems have been critical to sustaining life and establishing civilizations throughout history[1]. **As global populations grow, increased urbanization, agricultural and industrial production, combined with poor sanitation practices, have led to a widespread increase in pollution of freshwater bodies, creating an impending crisis of clean water scarcity in many regions of the world**. One major threat to many freshwater systems is the proliferation of toxic algal and cyanobacterial blooms. Western Lake Erie has experienced several large toxic cyanobacterial harmful algal blooms (cyanoHABs) in the last few years, leading to major environmental and human health risks[2]. Prior to P load reductions in the 1970s, cyanoHABs in Lake Erie were mostly $N_2$-fixers (e.g. *Aphanizomenon* and *Dolichospermum*[3], formerly *Anabaena*[4]. Now, summer cyanoHABs are primarily non-$N_2$-fixing *Microcystis*, which blooms in Maumee Bay[5] and *Planktothrix*, which blooms in Sandusky Bay[6]. The toxic *Microcystis* cyanoHAB in Lake Erie in August 2014 (Figure 1) created a water crisis that forced the shutdown of the public water supply to over 400,000 people in Toledo, OH[2]. Blooms in Lake Erie have been occurring sporadically for decades, and have now become a regular occurrence[6], and climate change increases the likelihood for more expansive blooms, exposing larger populations to water-borne toxins[7]. Despite cyanoHAB toxicity being a major human and ecosystem health hazard, it is not fully understood what causes and influences the underlying toxicity[8]. Several studies have investigated the effects of cyanotoxins on grazers[9,10], **but no studies have investigated the link between grazing activity and toxicity. It is hypothesized that, since cyanotoxins may negatively impacts grazer communities, there should be a feedback loop between grazers and cyanoHAB toxin production.** This study will investigate the impact of grazing rates on toxin production by utilizing a dilution experiment. Dilution experiments are used to quantify grazing rates in natural phytoplankton communities. The experiment will be run using bioassays following the methodology of Landry and Hassett[11] to quantify grazing and pair that with a cyanotoxin screening (e.g. Microsystin, anatoxin, etc.) using the methods indicated by Boyer[12]. The filtered lake water used for the dilution will be filtered using a 0.2 µm pore-size filter to remove algae, cyanobacteria, and grazers[13]. All bioassays will receive a 20 mg $L^{-1}$ $NaHCO_3$ addition to avoid the potential for inorganic C limitation[14]. The bioassays will then be run at 5%, 10%, 15%, 25%, 50%, 75%, and 100% dilutions in triplicate. Cyanotoxin synthesis will be calculated as the biomass-normalized change in cyanotoxin concentration and will be plotted against the dilution factor (Figure 2). This analysis will reveal if there is a correlation between the production of cyanotoxins and grazing, which will help fill gaps in the understanding of toxin production in cyanoHABs. **This research will help clarify what leads to differences in toxicity response in cyanoHAB bloom ecology and inform future research questions relating to mechanisms and interactions influencing cyanoHAB toxin dynamics.**

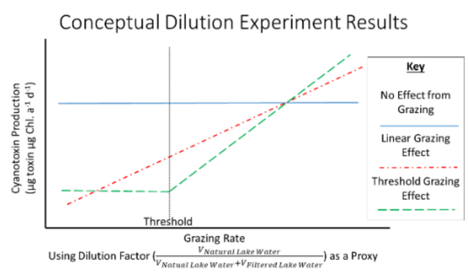


*Figure 2: Conceptual Results from a Dilution Bioassay relating toxin response to grazing rate*

**Project Budget**

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| Drive from Morehead City, NC to Put-In-Bay, OH (788 miles x ~$0.50/mile) | $400 |
| Lodging | $200 |
| Sampling Supplies, Toxin Sample Shipping, and Toxin Analysis | $400 |
| **Total Requested from Sigma Xi** | **$1000** |

Total Project Budget ($10,000)

**Budget Justification**

The drive from Morehead City, NC to Put-In-Bay, OH is 13.25 hours and lodging will be required for one night each way. Further transportation costs and lodging at the field site is covered by the Lake Erie Center grant. The sampling supplies refer to bioassay carafes that will be developed and made for this project. Most of the toxin analysis is covered by the Lake Erie Center grant mentioned; however, this project will require many more toxin screenings to occur, thus the $400 will pay for the additional screenings and the shipping of the samples to the collaborator running the samples. The total project budget covers this component, boat time, lab technician time, drive back to Morehead City, NC, field site lab space, and field site lodging (please see Lake Erie Center Grant funding source).

**Literature Citations**


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