Investigating the Drivers of Cyanotoxins and Taste-and-Odor Compounds in Streambed Algal Mats

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INTRODUCTION

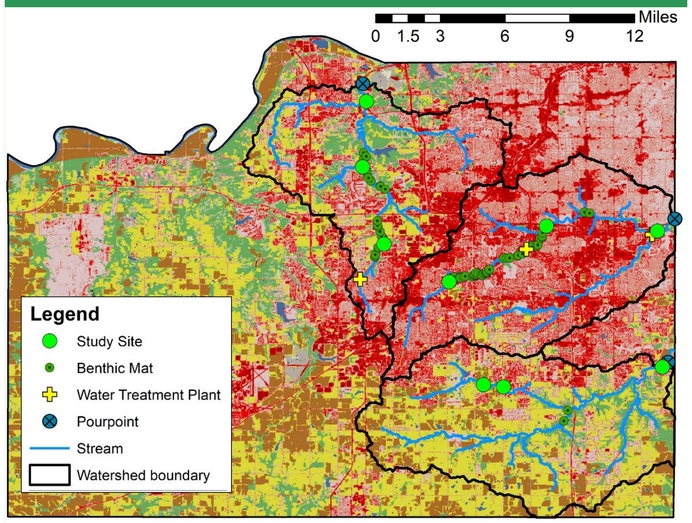
Cyanobacteria can grow in freshwater environments and have been found to release a variety of chemicals, including taste-and-odor compounds and cyanotoxins. Taste-and-odor compounds make the public skeptical of safe drinking water and are expensive to treat. Cyanotoxins cause liver and nerve damage and have been linked with livestock and pet deaths. Benthic algae are less understood compared to their planktonic counterparts and the variables that promote the production and release of toxins are poorly understood.

With this study, we investigate how land use of stream ecosystems impacts the abundance of cyanobacteria-dominated mats and the rate of toxin (microcystin, anatoxin-a, and saxitoxin) and nuisance compound (geosmin and MIB) production.

RESEARCH OBJECTIVES

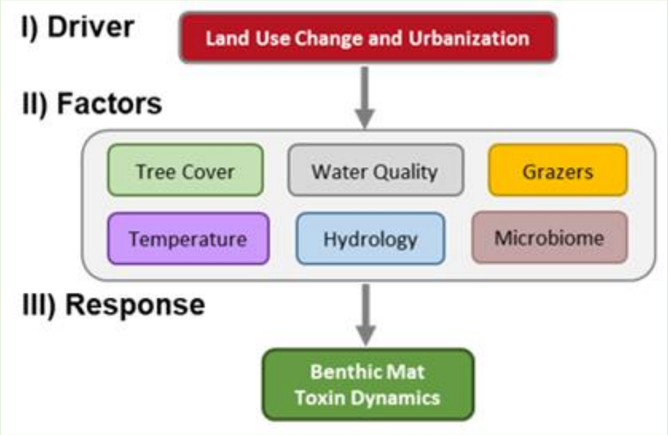
1) To assess the cyanotoxin and taste-and-odor compound levels in three Kansas streams
2) To analyze the impacts of water quality on cyanotoxin and taste-and-odor compound release
3) To relate land-use impacts on water quality and cyanotoxin and taste-and-odor compound release

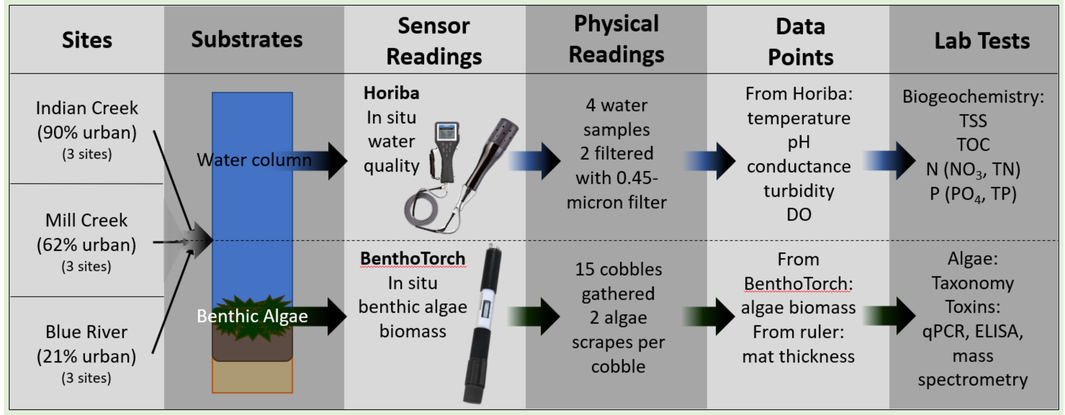
STUDY SITE



Our study sites are three streams with stark land uses differences in Johnson County, KS: Indian Creek (90% urban), Mill Creek (62%), and Blue River (21%). Apart from land use, the watersheds are similar providing a testbed for assessment of land-use impacts.

CONCEPTUAL MODEL



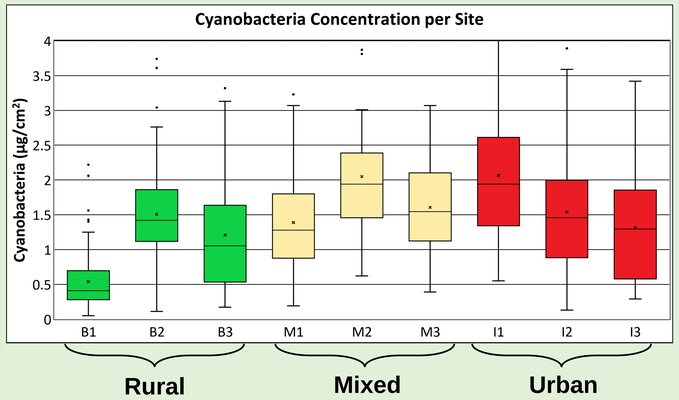


SAMPLE COLLECTION & TOXIN ANALYSIS

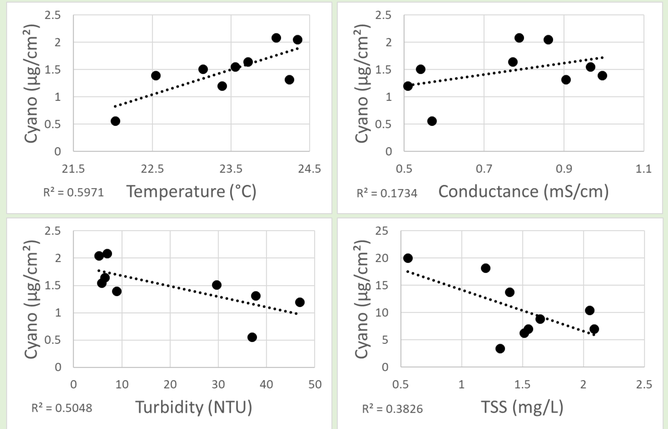
Sample Collection: Samples collected weekly since August 2021. Sediment, nutrients, and dissolved organic carbon samples sampled from water. Benthic algae samples are scraped from 15 cobble from each site in an aggregate sample. Two field sensors are utilized: Horiba U-52 for water and chemical parameters and the BBE Moldaenke BenthoTorch for algae community composition.

Toxin Analysis: Intracellular toxins and compounds are extracted from the algae by lysing the cells in freeze-thaw cycles. The extracted solution is analyzed for toxin concentration (microcystin, anatoxin-a, and saxitoxin) via ELISA kits, taste-and-odor compounds (geosmin and MIB) on an GC-MS, and toxin-producing gene abundance analysis via qPCR.

RESULTS



Urban streams tend to have slightly higher concentrations of cyanobacteria. Site B2 shows that site specific characteristics outweigh general stream characteristics. Site B2 is the location of a bridge construction, and therefore has stream characteristics more similar to urban streams (less vegetation cover, engineered stream banks, etc.)



Several factors have shown trends on their impact to the cyanobacteria concentrations. Temperature and conductance show positive, direct relationships, and turbidity and TSS show inverse relationships.

CONCLUSIONS

Cyanotoxin and taste-and-odor data is still being processed following this fall's field sampling. Nutrient data, which is also in process, can help elucidate the differences in land use. For now, it appears site specific factors have more impact on cyanobacteria than watershed scale factors. It also appears all sites satisfy the algae's nutrient requirements.

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