OHIO DEPARTMENT OF HIGHER EDUCATION HARMFUL ALGAL BLOOM RESEARCH INITIATIVE

AGENCY FUNDING PRIORITIES

Ohio Department of Health:

- Human health and toxicity:
    - health effects of consumption of low levels of cyanotoxins (through water, fish, vegetation) at or exceeding US EPA Health Advisory Levels (microcystin, saxitoxin, cylindrospermopsin, anatoxin-A) on sensitive populations including children, pregnant women, and nursing mothers
    - health effects of recreational exposures of cyanotoxins including incidental ingestion, inhalation and from dermal contact cyanotoxins on sensitive populations including children, pregnant women, and nursing mothers
- Development of rapid methods to detect cyanotoxin exposure in biological media
- Impact of cyanotoxin exposure (all toxins) on metabolic functions and the microbiome.
- Impact of cyanotoxin exposure (all toxins) on immune systems.
- Impact of total body burden from exposure to multiple cyanotoxins.
- Health effects of inhalation of cyanotoxins and direct connection to the bloodstream.
- Ability and rate of humans and animals to eliminate toxins after exposure.
- Impact of nitrogen on cyanotoxin toxicity.
- Cyanotoxin reaction kinetics – Expanding these studies to application for:
    - smaller scale (lower volume) drinking water treatment systems such as ponds or springs
    - application for treatment at low level detections in a public water system that exceed drinking water health advisory levels where healthcare facilities or food service/retail food operations want to install treatment to remove low levels of cyanotoxin
- Various media treatment efficacy for microcystin, saxitoxin, cylindrospermopsin and anatoxin-a removal for use in:
    - smaller scale drinking water treatment systems such as ponds or springs
    - application for treatment at low level detections in a public water system that exceed drinking water health advisory levels where healthcare facilities or food service/retail food operations want to install treatment to remove low levels of cyanotoxin
- Infiltration of cyanotoxin into ground water beneath the Lake Erie Islands and potential impacts on drinking water wells. Identification of infiltration pathways and mechanisms can also be applied to inland lakes hydraulically connected to ground water.
- Prevalence and occurrence of all cyanotoxins (other than microcystin) in lakes, ponds and springs used for recreation and private drinking water supplies. These systems are commonly shallower and have less water volume and may be more susceptible to the formation of algal blooms.
- Development and validation of a rapid, portable, cyanotoxin in water field kit.

Ohio Environmental Protection Agency:

- Reservoir management strategies and plans to mitigate HABs and protect/improve source water quality
    - Research projects that aim to assess the efficacy of cyanobacteria control (e.g., algaecides, ultrasound) and/or nutrient reduction (e.g., alum treatments to upground reservoirs, diversion/treatment train wetlands)
        - Prioritize studies that address emerging issues (e.g., algaecide effectiveness in cold temperatures at systems with persistent Planktothrix rubescens blooms during winter)
    - Efficacy studies (pilot demonstrations) of emerging technologies and support for transfer of technology to PWS and/or recreational waters
        - Prioritize technologies for use in drinking water with NSF/ANSI/CAN standard 60/61 certification. New technologies reported the long process for certification that delayed use in drinking water facilities.
    - Projects that support developing reservoir management plans at drinking water reservoirs
        - Ohio EPA HAB grants funded monitoring tools (e.g., multi-parameter data sonde, microscope, staff training) for public water systems during the initial period when HAB rules for drinking water systems became effective. Since this time some PWS report the challenges to use these tools for informed reservoir management, particularly at smaller water systems with limited staffing and fewer source water options. Prioritize projects that include objective to develop reservoir management plans with PWSs. May also consider grant support for consulting company that can develop reservoir management plan, tools to analyze monitoring data, and reservoir treatment for multiple source waters/PWSs clients.
- Identification, occurrence, and environmental drivers of emerging cyanotoxins
- HAB impacts on the beneficial reuse of drinking water treatment residuals and dredge (sediment)
    - Ohio EPA staff are working closely with funded HABRI project lead researchers. The projects have already produced helpful data but also raise new questions to be resolved
    - Additionally, dredge materials in HAB affected areas (Toledo and Sandusky harbors) are a focus for beneficial reuse. The complex matrix and variability of dredge materials create a challenge for analytical methods to quantify cyanotoxins (priority microcystins) and assess the potential concerns for beneficial reuse of these materials.
    - Prioritize proposals that can/will commit to developing analytical methods and capacity within Ohio
- Use of satellite data to detect HABs at inland waters: evaluation of historic data available for Ohio inland lakes and validation of inland lake data
    - Under the federal CyAN project, historic satellite data is available for Ohio's large inland lake and an independent trend analysis of this data would be useful
    - Currently, Ohio agencies use this data to inform sampling at state park beaches and questions remain on the use and validity to inform advisories and potential for impairment determination for recreational use.
    - Additionally, data analytics tool/development would improve the timeliness and efficiency to share satellite data with partners and public.

Ohio Department of Natural Resources:

- Basic Science Needs
    - Relative toxicity of various microcystin (MC) congeners: Every MC congener is treated as LR (which is likely an overly conservative approach)
    - Analytical methods: Reliable standards have only been developed for a limited number of MC congeners
- Watershed Nutrients
    - Dynamics of nutrient mobilization and transport
        - Effectiveness of wetlands (how constructed and where placed)
            - What size/type of wetland draws down the most phosphorus?
            - How many acres and/or individual wetlands are needed to make a measurable and impactful nutrient reduction? Further, where should wetlands be located/placed for best return on investment (please be aware of other ongoing effort in this space. Please work hard not to propose duplicate efforts)
        - Effect of hydrology
        - Effect of agricultural practices
    - Mitigation
        - Cost : benefit (ROI) analysis of alternative practices
        - Prioritizing areas of concern by potential benefit
        - Agricultural practice development
- Monitoring:
    - Nutrients
        - What is the contribution of tributaries themselves to amount of TP, TPP, and DRP?
            - Are the rivers sources or sinks?
            - Are they always sinks or just during low flow? High flow?
            - streambank erosion is adding phosphorus
        - In-lake dynamics – linkages to HABs
    - Microcystin concentrations:
        - In water: Why are some blooms more toxic than others?
        - In fish muscle tissue: Methods are still relatively new and developing (e.g., optimizing analytical methods or new mass screen procedure). Currently sample processing is limited by cost and staff time
    - Do Microcystins bioaccumulate in fish muscle tissues?
        - Concentrations before, during, and after bloom
        - How are fish taking up MC? What's the pathway / mechanism?
        - What is the relative contribution of diet, uptake by the gills, etc.

- Impacts
    - Limnological effects
        - Are HABs negatively affecting habitat quality?
        - Role in LE dead zone / hypoxia
    - Food web dynamics / function
        - Lower trophic dynamics
        - Fish
            - Physiological stressors: Is MC exposure stressful to fish? Individual-vs-Population effects?

        - Community structure: Are some species / life stages more sensitive to MC than others? Benefits to desirable (sportfish) vs undesirable (invasive) fishes?
        - Sportfish recruitment / growth
    - Users
        - Economic impacts of HABs on participation in water-related recreational activities
            - Beaches
            - Angling / boating
                - How many trips (or fishing licenses) are lost and value of those losses because of HABs or the perception of HABs?
                - Angler perceptions of the risk of eating fish living in HABs?

Ohio Department of Agriculture:

- Nutrient losses associated with:
    - application rate at tri-state recommendations
    - subsurface placement of P versus surface broadcast
    - broadcast application of fertilizer in season versus fall broadcast application
- Economics studies assessing agricultural best management practices:
    - Water management strategies on the field (retention ponds and/or wetlands). What are the economics behind taking crops out of production
    - When is the return on investment for cover crops
    - When can I expect to pay down equipment purchased to do subsurface nutrient placement (both commercial and manure subsurface placement)
- Social science studies:
    - willingness to adopting agricultural best management practices
    - Barriers to adopting agricultural best management practices
    - Farmer decisions on rented ground
- Water management studies:
    - pros/cons of drainage water structures (e.g., how to properly manage and where to locate drain water control structures)
    - pros and cons of two stage ditches
    - If on field retention ponds are utilized for water storage how much will farmers need to compensated
- Microbial changes associated with cover crops. Do these changes impact nutrient loss and/or nutrient retention
- Crop genetics and how this is affecting nutrient runoff