FORM BLOOM

How can we adapt to, and mitigate, harmful algal blooms?

PROJECT SUMMARY

FORMBLOOM work marries research on risk communication to harmful algal bloom forecasting, monitoring and mitigation. Solving the problem of blooms requires an understanding of how the physical environment links to geochemistry and bloom ecology, and this understanding must exist on the timescale upon which blooms develop and collapse – minutes to hours to weeks. Managing their impact is a key interim goal. This project identifies the key environmental factors that drive bloom onset, duration, and cessation while also evaluating the impact blooms have on ecosystem services, working with ecosystem managers to understand how we might mitigate blooms, and how we can manage bloom risk.

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FORecasting tools and Mitigation options for diverse BLOOM-affected lakes

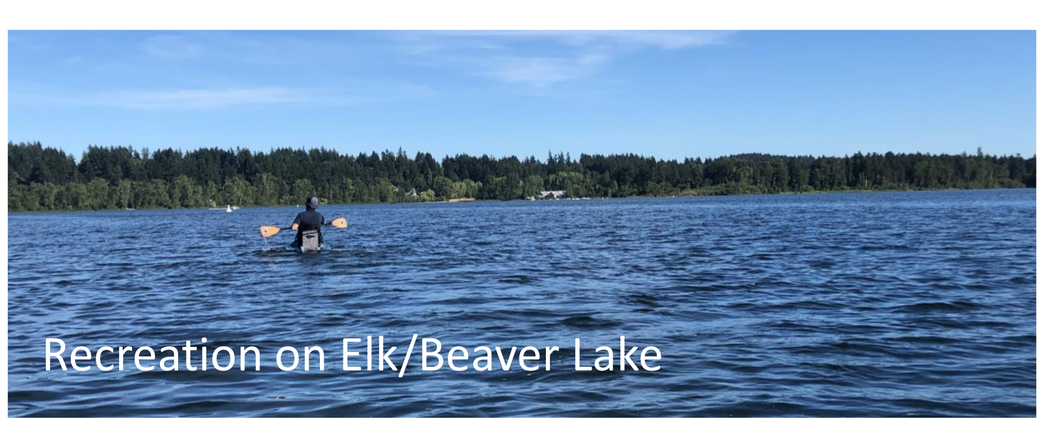
Progress

Bloom adaptation:

- Identified uneven approaches and capacity nationally for handling bloom risk and communications.
- Improved methods to estimate of the size and extent of blooms that combine traditional, sensor-based, and remote-sensing tools.
- Demonstrated the presence of typically unmonitored toxins and toxin seasonality. Developed methods to predict toxin risk and supported method modifications for more accurate toxin quantification.
- Characterized climatic drivers of extended bloom season.

Bloom onset and mitigation:

- Showed phosphorus fertilization can lead to rapid bloom induction in whole lake experiment, and that blooms can modify the environment, vastly increasing nitrogen (in even without a direct input).
- Built framework for bloom mitigation based on ferrous-iron hypothesis and initiated first whole-lake experiment to test this hypothesis.
- Modelled benefits of floating solar arrays as an intervention, demonstrating thermal and light-related changes will decrease biomass, and impact phytoplankton communities



Recreation on Elk/Beaver Lake

Buffalo Pound Lake with harmful algal bloom

User Engagement

- Ongoing work with Buffalo Pound Lake Water Treatment Plant to improve diagnosis of bloom-related treatment. Identified cyanobacteria buoyancy as a cause of scum formation during treatment and provide links to taxonomic data. Adoption of processes during bloom periods to help manage scum formation. In 2022, the plant invested $250,000 in technology with co-benefits to research, and operations – with use of technology in operations informed by our ongoing engagement.
- Spatial maps for a key water resource were generated, and new partnerships with the Saskatchewan government have expanded this work to allow extension of the time series of spatial assessment of bloom intensity.
- The Capital Region District in BC and local groups that use Elk/Beaver Lake have been actively involved in initial surveys and choice experiments to understand preferences and willingness to pay associated with lake treatments to improve Elk/Beaver Lake.

Results

- Ongoing work suggests substantive impacts of blooms on lake use. As well, there is high willingness to pay to mitigate blooms, which suggests support for watershed and lake-based interventions.
- Low sediment redox promotes cyanobacteria blooms across a wide trophic range meaning that bloom management practices will have to manage more than just nutrient loads.
- Flow management of reservoirs has the potential to significantly alter water quality and bloom risk. Large storms can disrupt thermal structure allowing sediments to warm and changes to inflow waters can alter water quality making it difficult to treat. Reservoirs are designed for predictable water quality, flows, and levels and yet must become more adaptable to climate change.
- Identified triggers and preconditions for blooms in several lake types. Access to nutrients, light, and lake stability are important but differ in their roles between lakes because of morphological, residence time, nutrient ratio, and sediment redox differences. Blooms can show inherent forecastability in terms of biomass based on timescales for biomass increase. However, key factors, like toxin risk, show far greater complexity.
- User-interest in insights and adaptation + mitigation advice is high. We we are capacity-limited, nationally and within the project, at meeting these vast needs given large number of bloom-affected lakes. Access to new tools, including remote sensing, toxin testing and sensors is of high interest among users as is specific advice on how to solve the problem in 'my lake'.

Outcomes and application uptake

- Bloom risks are mediated by climate and nutrient inputs. Interventions to mitigate blooms need to be tailored to lakes and watersheds, with several promising interventions identified and testing is underway with evidence of both strong interest and willingness to pay to remediate bloom-impacted lakes.
- While mitigating blooms is a key goal to help protect aquatic ecosystem services, adapting to blooms is equally important, given the risks and costs they impose today and often long recovery periods. Uneven, often weak capacity in assessing and communicating bloom risks can lead to unnecessary health risks.
- Strong partnerships have helped advance our work – enhancing understanding and uptake of tools for adaptation. Strong partnerships have also informed design of our tools to better align with local conditions, user interests, and capacity.

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