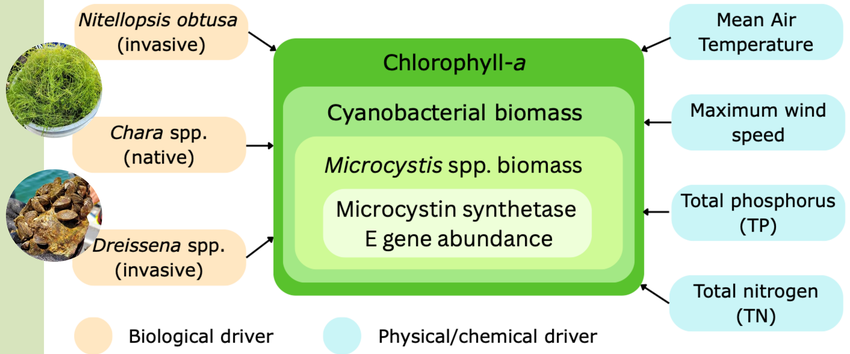
Safe to Swim? Conventional Algal Bloom Indicators Mask Toxin Risk

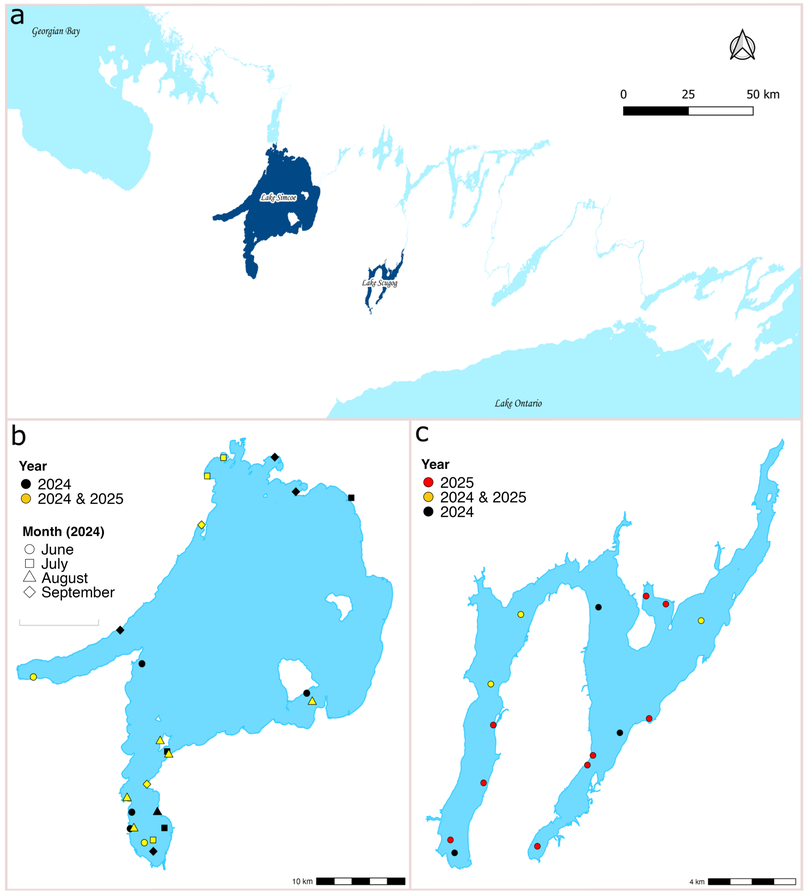
Flavia Breje[1], Brian Ginn[2], Tyler Harrow-Lyle[1], Andrea Kirkwood[1]; [1]Ontario Tech University, [2]Lake Simcoe Region Conservation Authority

1. Background & Objective

- Synchronous, lake-wide cyanobacterial blooms occurred across Lakes Simcoe and Scugog during summer 2024
- Drivers of bloom development across **broad** to **specific** phytoplankton metrics were investigated using **Bayesian regression models (BRMs)**

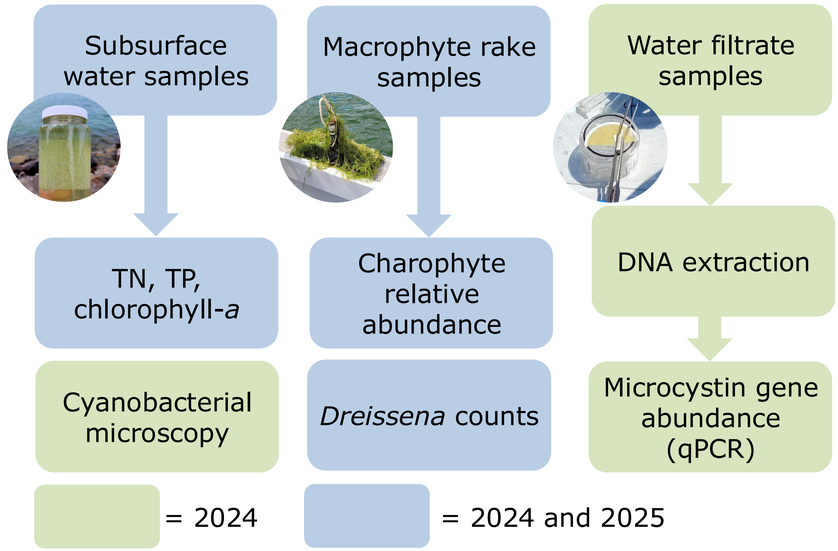


2. Sampling Locations

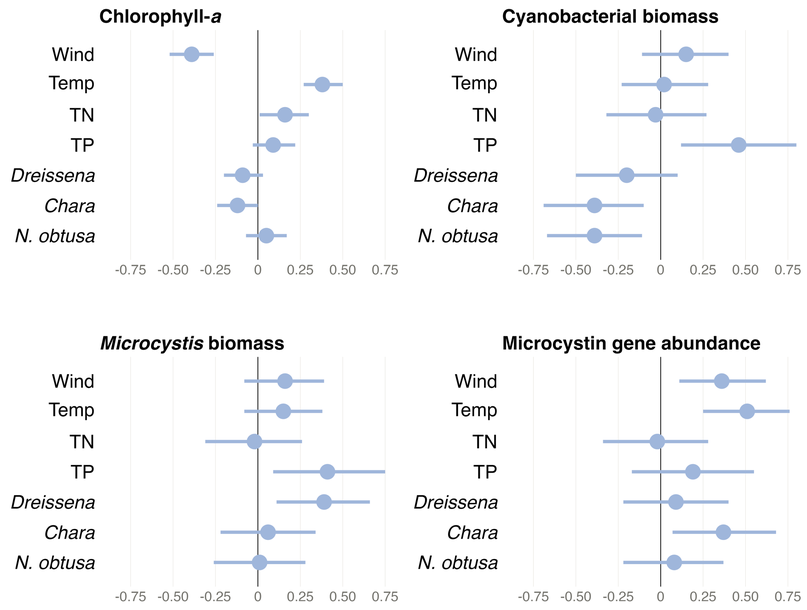


Trent Severn Waterway (a) summer monthly sampling sites of Simcoe (b) and Scugog (c) in 2025 (n=119) and 2024 (n=47)

3. Methods



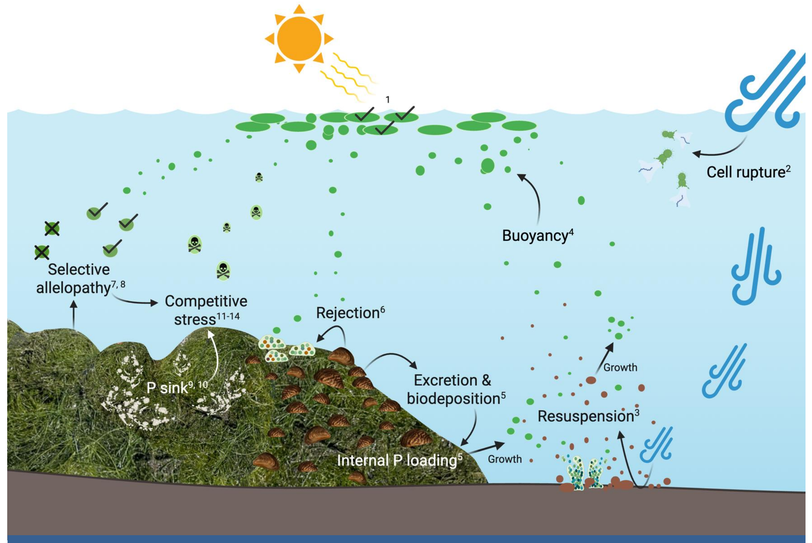
4. Results



BRMs frameworks: data for chlorophyll-*a* were drawn from 2024 and 2025; all remaining models were based on 2024 data; filled circles = posterior mean, lines = credible interval

- **Wind** reduced chlorophyll-*a*, but increased cyanobacterial biomass, *Microcystis* biomass, and microcystin gene abundance
- ***Chara*** and ***Dreissena*** reduced chlorophyll-*a* and cyanobacterial biomass but increased microcystin gene abundance and *Microcystis* biomass, respectively

5. Discussion



6. Management Implications

- **Relying solely on chlorophyll-*a* after wind events or in dreissenid and charophyte dominated lakes may underestimate bloom toxicity**
- Incorporating cyanobacterial specific metrics like *Microcystis* biomass or microcystin toxin measurements into monitoring programs is critical to avoid false indications of improved water quality



7. Acknowledgements

We conducted this research on the traditional territories the Mississaugas of Scugog Island First Nation, and the Chippewas of Rama, Beausoleil, and Georgina Islands First Nations. We acknowledge the enduring presence of Indigenous people as stewards of these lands and waters and are grateful to be able to conduct research here.



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References

1. Rigosi, A., Carey, C. C., Ibelings, B. W., & Brookes, J. D. (2014). The interaction between climate warming and eutrophication to promote cyanobacteria is dependent on trophic state and varies among taxa. *Limnology and Oceangraphy*, 59(1), 99–114.
2. He, Q., Liu, Z., & Li, M. (2024). Effects of aeration induced turbulence on colonial morphology and microcystin release of the bloom-forming cyanobacterium Microcystis. Journal of Oceanology & Limnology, 42, 1827-1838.
3. Wang, J., Chai, J., Xu, R., & Pang, Y. (2024). The effects of wind-wave disturbances on sediment resuspension and phosphate release in Lake Chao. *Science of The Total Environment, 912*, 169254.
4. Reynolds, C.S., Oliver, R.L., & Walsby, A.E. (1987). Cyanobacterial dominance: the role of buoyancy regulation in dynamic lake environments. *New Zealand Journal of Marine and Freshwater Research*, 21(3), 379–390.
5. Li, J., Ianaiev, V., Huff, A., & Katsev, S. (2021). Benthic invaders control the phosphorus cycle in the world's largest freshwater ecosystem. *PNAS, 118*(6), e2008223118.
6. Vanderploeg, H.A., Liebig, J.R., Carmichael, W.W., Agy, M.A., Johengen, T.H., Fahnenstiel, G.L., & Nalepa, T.F. (2001). Zebra mussel (*Dreissena polymorpha*) selective filtration promoted toxic Microcystis blooms in Saginaw Bay (Lake Huron) and Lake Erie. *Canadian Journal of Fisheries and Aquatic Sciences, 58*(6): 1208-21.
7. Berger, J., & Schagerl, M. (2003). Allelopathic activity of *Chara aspera*. *Hydrobiologia*, 501, 109–115.
8. Berger, J., & Schagerl, M. (2004). Allelopathic activity of Characeae. *Biologia, Bratislava, 59*(1): 9-15
9. Kufel, L., Kufel, I. (2002). *Chara* beds acting as nutrient sinks in shallow lakes—a review. *Aquatic Botany*, 72(3-4), 249–260.
10. Kufel, L., Biardzka, E., & Strzałek, M., 2013. Calcium carbonate incrustation and phosphorus fractions in five charophyte species. *Aquatic Botany*, 109, 54–57.
11. Oh, H.-M., Lee, S. J., Jang, M.-H., & Yoon, B.-D. (2000). Microcystin production by *Microcystis aeruginosa* in a phosphorus-limited chemostat. *Appl. Environ. Microbiol.*, 66(1), 176–179. Pimentel, J. S. M., & Giani, A. (2014). Microcystin production and regulation under nutrient stress conditions in toxic *Microcystis* strains. *Applied Environmental Microbiology*, 80(18), 5836–5843.
12. Pimentel, J. S. M., & Giani, A. (2014). Microcystin production and regulation under nutrient stress conditions in toxic *Microcystis* strains. *Applied Environmental Microbiology*, 80(18), 5836–5843.
13. Cao, Q., You, B., Xu, H., Liu, W., & Ma, S. (2025). Differential responses of *Microcystis aeruginosa* to single and repeated exposure to *Myriophyllum spicatum* extracts. *Algal Research*, 89, 104060.
14. Wang, J., Liu, Q., Feng, J., Lv, J., & Xie, S. (2016). Effect of high-doses pyrogallol on oxidative damage, transcriptional responses and microcystins synthesis in *Microcystis aeruginosa* TY001 (Cyanobacteria). *Ecotoxicology & Environmental Safety, 134*, 273–279.