*for*Water Research Snapshot

TO: *for*Water Members

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Subject: **Bacterial communities in the Glenmore Reservoir with an emphasis on cyanobacteria**

Cyanobacterial community composition within the sediment and water column of the Glenmore Reservoir (Calgary, Alberta) was analyzed in July 2017 and September 2020 to identify organisms that could potentially reduce water quality.

Research Summary

Lakes and reservoirs can be challenged due to climate change-exacerbated landscape disturbances (e.g., wildfire, stormwater flow) which lead to an amplified frequency of nutrient-rich runoff that delivers phosphorus (P) and nitrogen (N) to water supplies.[1] This is particularly of concern in some regions rich in fine sediment deposits, such as many parts of Canada.[2] Furthermore, these nutrients combined with increased surface water temperatures can result in optimal growth conditions for problematic cyanobacteria.[3,4,5] These organisms pose considerable health concerns by producing a variety of toxins, including microcystin (hepatotoxin) which is regulated in water treatment processes.[6] Some cyanobacteria and other bacteria such as *Streptomyces* are also able to produce the taste and odour (T&O) compounds, geosmin and 2-methylisoborneol (MIB).[7] It is expected that the frequency and severity of cyanobacterial blooms will increase due to climate change.[8]

The Glenmore Reservoir is a drinking water source for the city of Calgary, Alberta, and supplies drinking water to approximately 800,000 consumers.[9] Key risks to this reservoir have been identified as: run-off from agriculture and residential developments in the urbanized portions of the watershed and stormwater pollution and wildfires. Despite these potential risks, Glenmore Reservoir has historically been an oligotrophic (low nutrient) water source and does not have a history of cyanobacterial blooms.[10] However, there is a history of T&O events[11] and source water risks (e.g., wildfire and stormwater) have the potential to increase nutrient loading to the reservoir, which can promote cyanobacterial blooms.

Results

- In samples collected from Glenmore Reservoir in 2017, *Planktothrix*, a well-known microcystin toxin producing genus, was observed at secchi depth in Mid-Lake and in sediment samples from Mid-Lake and Weaselhead (Figure 1).[13,14] In 2020, *Planktothrix* was again observed in Bearspaw sediment samples but this genus and other cyanobacteria were in low relative abundance within samples both in 2017 and 2020. The current level of this risk is low but climate change-exacerbated disturbances could increase the risk associated with cyanobacteria and presence of toxins.
- Water and sediment samples collected in September 2020 were also analyzed for geosmin producing bacteria. No geosmin genes (needed to produce this compound) were observed. While these findings suggest a low risk,

Glenmore Reservoir has been experiencing taste/odour events, which calls for the need for continued monitoring to detect T&O producers and to expand targeted monitoring into the watershed.

- Future work should involve continued sampling of water and sediment samples to identify potential toxin and taste/odour producers. This includes seasonal and diurnal sampling which is critical for management and understanding of communities present in reservoirs or lakes as cyanobacteria are present at different abundances during the year and within the water column on a daily scale.[15]
- Additionally, a metagenomics approach would be beneficial for further understanding the bacterial community composition within samples and to identify the presence of genes required for toxin and taste/odour production.[16]

Figure 1

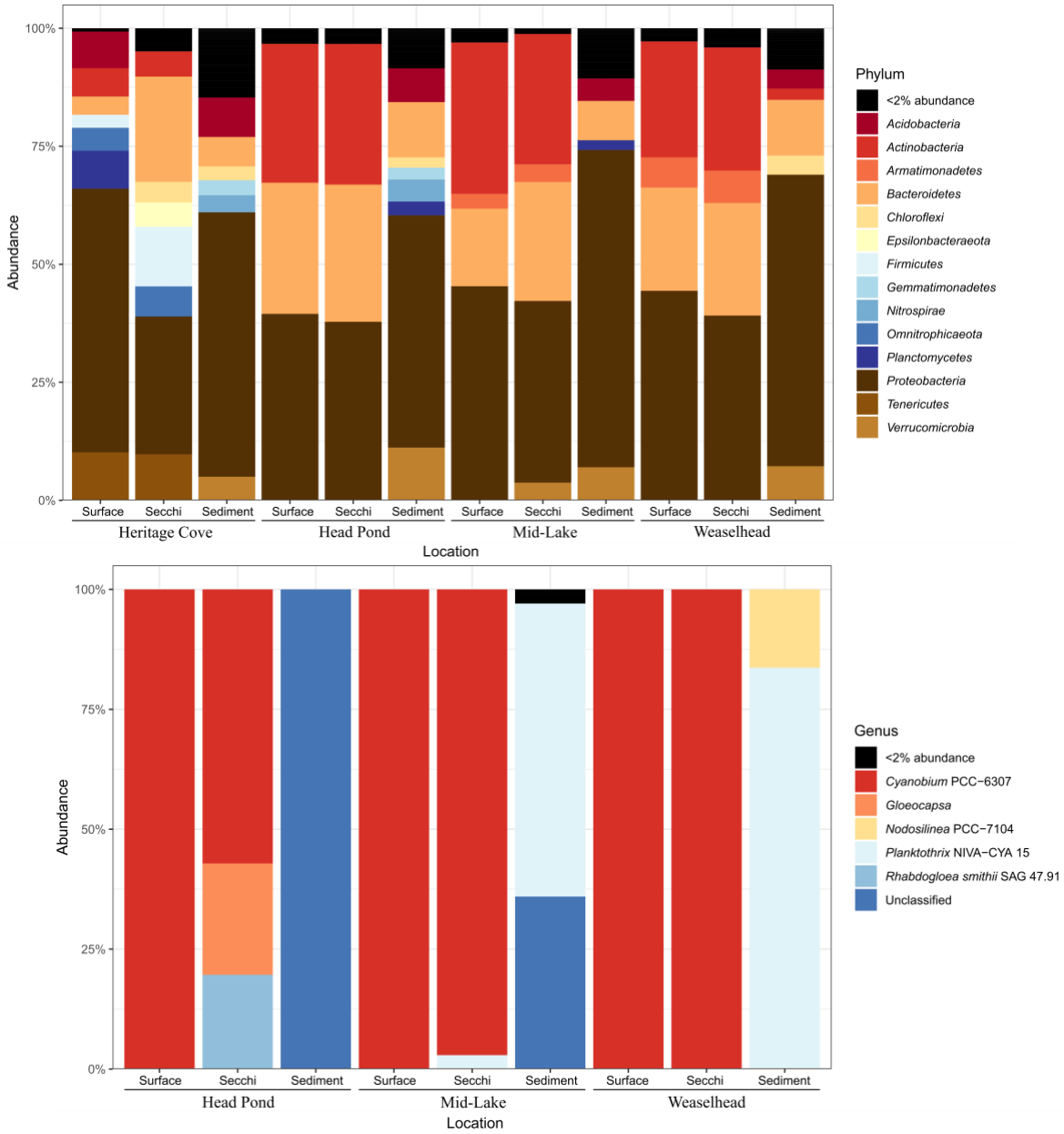

Figure 1. Stacked barplot of bacterial phyla (top) and cyanobacteria genera (bottom) in surface and secchi water samples and sediment samples from four sample sites in the Glenmore Reservoir from July 2017

that comprise of ≥98% of the community. Cyanobacteria 16S rRNA gene sequences were present in all samples (surface, secchi and sediment) except Heritage Cove but fell below 2% relative abundance. Despite low relative abundance, *Planktothrix* was observed which is a well characterized microcystin toxin producing cyanobacteria. It is recommended that monitoring continues to assess the presence of toxin and geosmin producing cyanobacteria.

1. Silins *et al*., 2009; 2014; Williams *et al*., 2019
2. Silins *et al*., 2014; Wagner *et al*., 2014; Emelko *et al*., 2016 ; Ellison *et al*., 2017
3. Silins *et al*., 2009; 2014; Emelko *et al*., 2011; 2016; Lopes *et al*., 2018; Paerl, 2018
4. Schindler, 1977; Paerl *et al*., 2016
5. De Senerpont Domis *et al*., 2007
6. Carmichael, 1992
7. Giglio *et al*., 2008; 2010
8. Chapra *et al*., 2017
9. Watson *et al*., 2001
10. City of Calgary, 2018
11. Watson *et al*., 2000
12. Aljoudi, unpublished
13. Shardlow, unpublished
14. Cameron, unpublished
15. Otten *et al*., 2016

References - a complete list is available upon request.

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