



2023 Benthic Count - Citizen Science in Action

2023 KAHSHE AND BASS LAKE STEWARD REPORT – EXECUTIVE SUMMARY

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ABSTRACT

The findings of all environmental water quality and biological monitoring for both Kahshe and Bass Lakes in 2023 have been summarized and compared to acceptable water quality indicators for algal friendly nutrients phosphorus and nitrogen as well as over 30 other parameters. Historical trends in water quality over four decades have identified no major contamination issues that would explain why Kahshe Lake was impacted by harmful algal blooms (HABs) in both 2020 and 2021 resulting in it being designated as 'vulnerable' by the Muskoka Official Plan. Elevated levels of phosphorus in Bass Lake have been attributed to natural causes following a District Causation Study; however, an HAB was documented in late 2023 and the Health Unit alert remains active. This report discusses why HABs are happening and identifies four key actions waterfront owners can take to reduce the likelihood of future HABs as our climate changes. Based on a KLRA-funded near-shore sampling program in 2021, we need look no further than to our own shorelines to understand why the historical monitoring at mid-lake, deep water sampling locations is not generating a biologically relevant picture of water quality close to the shore. This report also identifies some insights and linkages between our changing climate and its role in the development of late season HABs.

Executive Summary

2023 Kahshe and Bass Lake Steward Report

A review and analysis of all historical environmental monitoring on Kahshe and Bass Lakes can be found in annual Lake Steward Reports from 2012 through 2023. These documents have been posted on the KLRA web-site: <https://kahshelake.ca/Water-Quality>. This report captures the findings from sampling and analysis of both Kahshe and Bass Lakes in 2023 and has been structured to address the following parameters of potential concern for both Kahshe and Bass Lakes:

- Algal Nutrients and Other Factors Promoting Algal Growth
- Calcium Depletion
- Lake Acidification
- Metals and Other Chemicals of Concern
- Dissolved Oxygen Depletion
- Benthic Organism Health

The 2023 report also includes an overview of the climatological factors that have the potential to influence lake conditions. This demonstrated that air temperatures in 2023 were generally similar to the three previous years and to the 30 year normal for most months, with the exception of much warmer winter conditions in December and January. In the case of precipitation, total monthly amounts in April, June and July were noticeably greater than in previous years and compared to the 30 year normal, with much dryer conditions being recorded in November and December.

In 2023, the ice-out date for Kahshe Lake was April 14. The data from 1987-2023 for Kahshe Lake appear to generally follow the ice-out dates for the larger Muskoka Lakes and there appears to be a trend towards earlier ice-out dates on both Muskoka Lakes and Kahshe since the early 1970s.

Based on the DMM and MECP investigations, the following conclusions have been reached regarding the six water quality parameters identified above.

Algal Nutrients and Other Factors Promoting Algal Growth

Water quality monitoring of Kahshe and Bass Lakes by the DMM and the MECP has not identified any major water chemistry issues or trends in terms of algal friendly nutrients – phosphorus and nitrogen. Although both lakes have been classed as ‘Vulnerable’ under the updated Muskoka Official Plan (MOP), Bass Lake is expected to be removed due the findings of a DMM-funded Causation Study that identified natural causes as the reason for the elevated (>20 µg/L) levels of phosphorus, which is now one of three ‘Water Quality Indicators’ under the updated MOP. Kahshe Lake remains on the ‘Vulnerable’ list due to the documented presence of harmful blue-green algal blooms (HAB) in both 2020 and 2021, although none have been recorded since then. While Bass Lake is slated to be removed from the ‘Vulnerable’ listing, it may be re-listed, as there was an HAB in 2023 and it remains on the Simcoe-Muskoka Health Unit’s active list.

Trends in water temperature, which can accelerate algal growth also were examined and there was no evidence of a warming trend in either lake based on water temperature measurements dating back to

the early 1980s. Water clarity also has remained fairly steady over this four decade period, although clarity in Bass Lake is noticeably lower than in Kahshe.

And finally, it should be noted that the trend towards increasing numbers of HABs in Muskoka lakes continued in 2023, with 13 water bodies with documented HABs. This is cause for concern as the levels of algal-friendly phosphorus in Muskoka lakes have not increased over this time period. As such, changes in other factors that are known to accelerate algal growth and bloom development are happening. And, as we discovered in our Near-Shore Sampling Project in 2021, it is also possible that the historical sampling in mid-lake, deep water locations by the DMM and MECP is giving an excellent historical record of nutrient levels but not reflecting the elevated levels that have been documented in near-shore areas where algal blooms typically form.

Calcium Depletion

Decreasing lake water calcium concentration is an emerging concern for lakes on the Precambrian Shield in Ontario due to its impact on the reproduction and survival of zooplankton and other aquatic species that are important components of the aquatic food chain. The 2023 data confirm that there is no detectable trend towards decreasing levels of calcium in either Kahshe or Bass Lakes. However, as levels of calcium are fairly close to the aquatic growth limiting threshold of 1.5 mg/L and, as this threshold value would not be protective of all aquatic organisms, continued vigilance is necessary.

This is underscored by late season population explosions of *Holopedium* in Kahshe Lake since 2021. These pea sized, jelly-like orbs are not known to be toxic, but are an uncomfortable nuisance as they can be felt against your skin while swimming.

Lake Acidification

The waters of Kahshe and Bass Lake have acidity (pH) levels that are within a normal range and there is no evidence of an increasing or decreasing trend in acidity over the two decade monitoring period.

While the pH findings represent good news, it should also be recognized that the waters of Kahshe and Bass Lakes have low levels of alkalinity, and as such, are more susceptible to acidification as the ability of the water to buffer the acid input is low.

Metals and Other Chemicals of Concern

The analysis of over 30 additional anions, cations and other chemicals by the DMM in 2023 has, with one possible exception, identified no trends or aquatic toxicity issues. While there were some minor exceedances of chronic (long term) health protection benchmarks established by the MECP and other agencies in the early years, most of these exceedances were likely due to sampling or laboratory artifacts, as more recent sampling has shown concentrations that are in the expected range for non-impacted surface water bodies in Ontario.

In the case of aluminum, the aquatic benchmark has been exceeded in Bass Lake, with the highest concentration in 2023; however, the benchmark consists of a range in values and must be evaluated based on the pH and DOC concentrations in lake water. Based on these findings, the levels of aluminum need to be followed carefully in future monitoring to ensure that the waters of Kahshe and Bass Lakes are safe from an aquatic perspective.

The other finding from this data set is that there are numerous parameters that, like total phosphorus, are higher in Bass Lake compared to Kahshe Lake. There are also a couple of parameters (silicon and N-NO₃) where levels in Kahshe are higher than in Bass. The reason for these differences in the two lakes is unknown and was not evaluated in the DMM-funded Causation Study on Bass Lake.

Dissolved Oxygen Depletion

Dissolved oxygen (DO) in lake water is important, as it is essential for the survival of all aquatic organisms. A lack of oxygen in the lower layers of the lake (referred to as being anoxic) also can cause mobilization (release) of phosphorus from sediments.

Dissolved oxygen is influenced by seasonal temperature changes that factor into lake stratification, the process whereby lake water is turned over (mixed) in the late fall and again following the winter ice melt and then begins to stratify through the spring, summer and early fall as water temperature increases at the surface and DO levels decrease with increasing depth.

As expected, the spring measurement of DO at increasing water depths in both Kahshe and Bass Lakes for 2023 revealed that with only one exception (Bass Lake >4m), DO was adequate for aquatic organism survival down to lake bottoms. However, by early August 2023, as in all previous decades, DO levels in Kahshe Lake fell below the aquatic health-based Provincial Water Quality Objective (PWQO) at around 4-5m depth and remain that way down to lake bottom (20m). In Bass Lake, by mid-August, the 2023 DO levels steeply declined beyond a depth of 2m and fell below the aquatic PWQO at depths greater than around 2.5m.

From a biological perspective, unlike Kahshe Lake, there appears to be a trend towards DO levels in Bass Lake falling below the PWQO at more shallow depths (just below 2m) than back in the 1980s and 1990s when DO crossed below the PWQO at depths almost at lake bottom (just below 3m).

Benthic Organism Health

The presence of benthic organisms indicates the health of both the riparian and littoral zones, as these areas can be impacted by snowmelt, runoff, sedimentation and other shoreline development activities. Collected benthos are grouped into seven different categories based on their typical response to environmental contamination and are then compared to the Muskoka average from locations known to be remote from any shoreline development sources.

The 2023 assessment at two sites on Kahshe Lake confirmed that the benthic community is comparable to the Muskoka average for most family groupings, with the exception of % Chironimids and % EOT, where lower and higher benthic counts, respectively, are desirable outcomes. And, based on the benthic monitoring over the period from 2006 through 2023, there appears to be no increasing or decreasing trend in the various families of benthic organisms in Kahshe Lake.

Although the KLRA has not provided volunteer benthic counting support to the DMM for Bass Lake, we have been provided with the analysis results for 2023 and they revealed that the average (all years) index values for two sites on Bass Lake for %Chironimids are slightly lower than the Muskoka Average, and this is a good sign, as the species in this grouping are pollution tolerant. In the case of %EOT, the lower values relative to the Muskoka Average are not a desirable outcome, as these benthos are sensitive to pollutants. However, it was noted that in the case of %EOT, the 2023 findings do indicate a healthier outcome for this grouping that was masked in the averaging approach using data from all

years. An evaluation of trends in benthic family groupings at both sites over time revealed no evidence of any trend in the health of these organisms over the period from 2016 to 2023.

Based on the 2023 water quality and benthic monitoring of Kahshe and Bass Lakes by the DMM and the MECP, no major water quality issues or trends were identified. However, given the documented occurrence of HABs in Kahshe Lake in both 2020 and 2021 as well as the late season population explosion of a zooplankton organism (*Holopedium*) known to be associated with decreasing levels of available calcium in Muskoka region lakes, it is clear that the tracking of water quality via the mid-lake, deep water sites of the DMM and MECP should not be completely relied upon as a fully representative assessment of water quality in the near-shore environment where algal blooms have been documented.

In the case of Bass Lake, the DMM identified it as a 'Vulnerable' lake and carried out a Causation Study in 2021-22. This study concluded that the elevated levels of total phosphorus in Bass Lake have resulted from natural causes. However, for the first time, Bass Lake had a documented HAB in 2023 and remains on alert status by the Simcoe-Muskoka Health Unit.

So, where do we go from here?

Kahshe Lake also has been identified by the DMM as a 'Vulnerable' lake and a DMM-funded Causation Study will be undertaken when funds are available. However, based on our concern following the development of late season HABs in 2021 and 2022, the KLRA funded a Near-Shore Water Sampling Project in 2021 to explore the chemistry of near-shore waters over the spring and summer season in an effort to better understand why Kahshe Lake has been impacted by HABs in spite of reasonably low and unchanged phosphorous levels reported by the DMM and MECP over the past 40 years.

The findings from this Near-Shore Water Sampling Project (NSWSP) have been published in a final report available on the KLRA Water Quality web portal. The NSWSP identified some very useful insights and linkages between our changing climate, its impact on water quality and the development of late season HABs in Kahshe Lake. Briefly, the NSWSP demonstrated that:

- Mid-lake, deep water sampling in the spring of the year is a reasonable way to track long-term, historical changes in water quality but is not providing a biologically relevant assessment of water quality in the near-shore environment where HABs have been documented.
- The mid-lake, deep water sampling also has failed to capture higher total phosphorus levels in the east end of the lake which is subject to inflow from Bass Lake, as there are no DMM sampling sites in that area.
- Levels of algal-friendly nutrients (phosphorus and nitrogen) in the near-shore areas tend to increase and fluctuate as the season progresses, further limiting the relevance of the spring sampling of mid-lake sites in terms of assessing the potential for HAB development.
- The near-shore water chemistry findings for some algal-friendly nutrients appear to be associated with human & animal waste sources which are known to be linked with algal growth and HABs.
- Although more study is warranted, the near-shore findings point to accelerated leaching and/or runoff of soil-borne nutrients due to a changing climate which is resulting in more intense rainfall events.

Although we have virtually no control over the change that is affecting our climate, there are actions we can and must take to minimize the accelerated leaching of algal friendly nutrients to our shoreline water

and thereby reduce the potential for future algal blooms. These actions have been thoroughly explored by the Conservation Committee and are summarized below:

- 1. Divert roof drainage and runoff from paths and other hard surfaces away from your septic system and the shoreline. If necessary, direct rain water into rock-filled drainage pits.**
- 2. Keep most of your shoreline as natural as possible with a zone of trees, shrubs or tall grass between the shore and any lawn area to discourage grazing by Canada geese and to reduce soil & goose poop runoff into the lake.**
- 3. Have a licensed professional pump out and inspect your septic system for failures and deficiencies every 3-5 years and more often for aging systems installed pre-2000. The Town will be inspecting in 2023, but we don't need to wait until then and be subject to system shutdown until failing systems are repaired.**
- 4. Don't use phosphorus or nitrogen fertilizers or cleaning agents anywhere near the shore.**

Well, that's it for me. It has been a pleasure to serve as your Lake Steward since 2011 and I now hand it over to Sara Varty who has accepted the role going forward. All the best Sara!



Ron Pearson, M.Sc.

Kahshe and Bass Lake Steward - Conservation Committee