Current Algal Bloom Status - Kahshe and Bass Lakes

February 2022

Background:

Algae are simple, typically small aquatic organisms and range in structure from unicellular (a microscopic single cell) to multicellular and as they produce and grow, form colonies that appear on the surface or attached to various substrates. Algae are always present in lakes and rivers and are at the base (primary) of most lake food webs, and as such, are critical components of a healthy aquatic environment. Without algae, zooplankton (small animals that feed on algae) would not survive, and this would impact the survival of fish and other animals further up the food chain.

As identified in a Muskoka Watershed Guide document (MWC, 2017), there are three main types of algae that may potentially bloom in the Muskoka area:

- **Filamentous Green Algae**
  - These are unicellular or multicellular and may form filaments that range from several millimetres to a metre in length. They can be found free-floating in shallow water on the bottom near shore or attached to submerged objects like rocks. They are typically green in colour, but can vary in shade depending on age and nutrient content. Some species form colonies that appear as cottony clumps, while others form thready, silky, slippery masses that are slimy to the touch. Blooms usually occur in the spring after heavy runoff or in the summer following hot spells and may appear as clumps or dense mats that float on or just beneath the surface of the water. Blooms can be a nuisance as they may produce a grassy or unpleasant odour. Bloom-forming filamentous green algae commonly found in Muskoka include: *Spyrogyra, Zygnema, Mougeotia, Cladophora*
- **Chrysophytes**
  - Most are unicellular with a few species forming colonies. They are generally found in low-nutrient lakes and some can move vertically though the water column. Blooms usually occur in spring or early summer. Colonial species may form a bloom below the thermocline in stratified lakes and the water may appear cloudy or coloured. Other species may form a yellowish-green bloom in the upper layers of the lake that is highly visible. Blooms may produce taste-and-odour compounds often described as fishy, musty, or earthy. Bloom-forming chrysophytes commonly found in Muskoka include: *Uroglena, Synura*
- **Cyanobacteria (Blue-Green Algae)**
  - These are actually bacteria, but have features in common with algae. Most are unicellular and often blue-green in colour. Cyanobacteria generally fall into two types. First, those that reside and grow in sediments, obtaining their phosphorus from the sediment and manufacturing their own nitrogen through a fixation process. Because these organisms can thrive in low nutrient waters like those of Kahshe Lake, management through shoreline source reduction may have limited effects. The other type is referred to as planktonic, and these species reside in the water column. They are unique in that they can control their buoyancy to move vertically through the water column and position themselves for optimal light, nutrients and temperature. These types of cyanobacteria are more responsive to nutrients (primarily phosphorus) in the water and as such, source reductions, particularly of phosphorus, have a greater chance of reducing the potential for blooms to develop. Some

species of both types have the ability to produce toxins, making humans and animals sick if exposed to high concentrations. Blooms most commonly occur in late summer and early fall in areas where the water is shallow, slow moving and warm; however they may also be present in deeper, cooler water. Blooms typically look like pea soup or spilt paint with a bluish or greenish colour. Fresh blooms often smell like freshly mowed grass, while older blooms may smell like rotting garbage. Bloom-forming cyanobacteria commonly found in Muskoka include: *Anabaena, Dolichospermum, Aphanizomenon, Gloeotrichia*

For anyone wishing to identify algal materials based on visual appearance, an excellent field guide has been published by Huynh and Serediak (2006).

Conditions that Promote Algal Blooms

When conditions are favourable, both benthic and planktonic cyanobacteria as well as other types of algae can increase to levels that result in poor water quality and an algal bloom or scum may form. Conditions that promote bloom development include:

- sufficiently high levels of nutrients in either sediments or water (primarily phosphorus and to a lesser extent nitrogen), as some species can manufacture their own nitrogen from the atmosphere);
- calm weather conditions and shallow water with low water flow;
- strong sunlight; and,
- high air and surface water temperatures

Nutrient enrichment and phosphorus in particular has been associated with increases in algal biomass in freshwater systems worldwide, and recent studies indicate that climate change is a potent catalyst for the further expansion of algal blooms because of the warming of surface waters, longer periods of open water (fewer ice covered days) and more intense rainfall which flushes soil-borne nutrients into near-shore waters. Rising air and water temperatures favour most bloom-forming planktonic blue-green cyanobacteria because they have higher temperature requirements and because they are able to regulate their buoyancy under conditions of reduced vertical water column mixing (lake turnover) which occurs under rising surface water temperatures as the season progresses.

Although algal blooms are the primary focus of concern, the sediment dwelling algae and those that grow on rocks along the shoreline are also of concern. They are aesthetically unpleasant and also make shoreline navigation difficult, due to their slimy and slippery nature. As the season progresses, and they complete their life cycle, they can be dislodged from bottom and shore growing locations and can drift into slow moving water of bays along the shore where they start to decompose. Many on Kahshe Lake have noticed the unpleasant odours that begin to arise in the late summer and fall as this process takes place. These floating mats also can be mistaken for late-season blooms, as they are dislodged and float into shoreline locations. However, on closer examination, they typically appear less vibrant than the colours of algae in an active bloom.

Algal Bloom Development in Ontario and Muskoka

In a 2011 publication (Winter et al., 2011), the Environment Ministry's investigations of algal blooms in Ontario were summarized and their findings confirmed the following trends:

- The total number of algal blooms reported in Ontario increased significantly from 1994 to 2009, and there also were significant increases in the number of blooms dominated by cyanobacteria and chlorophytes.
- Most lakes (50) had a single bloom report, 11 lakes had blooms reported in two years, four lakes had reports in three years, and one lake had reports in eight of the years between 1994 and 2009.
- In 2009, 16 of the 24 blooms reported tested positive for the presence of microcystin, one of several toxic substances which can be released by blue-green algal blooms.
- A significant increase in day of year the last bloom was reported in a given year was observed, indicating that blooms are being detected and reported later in the year compared to 15 years ago. In contrast, no change was seen in day of year the first bloom was reported.

While this Environment Ministry report only covered algal bloom development through 2009, the detection of increasing numbers of harmful blue-green algal blooms has continued to increase, as confirmed by the Simcoe- Muskoka Health Unit in the table below.

Blue-Green Algae Impacted Lakes in the Muskoka Area- 2018 through 2020

Year	Blue-Green Algal Bloom Impacted Lakes	Number of Bloom Alerts
2018	Three Mile, St. John, Leonard, Rosseau, Lamont Creek	6
2019	Three Mile, Brandy, Bass (not ours), Echo, St. John, St. George, MacLean	8
2020	Three Mile, Brandy, St. John, Black, Leonard, Simcoe, Bruce, Muskoka, Silver, Stewart, Little, Ten Mile, Otter and **Kahshe Lakes**	18
2021	Georgian Bay, Three Mile, Little, Stewart, **Kahshe**, Mary, Menaminee, Fawn, Paint, St. John, Leonard, Bass Lakes	13

Unfortunately, as noted above, harmful blue-green algal blooms have now been confirmed in Kahshe Lake in both 2020 and 2021. In 2020, the bloom was located along the northern shoreline in the Oak Road vicinity and was investigated by staff from the Ontario Ministry of Environment, Conservation and Parks (MECP). In 2021, the first report of a bloom was in the east end of the lake (actually in the Kahshe River), but this was followed by reports of similar blooms in several areas of the lake, and as such, the alert was issued to cover the entire lake. Further details on these specific blooms and any others going forward have been tabulated at the end of this document and this information will be updated should any further bloom take place in 2022 or beyond.

Why are Algal Blooms of Concern?

Blooms of cyanobacteria are of particular concern in freshwater systems because of the potential of many species to produce toxins (Winter et al., 2011). Those produced by cyanobacteria impact human and animal health and can affect freshwater ecosystem processes. They are generally classified into two groups:

- neurotoxins and hepatotoxins, which can cause acute lethal poisoning; and
- cytotoxins, which are not highly lethal to animals but show selective bioactivity.

Several species of cyanobacteria and chrysophytes also release noxious taste and/or odour-causing compounds that can have negative impacts on the public and the drinking water industry. For example, in the early 2000s, taste and odour events in Lake Ontario had major impacts on the drinking water

provided to a large consumer population drawing from these sources and caused widespread public reaction.

The severity of symptoms and the level of risk to health depend on how you are exposed to blue-green algal toxins. Human health effects from contact with these toxins may include:

- itchy, irritated eyes and skin from direct contact through activities such as swimming and water skiing, and
- flu-like symptoms, such as headache, fever, diarrhea, abdominal pain, nausea and vomiting if large amounts of impacted water are ingested.

To give a better idea of the potential impact of a blue-green algal bloom, here's a listing of the Health Unit's advisory to property owners.

- As a precautionary measure, the health unit urges residents and businesses not to drink water from this lake where blue-green algae is visible and to take the following precautions:
- do not use the lake water for the preparation of infant formula
- do not allow pets or livestock to drink or swim in the water where an algae bloom is visible
- be cautious about eating fish caught in water where blue-green algae blooms occur
- do not use herbicides, copper sulphate or other algaecides that may break open algae cells and release toxins into the water
- avoid water sport activities where an algae bloom is visible

Some additional facts regarding the health advisory have been confirmed via personal contact with the Muskoka-Simcoe Health Unit:

- once a bloom is confirmed, the MECP will continue to monitor the bloom area and collect samples for microcystin analysis;
- the health advisory will remain in effect until the sampling and analysis confirms that: 1) the bloom is no longer visible and 2) the concentrations of microcystin LR have met the Drinking Water standard of 1.5 µg/L.

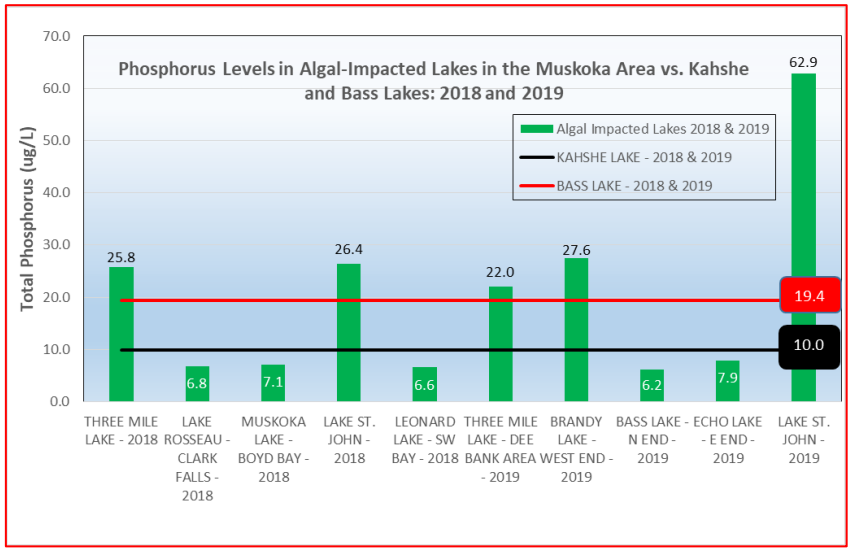
A few additional health-related facts that are generally associated with exposure to toxic algal blooms are listed below:

- boiling the water is not recommended, as it could break open the algal cells and release more toxins
- the same applies to the use of disinfectants including chlorine, as they too can damage cell membrane integrity, releasing internal toxins
- there is no convincing evidence that the occurrence of a blue-green algal bloom in one year will result in blooms the following year, but this is difficult to verify, as blue-green algae are naturally present in all lake waters and sediments; the more important factors are the conditions that favour the formation of a bloom, and these include air and water temperature, nutrient status and in some cases, precipitation events that factor into the accelerated growth of these organisms.

How Susceptible Are Kahshe and Bass Lakes to Algal Blooms?

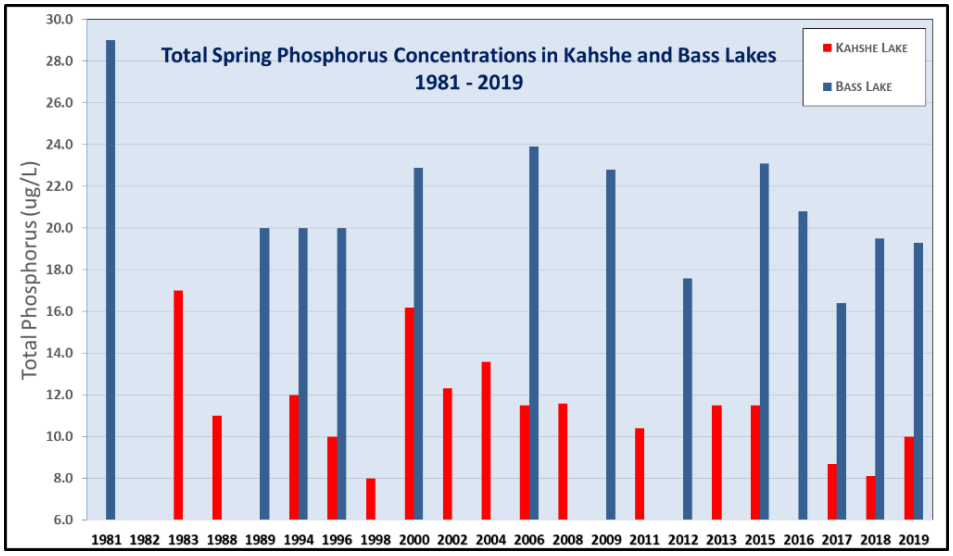
The evaluation of algal bloom development by the Ontario Environment Ministry (Winter et al., 2011) included the following observations and conclusions regarding the susceptibility of Ontario lakes to algal bloom development:

- Global increases in algal blooms have primarily been attributed to nutrient enrichment exacerbated by climate change.
- General increases in human activity including cottage and residential development on and around the lakes in which blooms have been reported may have contributed to increases in nutrient inputs, promoting the growth of filamentous green algae and cyanobacteria.
- The lakes from which blooms of cyanobacteria were reported were characterized by higher total phosphorus concentrations (15 µg/L) compared to a dataset from 1,074 Ontario lakes (9 µg/L).
- However, the lakes in which the blooms were reported varied in total phosphorus concentrations, and 26% of the lakes were classified as oligotrophic, with less than 10 µg/L.
- The development of cyanobacterial blooms in low nutrient lakes indicate that an array of other factors likely contributed to bloom occurrence. These included the type of cyanobacteria involved (benthic vs planktonic) availability of iron which is involved in the release of phosphorus from sediments under low oxygen conditions, as well as environmental stressors including acidification and associated base-cation declines, the presence of invasive species, and climate change.



Climate change, specifically rising air temperatures, promotes conditions that favour cyanobacteria and the formation of blooms, including increased water temperatures, more intense precipitation events which can leach nutrients from the shoreline soils, lengthening of the ice-free season, and reduced water column mixing (stratification) as the season progresses.

Although it no longer can be discussed in terms of a 'likelihood', it is still important to understand how the total phosphorus levels in Kahshe and Bass Lakes compare with levels in lakes where blue-green algal blooms have been documented. A chart of these findings has been inserted aside and confirms that harmful blue-green algal blooms have developed in several of the impacted lakes that had total phosphorus levels well below those in Kahshe and especially Bass Lakes. Based on these findings, the presence of blue-green algal blooms in November 2020 and October 2021 should not come as a surprise and this development underscores the importance of renewed efforts to drive our nutrient levels even lower than they currently are, as our climate is changing, and creating conditions that favour algal growth and bloom development.



A chart of total phosphorus levels in Kahshe and Bass Lakes over the past four decades underscores the fact that in both lakes, levels have remained very steady with no evidence of an increasing or decreasing trend. What this comparison doesn't tell is how reliable the results from mid-lake, deep water locations like these are at predicting the concentration of nutrients close to shore. A Near-Shore Water Sampling Project to explore the relationship between mid-lake and near-shore levels of algal friendly nutrients was developed and undertaken in 2021. The findings from that project have been posted under the Water Quality tab and confirmed that near-shore levels of algal-friendly nutrients are not adequately represented by mid-lake levels from spring sampling. This was particularly evident as the season progressed, as levels of some forms of nitrogen and to a lesser extent, total phosphorus were found in near-shore waters in late September at levels well above those from mid-lake samples following spring sampling.

So what can we do to minimize the potential for increasing algal growth going forward? While we can't do much on a local level to alter the warming effects of climate change there are actions that will reduce the impacts of more intense rainfall events that appear to be flushing soil-borne nutrients from septic systems and from lawns that are grazed by Canada geese. These are summarized below:

- **Pumping out and having our septic systems (tanks/leaching beds) inspected on a regular basis;**
- **Managing our properties to increase vegetative cover, minimize impervious surfaces and divert roof drainage away from septic system leaching areas**
- **Managing our shorelines to keep them as natural and as vegetated as possible to make them less attractive to grazing by Canada geese and less likely to result in soil erosion directly into the lake, and;**
- **Completely avoiding the use of phosphorus or nitrogen fertilizers on any existing lawns, gardens or flower beds in the vicinity of the shoreline.**

In the event of an algal bloom, it needs to be reported to the Spills Action Centre of the MECP. The phone number is: **1-800-268-6060**. If the Ministry does identify it as a toxic blue-green or other type of toxic algae, the Simcoe-Muskoka Health Unit will keep residents informed via health advisories regarding and restricted conditions for use of the water for consumption and recreational purposes.

Algal Alert Status – Kahshe Lake

The table below summarizes the investigative and reporting status of all algal blooms on Kahshe Lake. This table will be updated as any new confirmed HABs are documented and reported.

Date	Date Water Sampled by MECP	Algal Species Identified in Bloom	Toxin Analysis Findings	Date Alert Issued by SMHU	Date Alert Lifted/Resolved by SMHU
2020 – Oak Road Area					
Nov 7-8, 2020: Bloom noticed & reported	Nov 9, 2020	*Anabaena* *Dolichospermum* *Woronichinia* Diatoms e.g. *Tabellaria*	Microcystin <RDL of 0.1 µg/L Anatoxin-A <RDL of 0.2 µg/L	Nov 11, 2020	-
Nov 24, 2020: Bloom no longer present	Nov 24, 2020	None present.	Microcystin <RDL of 0.1 µg/L Anatoxin-A <RDL of 0.2 µg/L	As above	Dec 4, 2020
2021 – First report in East end then mid-lake and Oak Road area					
Oct 2, 2021	Oct 4, 2021 (sample taken on Oct 2 by owner)	*Anabaena* *Dolichospermum* *Woronichinia,* *Microcystis,*	Total Microcystins 3.78 µg/L Anatoxin-A <RDL of 0.2 µg/L	Oct 8, 2021	-
Nov 2, 2021 Bloom not observed	Nov 2, 2021	None present.	Total Microcystins <RDL of 0.1 µg/L Anatoxin-A <RDL of 0.2 µg/L	As above	Nov 10, 2021

Literature Cited

Huynh, M. and Serediak, N. 2006. *Algae Identification Field Guide*. Agriculture and Agri-Food Canada. 40 pages.

Muskoka Watershed Council (MWC). 2017. *Algae – Quick Guide*. 1 page.

Winter, J.G., DeSellas, A.M., Fletcher, Heintsch, L., Morley, A., Nakamoto, L. and Utsumi, K. 2011. *Algal blooms in Ontario, Canada: Increases in reports since 1994.* Lake and Reservoir Management, 27:2, 107-114.

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