WHITE LAKE PROPERTY OWNERS ASSOCIATION ENVIRONMENT VOLUNTEERS

White Lake Algal Blooms
1860 to 2025

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1. Introduction: Algal Bloom Trends in Ontario

Climate change and other stressors have resulted in algal blooms becoming more frequent, occurring earlier in the year and persisting for longer periods of time. This is a trend reported in the literature and on government websites.

White Lake is now at capacity which means that any additional input of nutrients makes it more likely that algal blooms will occur. White Lake is a shallow warm water lake and thus is more vulnerable than most lakes in Ontario to both natural and man-made pressures. **We need to do our part in controlling and reducing our impact on White Lake**, especially when other stressors not under our control are intensifying.

This means maintaining a healthy shoreline, respecting setbacks for building projects, maintaining septic systems and reducing boat wakes and other disturbances to the shoreline and near-shoreline sediments. All of these actions will reduce the amount of nutrients entering the lake at the very locations where zebra mussels are active.

What Controls Algal Blooms?

Algae bloom when conditions are right for its rapid and uncontrolled growth. These conditions include the presence of excess nutrients (phosphorus) and other chemical species, favourable water temperature and clarity, sunlight, and the action of wind and waves. For White Lake, the presence of zebra mussels is an additional factor promoting the growth of filamentous green algae. These mussels tend to concentrate nutrients from open waters to the shoreline area where filamentous algal blooms occur. Zebra mussels also selectively filter out and consume green algae while at the same time rejecting blue-green algae. This promotes the growth of blue-green algae over green algae.

The severity of the algal bloom resulting from the sum of the above factors can be intensified by the runoff of nutrients from areas of shoreline which have been de-treed or altered in such a way that nutrients can enter the lake unmoderated by the presence of trees and other natural shoreline vegetation which prevents or slows entry nutrients into the lake. Algal blooms are notoriously hard to predict because they result from the interactions of a number of physical and chemical parameters, some of which are very difficult to measure.

As mentioned above, algal blooms can be significantly influenced by the presence of zebra mussels (Dreissena polymorpha), an invasive species that has transformed many freshwater ecosystems across North America and Europe. These mollusks, originally from the Caspian and Black Sea regions, were introduced to the Great Lakes in the 1980s and have since spread to numerous inland lakes. Their impact on algal blooms is multifaceted, involving nutrient cycling, water clarity, and ecological interactions.

Nutrient Dynamics

One of the primary factors influencing algal blooms is nutrient availability, particularly phosphorus and nitrogen. Zebra mussels are filter feeders that consume plankton, including phytoplankton (the microscopic algae responsible for blooms). By filtering out these algae, zebra mussels can initially reduce algal populations, leading to clearer water. However, their feeding habits also contribute to a shift in nutrient dynamics.

When zebra mussels filter water, they selectively remove smaller phytoplankton while allowing larger particles, including detritus and dissolved nutrients, to accumulate in the water column. This process can lead to a paradoxical situation where, despite the initial reduction in algal biomass, nutrient concentrations increase, particularly phosphorus. The accumulation of nutrients can promote conditions favorable for certain algal species, particularly cyanobacteria (blue-green algae) to thrive.

Changes in Water Clarity

The filtering action of zebra mussels increases water clarity by reducing the concentration of suspended particles. While clearer water might seem beneficial, it can alter the ecosystem in ways that promote algal blooms. Increased light penetration can enhance the growth of submerged aquatic plants, which can subsequently die back and decompose, releasing additional nutrients into the water. These nutrients, combined with the right environmental conditions, can trigger harmful algal blooms.

Moreover, clearer water can change the competitive dynamics among phytoplankton species. Some algal species, particularly those that are adapted to high light conditions or those that can rapidly take advantage of nutrient spikes, may dominate the community, leading to blooms that can produce toxins harmful to aquatic life and humans.

Ecological Interactions

The presence of zebra mussels can also disrupt established food webs. By significantly reducing the abundance of certain zooplankton species that graze on phytoplankton, zebra mussels can indirectly facilitate algal blooms. With fewer grazers in the ecosystem, phytoplankton populations can grow unchecked, leading to increased frequency and severity of blooms such as we have experienced on White Lake..

Additionally, the overall biodiversity of the ecosystem may decline as zebra mussels outcompete native species for food and habitat. This loss of biodiversity can destabilize the ecosystem, making it more susceptible to algal blooms. A less diverse community may be less resilient to environmental changes, further increasing the likelihood of bloom events.

Conclusion

Inland lakes with zebra mussels are subject to complex interactions that can influence algal blooms. While zebra mussels initially reduce algal populations through their filter-

feeding behavior, they also alter nutrient dynamics, enhance light penetration, and disrupt food webs in ways that can lead to increased algal blooms. Understanding these interactions is crucial for managing and mitigating the impacts of algal blooms in affected ecosystems. Effective management strategies must consider the role of zebra mussels and other invasive species to promote healthier aquatic environments and protect local biodiversity.

2. White Lake Algal Blooms: 1860 to 1976

It has been mentioned on several occasions at public forums that in the past there were regular lake-wide algal blooms. These comments may be valid, but they do not imply that algal blooms in White Lake define its natural state, and that more recent blooms are nothing to be concerned about.

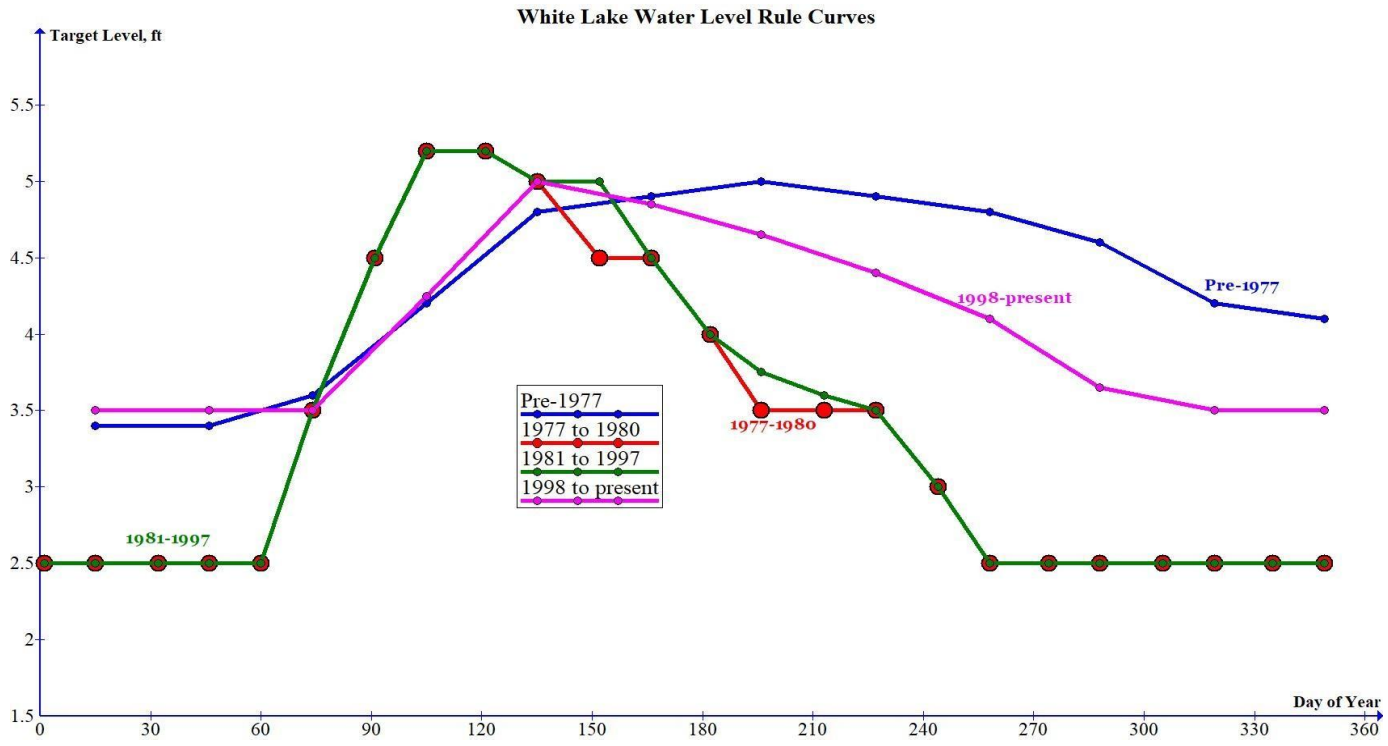
These comments stem from anecdotal reports before and during the 1970s of regular algal blooms on White Lake. These blooms are reported in the literature and require a more rigorous analysis of facts when comparing them to more recent algal blooms.

There are several factors which at that time resulted in algal blooms. These include:

1. Water Regime – water levels over the summer months.
2. General use of phosphate detergents and related products.
3. Poor performance of existing septic or other waste disposal systems.
4. Commercial logging in earlier decades contributed to the nutrient load in lake water and lake sediments. This input stimulated large algal blooms, which are

recorded in the sediments and revealed by paleolimnological studies of White Lake.

Below is a graph showing the varying water level regimes that MNRF[1] has applied to White Lake:



The data used for the above graphs was taken from a 1989 paper written by H. von Rosen[2], Fisheries Management Officer, Carleton Place District.

The graph shows that up to 1977, water levels in White Lake were kept high to *"satisfy the desire of the local population for boating purposes"*. In that report, von Rosen states that within two years of the initiation of this regime *"midsummer algal blooms appeared, leaving green slime on the shores; rock rubble was covered with calcareous algae"*. Water levels in the lake impeded the turnover of waters in the lake resulting in these algal blooms. Fish populations also suffered. He also states in his paper, that once a change in water regime was made, it took up to five years to fully take effect. The current water level regime used is intermediate between very high and very low water levels resulting in the most satisfactory results possible.

[1] Ontario Ministry of Natural Resources, Forestry

[2] H. von Rosen; White Lake Fisheries Assessment; Ministry of Natural Resources, Carleton Place District, 1989.

In another government publication, Anthers and Kerr[3] state that*: "White Lake is a partially artificial lake that has always been subject to annual and seasonal draw-downs. Five different water level management regimes have been utilized over the past fifty years. From 1860 to 1960 the dam at Waba Creek was operated by Stewart's sawmill with the floodgates opened regularly to allow for the floating of timber downstream. The frequent water fluctuations (up to 1.5 m) maintained a good flushing rate and kept the water clear, rocky shoals clean, and maintained a good walleye fishery. In 1968, a new concrete dam was constructed and water levels were kept high followed by a winter draw-down during the period from 1968 to 1976. Summer water levels were stabilized for the benefit of boaters and shoreline property owners. This stable water level regime resulted in accelerated eutrophication with rapid growth of aquatic plants, reduced water clarity and subsequent failure of the walleye fishery. By 1972, anglers reported that spawning beds had silted over, an absence of small fishes, and by 1976/1977, walleye had all but disappeared from the lake".*

In 1977, the water level management regime was altered to allow gradual summer draw-downs (0.76 m/yr.) to clean spawning shoals and reduce midsummer algal blooms. Fall and winter water levels were stabilized by mid-late September each year. This resulted in increased walleye spawning activity on traditional spawning sites.

During the 1970s, Canada banned or reduced phosphates in detergents and other products. It is likely that the high-water level regime in place during the time when phosphates were permitted and used widely, contributed to the production of algal blooms in White Lake. This source of phosphate is much reduced, although still present today.

In 1973, the White Lake Water Quality Committee conducted a massive sampling of White Lake waters for coliform bacteria. They collected and had analyzed 375 samples on three different occasions. Results of their study were released the same year.

When compared to coliform counts recorded in more recent times from WLPOA[4] samples, the counts were significantly higher in the mid-1970s. This was likely due to the large number of septic or waste disposal systems which were underperforming relative to today's standards. This source of phosphorus would also have been a significant contributor to the algal blooms reported during this time period.

Today the nature and cause of algal blooms in White Lake are quite different as is discussed below. We will not elaborate on this further other than to say that outflow from septic systems, the change in phosphorus cycling by zebra mussels, climate change, year-round use of cottages as residences, increased boating effects, shoreline degradation, invasive species, and exposed surface runoff should now be the subject of our attention.

[3] A. Anthers and S.J. Kerr; The Fishery of White Lake, Technical Report TR-107, Southcentral Sciences Section, Ontario Ministry of Natural Resources, Kemptville, ON 31p. 1998

[4] White Lake Property Owners Association.

3. White Lake Algal Blooms: 1977 to 2021

The data contained in the table below tell the story of more recent algal blooms in White Lake. Prior to 2013 and for a period of at least 25 years, there were no reported algal blooms on White Lake. During that time, however, the number of cottages, trailers and commercial tourist units have increased from 475[5] to 1538 (2018), an increase of 324%. Available numbers also show that from 1985 to 2018, permanent homes on White Lake increased by 354% to 209. These trends are continuing today.

The table below indicates that White Lake is no longer capable of absorbing and processing additional nutrients coming from any source. The lake is now experiencing multiple algal blooms every year with a record five blooms in 2021.

In addition to local sources of nutrients, for every square kilometre of lake surface, there are 9.3 square kilometres of watershed also contributing to nutrient loading. The effects of this input are amplified by climate change (warmer temperatures, longer ice-free seasons) and the presence of zebra mussels concentrating nutrients in the nearshore.

The table also shows that the arrival of zebra mussels in White Lake resulted in a change in algal bloom patterns. Prior to their arrival, there were no significant filamentous green algal blooms. However, blue-green algal blooms occurred each year from 2013-2015. All of these blooms were *Anabaena* blue-green algae.

Following the arrival of zebra mussels, phosphorus cycling in the lake changed. As a result, White Lake now experienced annual filamentous green algal blooms as well as blue-green algal blooms. However, the blue green algal blooms were now *Microcystis*. In 2021, White Lake experienced blue-green algal blooms from both *Anabaena* and *Microcystis*.

White Lake is a very shallow (average depth of 3.1 m), productive, warm-water lake, and as such is very susceptible to changes in water quality resulting from human activities. When a lake like White Lake is overused, then the rate at which the lake is nutrient enriched (eutrophication) is accelerated.

[5] J.P. Ferris, White Lake Integrated Resources Management Plan, Part I, *Ministry of Natural Resources, Lanark and Renfrew Counties, December, 1985.*

White Lake Algal Blooms by Year: 1977 to 2025				
Year	**Green Algae**		**Blue-Green Algae**	
	Summer	***Fall***	***Summer***	***Fall***
1977 to 2012 (25 years)	-	-	-	-
2013	-	-	-	1
2014	-	-	-	1
2015	-	-	-	1
 **Zebra Mussel Infestation**				
2016	-	-	1	-
2017	1	-	-	-
2018	2	-	-	2
2019	1	-	-	1
2020	1	-	-	1
2021	1	-	-	4
2022	1	-	-	2
2023	1	-	-	3
2024	1	-	-	-
2025	1	-	-	1

4. Annual Compilation of White Lake Algal Blooms

In the pages that follow, algal blooms for each year starting in 2013 are described. Provided is information of the type of bloom occurring, its start and end date, the extent of the bloom and whether or not these blooms were found to contain microcystin toxins.

Each annual report was abstracted from the full White Lake Water Quality Monitoring Program reports published each year by the Environment Volunteers of the White Lake Property Owners Association.

Any background information, such as weather conditions and level of total phosphorus measured, is provided in detail in our annual Water Quality Monitoring Program reports, which can be found on the White Lake Science and Information Website.

The authors emphasize that the algal blooms observed by our team are the minimum number for White Lake, and there may very well have been others on the lake which went undetected or unreported. No Provincial or local authority monitors water bodies for algal blooms. The Ministry of the Environment and local health units respond only to reports from the public at large. Currently only two volunteers are monitoring the 22 Km^2 of White Lake, which has a shoreline stretching nearly 100 km!

Algal Blooms – 2025

Green Algal Blooms

During 2025 at least two algal blooms were observed. One algal bloom was a filamentous green alga which has been occurring in the spring of every year since zebra mussels infested White Lake. This bloom occurred starting in early June (14th) and lasted for several months. The bloom occurred throughout White Lake, especially in areas where zebra mussels thrive and/or cottage lots have been cleared of trees or other vegetation. Green algal blooms are unsightly, but do not produce any dangerous toxins.

Green Algae Western Shore: June 14, 2025

Green Algae Western Shore: June 21, 2025

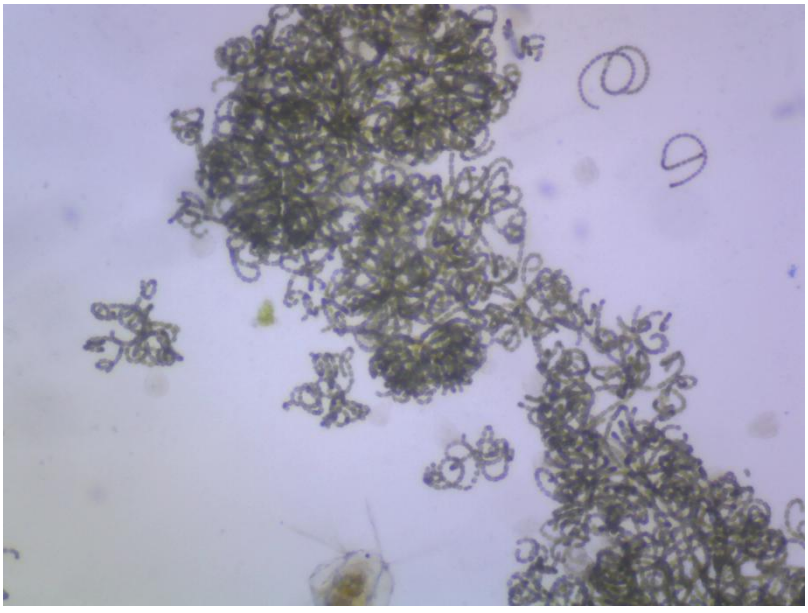
Blue-Green Algal Blooms

Since 2013, blue-green algal blooms have been occurring in White Lake every year save one. Before zebra mussels arrived in White Lake, blue-green algal blooms were occurring mainly during the summer months. Once established, zebra mussels effectively altered the cycling of phosphorous. Before zebra mussels infested the lake, blue-green algal blooms were more common when total phosphorus concentrations exceeded about 20 parts per billion during mid-July to mid-August. Once established, zebra mussels acted to change the conditions under which blooms would occur. Now, blue-green algal blooms occur at total phosphorus concentrations of 10 parts per billion or less and tend to occur later in the year during September into mid-October.

This year was no exception. A trusted observer reported to us that on October 5th, most of Pickerel Bay was covered with a layer of algae. We had visited the same site on September 28th during our regular lake sampling program and at that time, Pickerel Bay was clear of algal blooms. We did not return there until October 14th, at which time the bay was again clear of algal blooms.

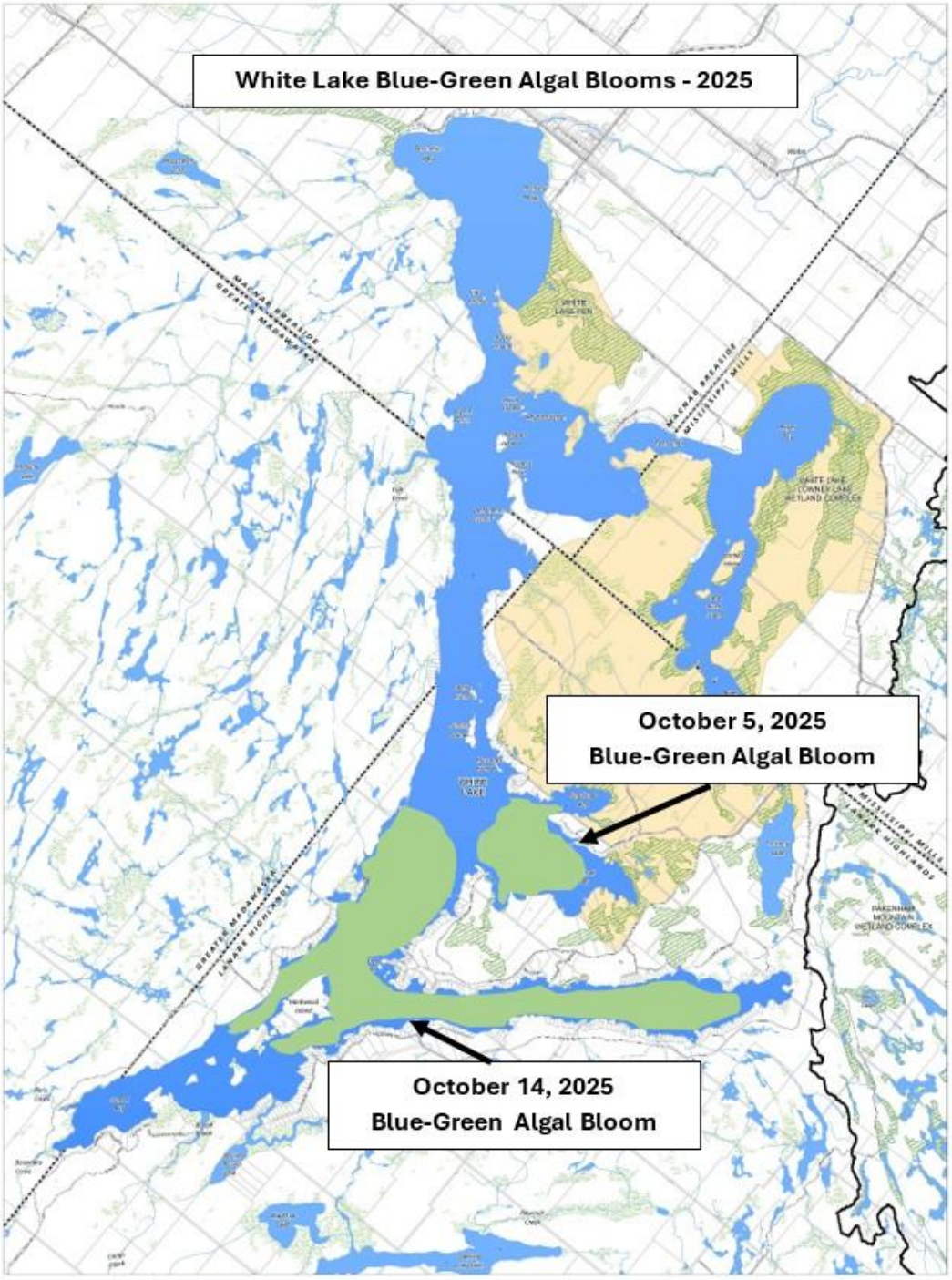
However, on October 14th, we did record a major blue-green algal bloom covering all of Three Mile Bay and parts of the lake north to the entrance of Pickerel Bay. The algal bloom lasted about 5 days before weather conditions changed and dissipated the bloom.

Microscopic examination of the bloom (see photomicrograph below) showed that the bloom was Anabaena blue-green algae. Because the bloom was not long lasting we did not report the bloom to the Ministry of the Environment.



The map below shows the extent of the algal blooms. Note that because no photos or samples were taken from the October 5th bloom on Pickerel Bay, we are not adding this

bloom to our statistics as a separate bloom, but rather consider it part of the more extensive October 14th algal bloom.



The photos below show the blue-green algae accumulating along the shoreline of White Lake.

The authors emphasize that the algal blooms observed by our team are the minimum number for White Lake, and there may very well have been others on the lake which went undetected or unreported. No Provincial or local authority monitors water bodies for algal blooms. The Ministry of the Environment and local health units respond only to reports from the public at large. Currently only two volunteers are monitoring the 22 Km^2 of White Lake, which has a shoreline stretching nearly 100 km!

Algal Blooms 2024

During 2024 one algal bloom was observed. This algal bloom was a filamentous green alga. This bloom occurred in early June and lasted for about a month. Green algal blooms are unsightly, but do not produce any dangerous toxins.

Although high concentrations of blue-green algae were observed in late September and in October, we determined that these did not constitute a bloom and therefore did not pose a threat to the general population.

2014 was only the second year in eleven years of monitoring during which the were no blue-green algal blooms. During those 11 years, White Lake experienced 16 blue-green algal blooms.

Algal Blooms 2023

During 2023 four algal blooms were recorded. The first type of algal bloom which occurred was from filamentous green algae. This bloom lasted, as in previous years, from mid-June until mid-September.

The second type of bloom was from blue-green algae which this year covered the deeper parts of the lake including Three Mile and Pickerel Bays and extending into the main water body (See Appendix 1). *Note that the Ministry of the Environment policy towards blue-green algal blooms is: "MOE regards any cyanobacterial (blue-green algae) bloom as potentially toxic, whether or not toxins are detected in the water upon testing"*[6],[7]

Green Algal Blooms

[6] Algal Blooms in Ontario, Canada: Increase in reports since 1994; J.G. Winter, A.M. DeSellas, R. Fletcher, L. Heintsch, A. Morley, L. Nakamoto, and K. Utsumi (all Ontario Ministry of the Environment scientists); *Lake and Reservoir Management*, 27:107-114, 2011.

[7] Cyanobacterial blooms in Ontario, Canada: continued increase in reports through the 21st century; Elizabeth J. Favot, Claire Holeton, Anna M., DeSellas & Andrew M. Paterson; Lake and Reservoir Management, 39:1, 1-20, DOL: 10.1080/10402381.2022.2157781.

The first algal bloom of the year started in mid-June and continued until the end of summer. This bloom was of a filamentous green alga, which grew in patches along the shoreline, especially were zebra mussels reside.

In 2023, the filamentous green algal bloom was less extensive than in previous years with fewer occurrences. However, there was an increase in this alga which accompanied one of the Blue-Green algal blooms (September 5 to 10, 2023).

Algae bloom when conditions are right for its rapid and uncontrolled growth. These conditions include the presence of excess nutrients (phosphorus), favourable water temperature and clarity, sunlight, and the action of wind and waves. For White Lake, the presence of zebra mussels is an additional factor promoting the growth of filamentous green algae. These mussels tend to concentrate nutrients from open waters to the shoreline area where filamentous algal blooms occur. The severity of the algal bloom resulting from the sum of the above factors can be intensified by the runoff of nutrients from areas of shoreline which have been de-treed or altered in such a way that nutrients can enter the lake unmoderated by the presence of trees and other natural shoreline vegetation which prevents or slows entry nutrients into the lake.

Viewed from underwater, the algae mass forms very large volumes extending from just below the surface of the lake all the way down to the lake floor. Other aquatic plants become enveloped within the growing mass. Over time, the algae die, collapses into itself and sinks to the bottom of the lake.

General Appearance of Filamentous Green Algal Bloom

This alga does not produce toxins in the water and so the bloom is considered a nuisance bloom. However, when large mats of algae die and decompose, the water column can become anoxic (no oxygen) causing the release of phosphorus trapped in sediments. Sediments contain about 200,000 times the concentration of phosphorus found in lake water. The released phosphorus can trigger a secondary bloom which could be larger and last longer than the original event.

Blue-Green Algal Blooms

Blue-green algal blooms are not benign and so warrant special attention. When these blooms occur, they can create a public health hazard and anyone using the lake should be apprised of the seriousness of this issue. Three such algal blooms were recorded in 2023 starting on September 5.

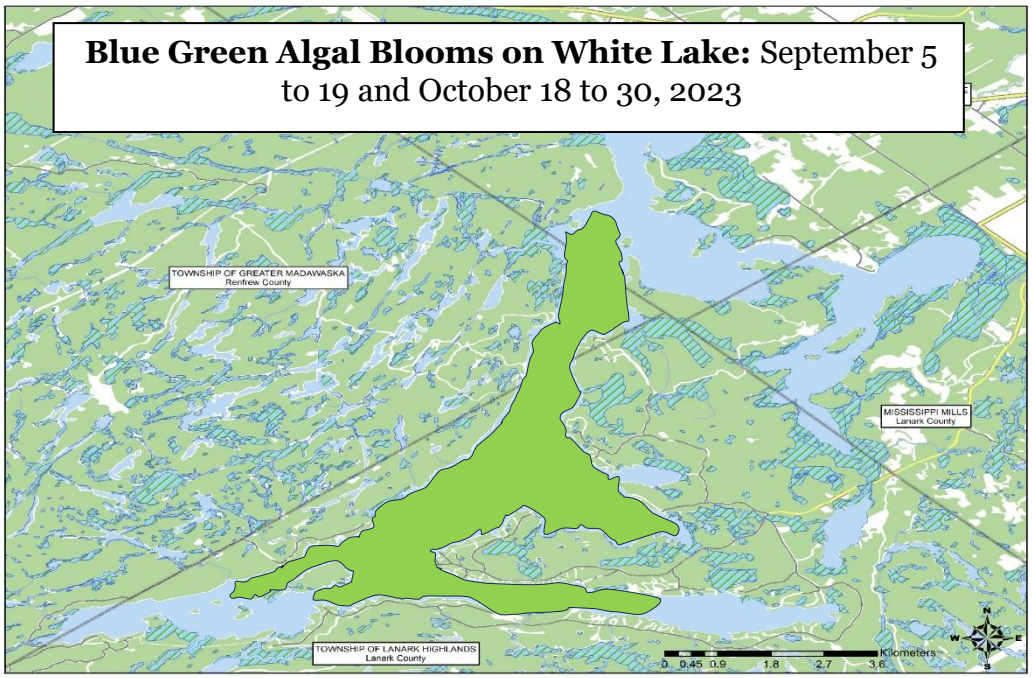
September 5 to 19, 2023 and October 18 to 30, 2023

In 2023, White Lake hosted three blue-green algal blooms. The first occurred on September 5 to 19; the second from September 30 to October 10; and the third from October 18 to 30.

The bloom affected areas from the southern end of Hardwood Island all the way up to the narrows including Three Mike and Pickerel Bays. Some surface scum derived from this bloom was visible in some of these areas. In all of these areas, significant concentrations of the anabaena blue-green algae were seen in the water column and later confirmed using a microscope.

The September 15 and October 18 blue-green algal blooms are discussed together because they had the same range of occurrence on White Lake. This is illustrated on the map below. The only difference between the two algal blooms is that the September bloom consisted mainly of anabaena blue-green algae whereas the October 18 bloom included significant concentrations of microcystis alga.

The photo below shows the appearance of the blue-green algal bloom along part of the shoreline of White Lake.



The Ministry of the Environment Conservation and Parks was notified and a staff scientist took a number of water samples for analysis for toxins. The results, shown below, indicate that the level of toxins was at or below the level of detection for the analytical method used. This result indicates that dangerous toxins had not developed in this algal bloom at time

of sampling. However, one must keep in mind that there is a possibility that toxins were produced at a later date or even at another location on the same date.

Analytical Results

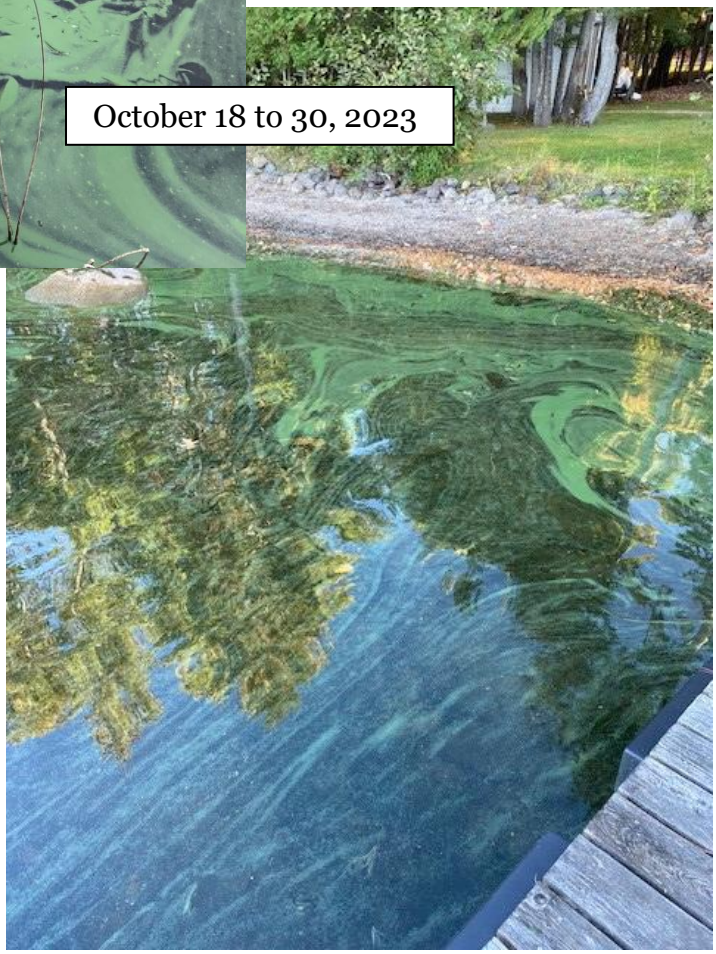
Lab ID: 12257001 **Date Collected:** 9/5/2023 3:59:00 PM
Field ID: 1-3T6PF4 **Matrix:** Water

Parameter	Result	Units	RDL	Rmk	Analyzed
E3469					
Total Microcystins	<0.10	µg/L	0.10		09/08/2023
E3568					
Anatoxin-A	<0 20	µg/L	0 20		09/08/2023
ORGANIC CHEMISTRY					
E3450					
3-Desmethyl-microcystin-LR	<0 050	µg/L	0 050		09/07/2023
3-Desmethyl-microcystin-RR	<0 050	µg/L	0 050		09/07/2023
Anatoxin-a	<0 050	µg/L	0 050		09/07/2023
Microcys in-HilR	<0 050	µg/L	0 050		09/07/2023
Microcys in-HtYR	<0 050	µg/L	0 050		09/07/2023
Microcys in-LA	<0 050	µg/L	0 050		09/07/2023
Microcys in-LF	<0 050	µg/L	0 050		09/07/2023
Microcys in-LR	<0 050	µg/L	0 050		09/07/2023
Microcys in-LW	<0 050	µg/L	0 050		09/07/2023
Microcys in-LY	<0 050	µg/L	0 050		09/07/2023
Microcys in-RR	<0 050	µg/L	0 050		09/07/2023
Microcys in-WR	<0 050	µg/L	0 050		09/07/2023
Microcys in-YR	<0 050	µg/L	0 050		09/07/2023

The occurrence of algal blooms is complicated and dependent on a number of factors including wind, temperature, sunlight, water depth, the presence of different phosphorus and sulphur containing compounds, as well as nitrate and nitrite concentrations, to name just a few.

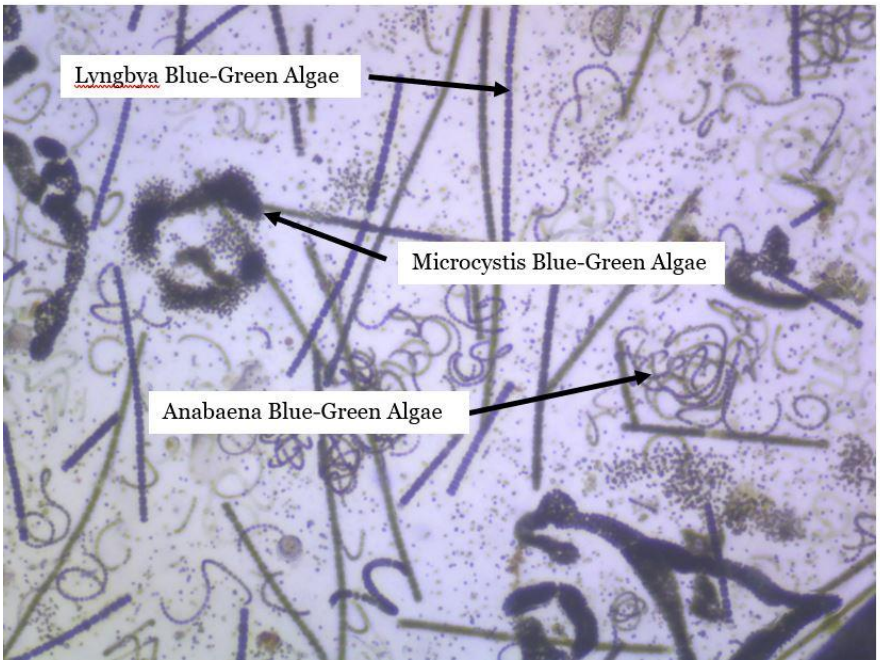
Below is a photo of the appearance of the October 18 to 30 blue-green algal bloom taken along the shoreline at different locations and contributed to us from cottagers.

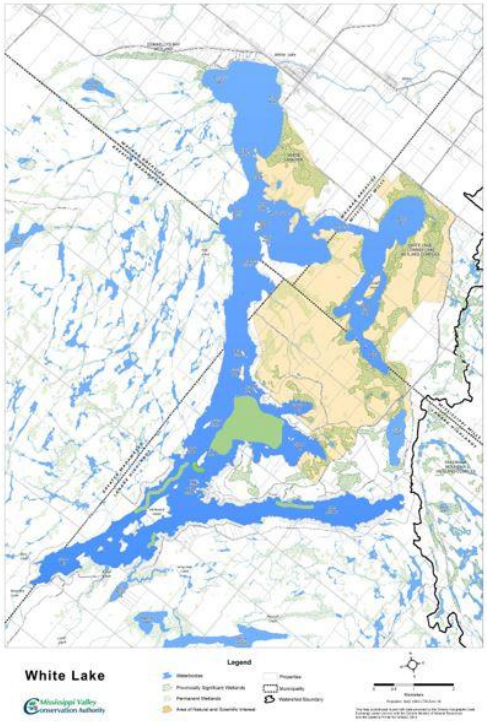
October 18 to 30, 2023



September 30 to October 10, 2023

Between the two algal blooms discussed above came an additional bloom with different characteristics than the other two: First; the range of distribution was smaller than the other two and the bloom contained comparatively equal concentrations of three different (taxa) blue-green algae. The map below and the photomicrograph illustrate our observations.





For all of the algal blooms discussed above, it should be noted that these blooms occurred in the deeper parts of White Lake. Shallow areas were not affected. This may be because during the fall months and in periods of low or no wind, that the lake becomes thermally stratified. This means that upper warmer waters are not mixing with deeper cooler water. At the same time, the level of oxygen close to the bottom of the lake is greatly reduced by consumption arising from decaying organic matter and microbial action.

Under these conditions, phosphorus stored in sediments, which is 200,000 times more concentrated than in the water column above, can be released and result in algal blooms.

During the late summer and fall of 2023 we experienced long periods of calm weather with low or no winds. These conditions would favour the release of phosphorus from sediments (also known as internal loading) as discussed above.

This phenomenon is one of the collateral effects of global warming and climate change.

White Lake Algal Blooms 2022

During 2022 two algal blooms were recorded. The first type of algal bloom which occurred was from filamentous green algae. This bloom lasted, as in previous years, from mid-June until mid-September.

The second type of bloom was from blue-green algae which covered parts of the lake including Three Mile and Pickerel Bays and extending into the main water body (See Appendix 1). Note that the Ministry of the Environment policy towards blue-green algal blooms is: "MOE regards any cyanobacterial (blue-green algae) bloom as potentially toxic, whether or not toxins are detected in the water upon testing"[8]

Green Algal Blooms

The first algal bloom of the year started in mid-June and continued until the end of summer. This bloom was of a filamentous green alga, which grew in patches along the shoreline.

In 2022, the filamentous green algal bloom was less extensive than in precious years with fewer occurrences than in 2021. The most serious and largest blooms were found immediately adjacent to newly de-treed and landscaped cottage lots, and areas of severely altered shorelines.

Algae bloom when conditions are right for its rapid and uncontrolled growth. These conditions include the presence of excess nutrients (phosphorus), favourable water temperature and clarity, sunlight, and the action of wind and waves. For White Lake, the presence of zebra mussels is an additional factor promoting the growth of filamentous green algae. These mussels tend to concentrate nutrients from open waters to the shoreline area where filamentous algal blooms occur. The severity of the algal bloom resulting from the sum of the above factors can be intensified by the runoff of nutrients from areas of shoreline which have been de-treed or altered in such a way that nutrients can enter the lake unmoderated by the presence of trees and other natural shoreline vegetation which prevents or slows entry nutrients into the lake.

Viewed from underwater, the algae mass forms very large volumes extending from just below the surface of the lake all the way down to the lake floor. Other aquatic plants become enveloped within the growing mass. Over time, the algae die, collapses into itself and sinks to the bottom of the lake.

[8] Algal Blooms in Ontario, Canada: Increase in reports since 1994; J.G. Winter, A.M. DeSellas, R. Fletcher, L. Heintsch, A. Morley, L. Nakamoto, and K. Utsumi (all Ontario Ministry of the Environment scientists); *Lake and Reservoir Management*, 27:107-114, 2011.

This alga does not produce toxins in the water and so the bloom is considered a nuisance bloom. However, when large mats of algae die and decompose, the water column can become anoxic (no oxygen) causing the release of phosphorus trapped in sediments. Sediments contain about 200,000 times the concentration of phosphorus found in lake water. The released phosphorus can trigger a secondary bloom which could be larger and last longer than the original event.

Blue-Green Algal Blooms

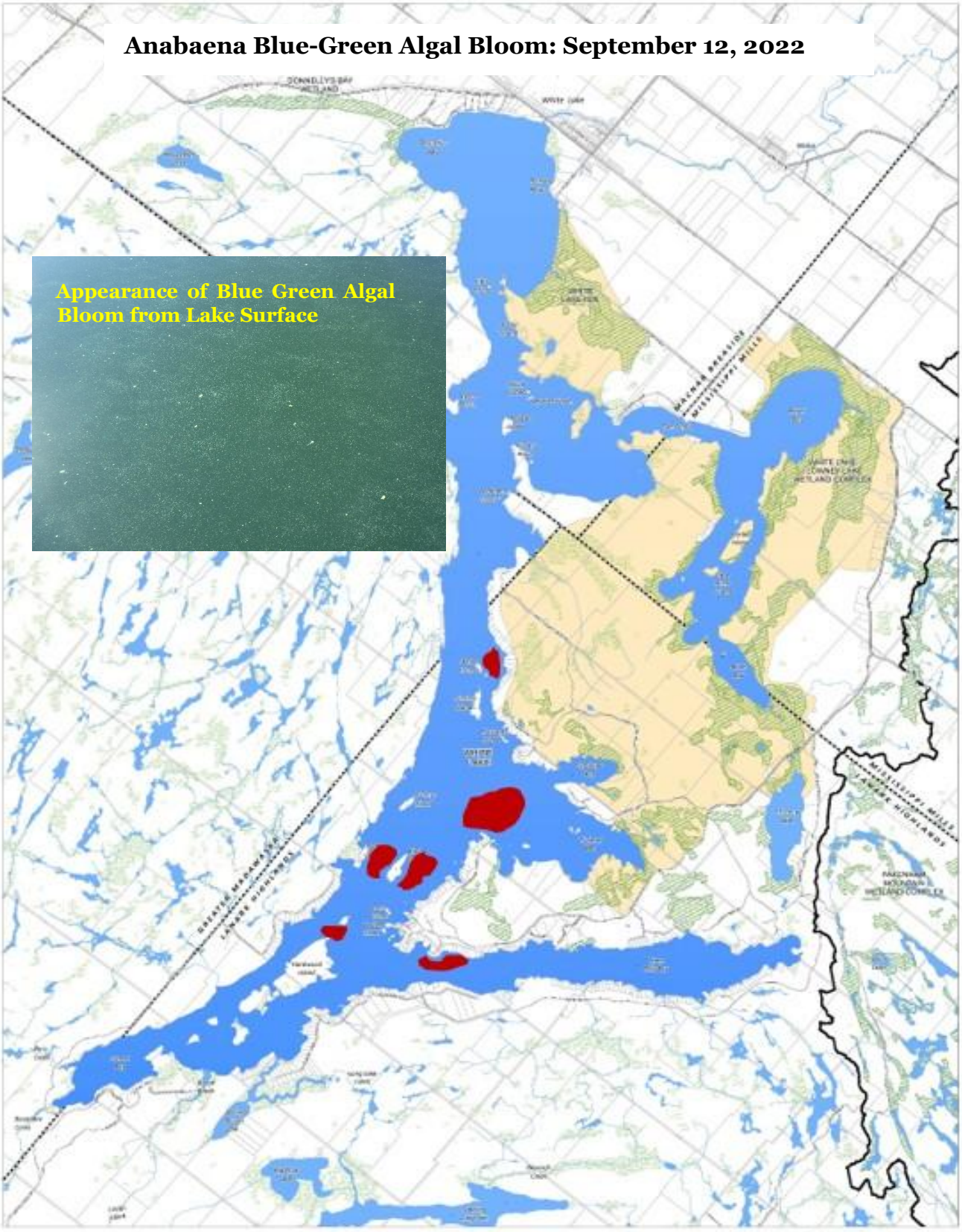
Blue-green algal blooms are not benign and so warrant special attention. When these blooms occur, they can create a public health hazard and anyone using the lake should be apprised of the seriousness of this issue.

In 2022, White Lake hosted one blue-green algal blooms detected on September 12,2022. The bloom was confined to about 6 patches located in the main water body of White Lake, as shown on the map below. The bloom was identified as anabaena and dissipated within a week. It should be noted that both anabaena and microcystis are present in all parts of the lake. During most of the water sampling season, it is possible to observe specimens of both of these algae in the water column, usually at very low concentrations

We know from the scientific literature that the presence of zebra mussels favours the propagation of microcystis over anabaena blue-green algae. However, in deeper waters, it may be possible that anabaena could have the advantage over microcystis for two reasons: 1) there are fewer or no zebra mussels present in deeper waters where the lake bottom is muddy; 2) anabaena has the ability to fix nitrogen from the atmosphere; microcystis does not. Both are capable of moving up and down the water column during the day using gas vacuoles, which are like air bubbles held within the algae.

The occurrence of algal blooms is complicated and dependent on a number of factors including wind, temperature, sunlight, water depth, the presence of different phosphorus and sulphur containing compounds, as well as nitrate and nitrite concentrations, to name just a few.

Anabaena Blue-Green Algal Bloom: September 12, 2022



Lake Scum

On May 31, 2022 large areas of the main water body of White Lake were covered with lake scum. At first glance the scum appeared to be an algal bloom, but on closer examination turned out to be a combination of flotsam from three sources brought together by a gentle wind on the lake surface.

The scum was composed of floating tree pollen grains intermixed with the white, fluffy down released by three in the *Salicaceae* family which includes willow, aspen, cottonwood and poplar trees. The down contains seeds. The third component was discarded exoskeletons (called *an exuviae***)** left behind by billions of flies and other insects hatching into adulthood from the lake surface.

It took several days for the action of wind and waves to clear the surface of the lake sending the lake scum to downwind shorelines or sinking to the lake bed.

White Lake Algal Blooms 2021

This year five algal blooms were recorded. The first type of algal bloom which occurred was from filamentous green algae. This bloom lasted, as in previous years, from mid-June until mid-September.

The second type of bloom was from blue-green algae which covered large portions of the lake including Three Mile and Pickerel Bays and extending into the main water body, especially on the eastern side of the lake. These extensive algal blooms consisted of two different blue-green algae occurring in different parts of the lake. The first two blue-green bloom was recorded on September 16 and the second two on October 8. Note that the Ministry of the Environment policy towards blue-green algal blooms is: “MOE regards any cyanobacterial (blue-green algae) bloom as potentially toxic, whether or not toxins are detected in the water upon testing”.[9]

[9] Algal Blooms in Ontario, Canada: Increase in reports since 1994; J.G. Winter, A.M. DeSellas, R. Fletcher, L. Heintsch, A. Morley, L. Nakamoto, and K. Utsumi (all Ontario Ministry of the Environment scientists); *Lake and Reservoir Management*, 27:107-114, 2011.

Green Algal Blooms

The first algal bloom of the year started in mid-June and continued until the end of summer. This bloom was green filamentous algae, which grew in large patches along the shoreline. Nutrients, such as phosphorus, supporting this alga comes from sediments, shoreline runoff where shorelines are disturbed, as well as nutrients dissolved in lake water.

In 2020, the filamentous green algal bloom was extensive and relatively intense compared to this same type of bloom in 2021. Although there were fewer occurrences than in 2020, the most serious and largest blooms were found immediately adjacent to newly de-treed and landscaped cottage lots, and areas with severely altered shorelines.

Algae blooms when conditions are right for its rapid and uncontrolled growth. These conditions include the presence of excess nutrients (phosphorus), favourable water temperature and clarity, sunlight, and the action of wind and waves. For White Lake, the presence of zebra mussels is an additional factor promoting the growth of filamentous green algae. These mussels tend to concentrate nutrients from open waters to the shoreline area where filamentous algal blooms occur. The severity of the algal bloom resulting from the sum of the above factors can be intensified by the runoff of nutrients from areas of shoreline which have been altered in such a way that nutrients can enter the lake unmoderated by the presence of trees and other natural shoreline vegetation which prevents or slows entry nutrients into the lake.

Viewed from underwater, the algae mass forms very large volumes extending from just below the surface of the lake all the way down to the lake floor. Other aquatic plants become enveloped within the growing mass. Over time, the algae die, collapses into itself and sinks to the bottom of the lake. Some species form gas pockets which cause algal masses to float to the surface of the lake followed by decomposition.

This year we observed numerous free-floating masses of algae on the surface of the lake in locations where there were no visible fixed blooms. Many of the blooms occurred in bays or small embayments along the shoreline.

Green Filamentous Algae - underwater view

Mougeotia Filamentous Algae

Green alga does not produce toxins in the water and so these blooms are considered nuisance blooms. However, when large mats of algae die and decompose, the water column can become anoxic (no oxygen) causing the release of phosphorus trapped in sediments. Sediments contain about 200,000 times the concentration of phosphorus

found in lake water. The released phosphorus can trigger secondary blooms. These could be larger and last longer than the original bloom event.

Blue-Green Algal Blooms

Blue-green algal blooms are not benign and so warrant our special attention. When these blooms occur, they can create a public health hazard and anyone using the lake should be apprised of the seriousness of this issue.

This year, White Lake hosted two different blue-green algal blooms. These blooms occurred simultaneously on two occasions; the first on September 16, and the second on October 8, 2021. The two types of algal blooms were: Anabaena (now called Dolichospermum), and Microcystis. The Anabaena bloom occurred in the main body of the lake (deepest water), Pickerel Bay and areas along the Eastern shoreline. The Microcystis bloom was located mainly in Three Mile Bay and adjacent areas.

The simultaneous occurrence of different types of blue-green algae has never been recorded before in White Lake. Prior to the infestation of White Lake with zebra mussels, only *Anabaena* blue-green algal blooms were recorded. Since the arrival of zebra mussels, only Microcystis blue-green algal blooms were observed. In 2021, we observed five algal blooms which is the largest number ever recorded for White Lake.

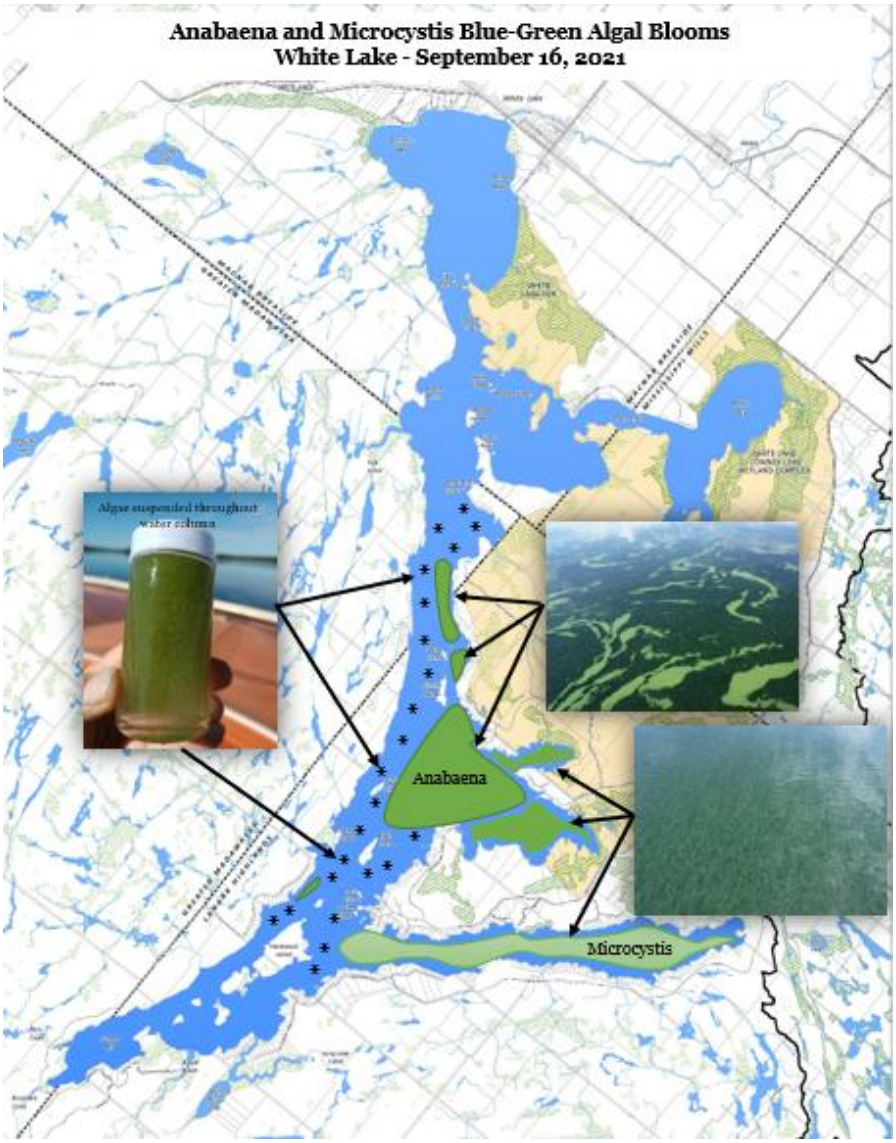
It should be noted that Anabaena and Microcystis are present in all parts of the lake. During most of the water sampling season, it is possible to observe specimens of both of these algae in the water column, usually at very low concentrations. In 2014 (two years prior to zebra mussel infestation), a lake-wide Anabaena blue-green algal bloom occurred in both deep and shallow areas of the lake.

We know from the scientific literature that the presence of zebra mussels favours the propagation of Microcystis over Anabaena blue-green algae. However, in deeper waters, it may be possible that Anabaena could have the advantage over Microcystis for two reasons: 1) there are fewer or no zebra mussels present in deeper waters where the lake bottom is muddy; 2) Anabaena has the ability to fix nitrogen from the atmosphere; Microcystis does not. Both are capable of moving up and down the water column during the day using gas vacuoles. In shallow waters, such as those in Three Mile Bay, the action of wind and waves would effectively mix the water column from the surface to the lake bed. This would allow both types of blue-green algae access to essential nutrients. Mixing would not be as efficient in deeper waters, giving Anabaena the advantage over Microcystis.

However, Microcystis responds to the presence of ammonium faster than other blue green species. Ammonium concentrations increase during the seasonal dieback and decomposition of aquatic plants. This will increase ammonium in the water column. Dense extensive aquatic plant growth associated with Three Mile Bay must trigger microcyctis blooms to some extent. The increase in aquatic plant growth stimulated by water clearance promoted by zebra mussels may also influence the location and extent of Microcystis blooms.

The occurrence of algal blooms is complicated and dependent on a number of factors including wind, temperature, sunlight, water depth, the presence of different phosphorus and sulphur containing compounds, as well as nitrate and nitrite concentrations, to name just a few.

The figure below shows the extent and intensity of the double blue-green algal bloom on White Lake first observed on September 16, 2021. This bloom lasted approximately 10 days, but re-emerged again on October 8, 2021. The second round of blooms were located in the same parts of the lake as the blooms observed nearly a month earlier, but of lower intensity. Because the second bloom occurred after the first bloom had disappeared, the second blooms are considered as separate blooms and not a continuation of the initial September 16 blue-green algal bloom.



Photos of the blooms are included in the figure to give the reader a better appreciation of the appearance of blue-green algal blooms. Also, it is easy to observe that the locations of

these algal blooms, as in other years, generally coincide with the most active and heavily populated areas of White Lake.

As noted earlier, blue-green algae are capable of producing toxins called microcystins. In sufficient concentrations these toxins can cause skin irritations as well as serious illness and death. For this reason, the Ministry of the Environment will sample and analyze algal blooms for their content of toxic compounds. For budgetary reasons, the MOE limits each lake to one sampling per year, although they will re-sample if there is believed to be a special need.

This year, only one sample was taken by MOE. The water sample was taken from the western shore of the lake in the zone affected by the Anabaena blue-green algal blooms. Although other parts of the lake were not sampled, the MOE advises that every bloom, whether tested or not, must be considered as toxic in the interest of public and personal safety. The Ministry of the Environment, Conservation and Parks reported the following results for the single sample taken:

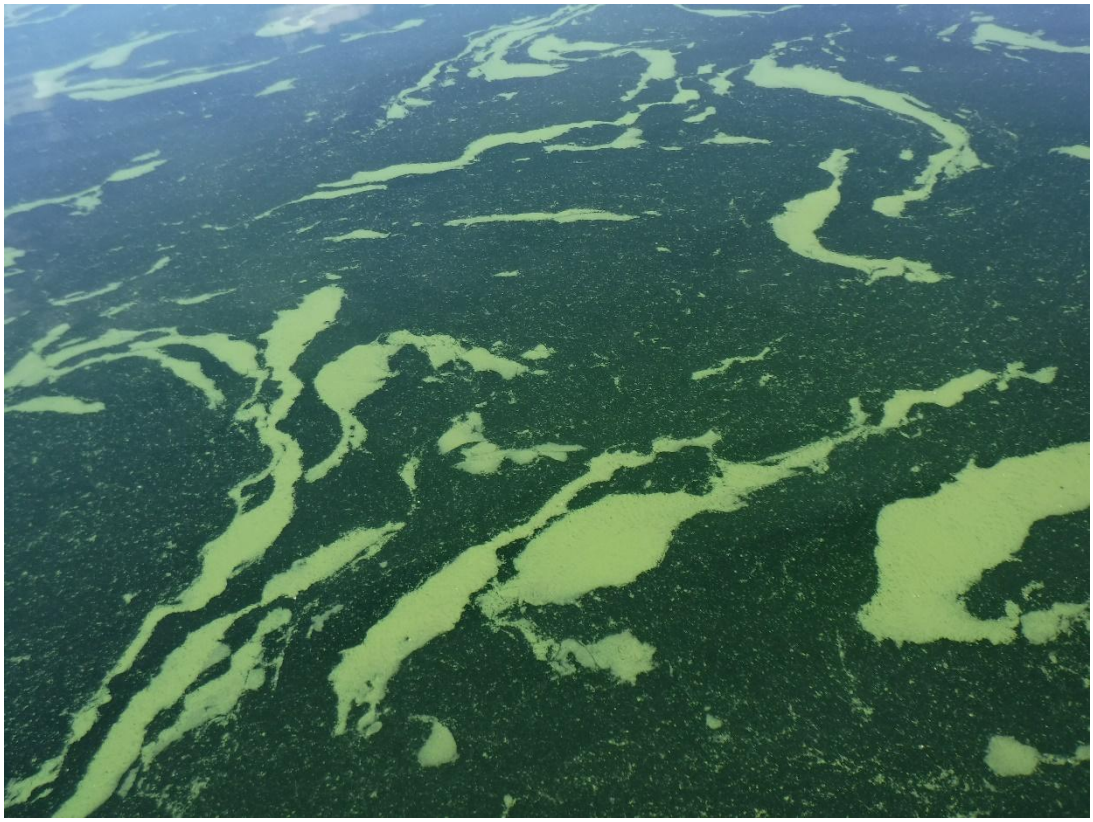
"As expected, a bloom of blue-green algae (Dolichospermum; formerly Anabaena) was confirmed. The total microcystin concentration was 0.56 ug/L and the anatoxin-A concentration was below method detection limits of 0.20 ug/L and 0.050 ug/L.

The sample was submitted for microcystin speciation analysis. The microcystin-LR concentration was 0.074 ug/L (Ontario Drinking Water Standard is 1.5 ug/L) and the microcystin-LA concentration was 0.14 ug/L (no provincial standard). All other analyzed species were below method detection limits of 0.050 ug/L."

These results confirm the presence of toxins in the sample taken, but in a concentration not dangerous to human or animal health.

In recent years, an annual pattern of algal blooms on White Lake is emerging. During early summer, we observe widespread nuisance filamentous green algal blooms, and in the fall, we observe blue-green algal blooms in large parts of the lake.

Below are photos of accumulations of dying or dead ababaena blue-green algae. During this phase blue-green algae can release high concentrations of microcystin toxins into the water column.



White Lake Algal Blooms 2020

In 2020 two algal blooms were recorded. The first type of algal bloom which occurred was from filamentous green algae. This bloom lasted, as in previous years, from mid-June until mid-September.

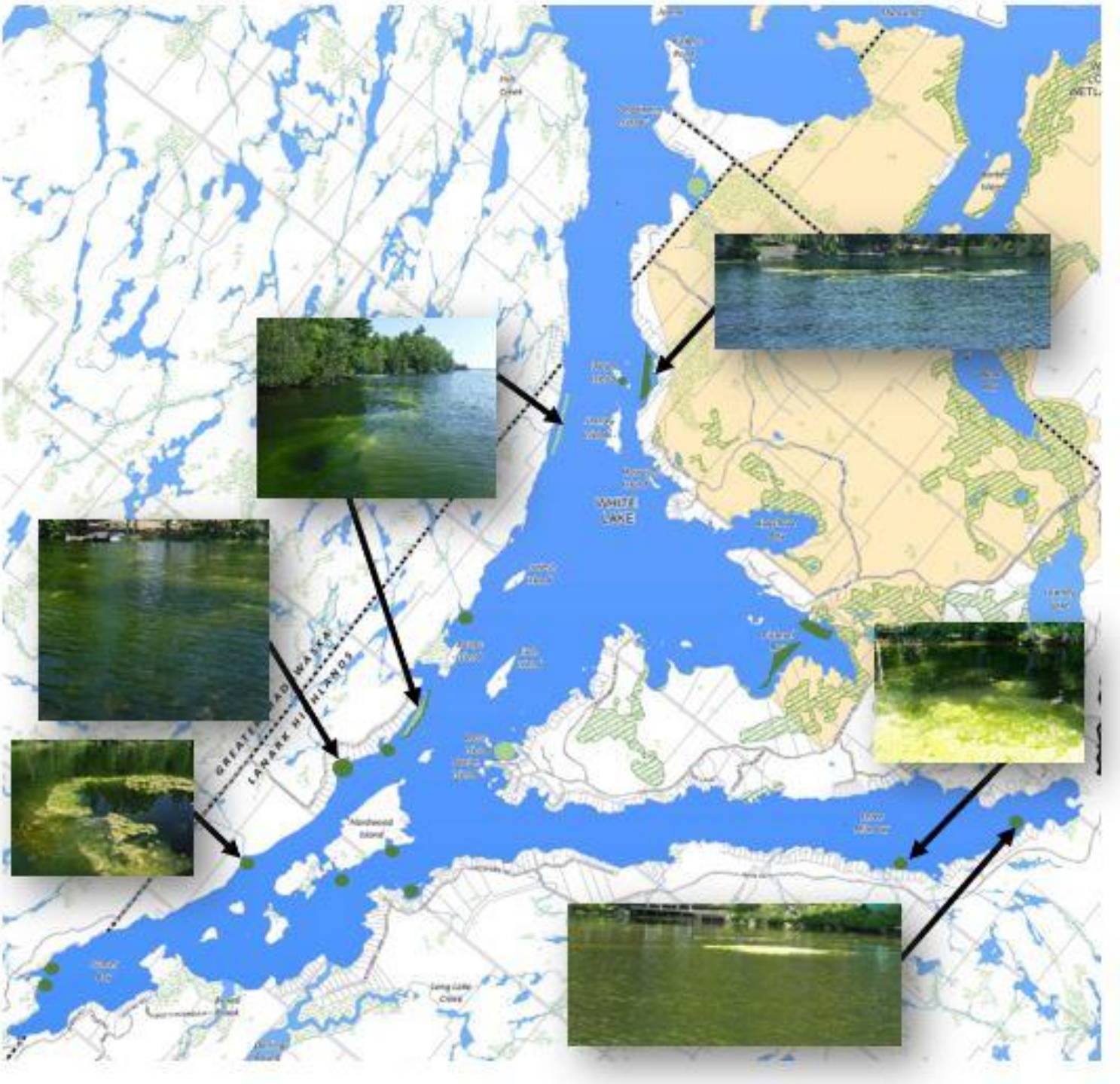
The second type of bloom was from a blue-green alga which occurred in Three Mile Bay and into the main water body, especially on the eastern side of the lake. In September of 2018, there were two blue-green algal blooms which occurred in the same area of the lake. The first of these blooms was certified as toxin producing, the second was not tested. This year, the bloom was not as intense and mostly confined to the water column. Note that the Ministry of the Environment policy towards blue-green algal blooms is: "MOE regards any cyanobacterial (blue-green algae) bloom as potentially toxic, whether or not toxins are detected in the water upon testing"[10]

Green Algal Blooms

The first algal bloom of the started in mid-June and continued until the end of September. This bloom was of a filamentous green alga, which grew in large patches along the shoreline. Nutrients, such as nitrogen and phosphorus compounds, supporting this alga comes from a number of sources. These sources include sediments, lake water and inputs from septic systems and surface runoff.

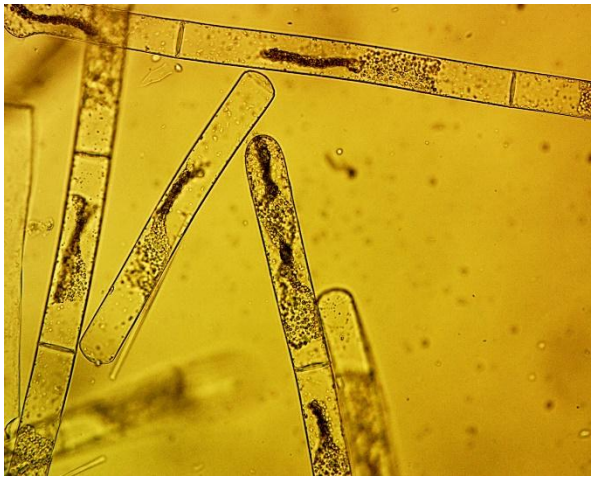
In order to assess the extent of this bloom, we mapped the occurrences of this bloom over a large part of White Lake. We toured the entire shoreline of White Lake south of Fish Creek in order to present a 'snapshot', for June 20, 2020, of algal bloom locations. We also collected samples at each site for microscopic examination. We were not able to examine the entire shoreline of White Lake (~ 97 km) due to time constraints, and so cannot report on other areas of the lake, in particular Hayes and Bane Bays, The Canal and the White Lake Village Basin. Below is a map of the survey area which includes insets of photos of the actual blooms.
In the map above, dark green is used to denote simultaneous surface and submerged filamentous green algae, and light green for submerged only. The size of the green dots indicates the relative size of the algal bloom area at each site, as does the length and width of lines for affected shoreline. The attached photos provide a visual representation of the algal bloom itself.

[10] Algal Blooms in Ontario, Canada: Increase in reports since 1994; J.G. Winter, A.M. DeSellas, R. Fletcher, L. Heintsch, A. Morley, L. Nakamoto, and K. Utsumi (all Ontario Ministry of the Environment scientists); *Lake and Reservoir Management*, 27:107-114, 2011.



Thirteen sites with algal blooms were sampled for purposes of identification. All sites sampled showed that the lime-green algal “clouds” forming under the surface represent just one genus of filamentous green algae- a type called Mougeotia, which is also

commonly known by the unappetizing name of 'elephant snot'. This alga does not produce toxins in the water and so the bloom is considered a nuisance bloom. The photo below shows a mass of their filaments magnified 200 times.



In addition to the blooms shown on the map, we observed numerous free-floating masses of the algae on the surface of the lake in locations where there were no visible fixed blooms. Many of the blooms occurred in bays or small embayments along the shoreline. During its lifetime, this alga produces gases which become trapped in the fine mesh of the algal mat and serve to raise the bloom from the lake floor to the surface, where it can be affected by the wind.

When large mats of algae die and decompose, the water column can become anoxic (no oxygen) causing the release of phosphorus trapped in sediments. Sediments contain about 200,000 times the concentration of phosphorus found in lake water. The released phosphorus can trigger a secondary bloom which could be larger than the original event.

Although there were large patches of this algal bloom in areas near unaltered forested shorelines, the most serious and largest blooms were found immediately adjacent to newly de-treed and landscaped cottage lots, and areas of severely altered shorelines. The occurrence and extent of these blooms have increased in recent years which may reflect the growth of zebra mussel populations, climate change and lake overuse.

Filamentous green algae of the type we are seeing in the lake has been resident in the lake for likely a good part of the existence of White Lake. Similar algal blooms have been reported recently in the news, in particular in the Rideau Canal, so the bloom in White Lake is not an isolated event.

Algae bloom when conditions are right for its rapid and uncontrolled growth. These conditions include the presence of excess nutrients (phosphorus), favourable water temperature and clarity, sunlight, and the action of wind and waves. For White Lake, the presence of zebra mussels is an additional factor promoting the growth of filamentous green algae. These mussels tend to concentrate nutrients from open waters to the shoreline area where filamentous algal blooms occur. The severity of the algal bloom resulting from the sum of the above factors can be intensified by the runoff of nutrients from areas of shoreline which have been de-treed or altered in such a way that nutrients can enter the lake unmoderated by the presence of trees and other natural shoreline vegetation which prevent nutrients from entering the lake.

Viewed from underwater, the algae mass forms very large volumes extending from just below the surface of the lake all the way down to the lake floor. Other aquatic plants become enveloped within the growing mass. Over time, the algae die, collapses into itself and falls to the bottom of the lake.

It is interesting to note that similar algal blooms occurred in 2019 (with lower intensity), but were of another species of filamentous green algae Sirogonium, one of a large family of filamentous green algae found in White Lake.

Blue-Green Algal Blooms

Blue-green algal blooms are not benign and so warrant special attention. When these blooms occur, they can create a public health hazard and anyone using the lake should be apprised of the seriousness of this issue.

This year, White Lake hosted one blue-green algal bloom. The bloom occurred in Three Mile Bay and the main water body, especially on the Western side of the lake. The bloom was identified as he blue-green algae as *Microcystis*, which is known to produce toxins.

The bloom was limited to the water column and was not intense enough to warrant testing by the MOE and because the bloom did not result in a surface scum which signals the large-scale death and decay of the algae. Microcystin toxins are usually released at this stage of the algal bloom.

However, the tell-tale surface scum of decaying *Microcystis* was observed at several locations including the southern shore of Stanley Island, the eastern shore of Birch Island and the area adjacent to the entrance to Pickerel Bay.

Southern Shore of Stanley Island, September 29, 2020

Fortunately, this surface algal scum dissipated over a period of a few days and it was not necessary to call the MOE for further study. The occupants of the cottages affected were advised of the dangers associated with this type of algal bloom and were asked to treat the bloom as potentially toxic, as is recommended by the MOE.

White Lake Algal Blooms 2019

This year two algal blooms were recorded in White Lake. The first type of algal bloom which occurred was from filamentous green algae. This bloom lasted, as in previous years, from the end of June until mid-September. Large and small patches of this algae were observed in almost every part of the lake save Hayes Bay and the Village Basin. This is a nuisance bloom which occurs along shorelines and can cover very large areas.

The second type of bloom was from a blue-green alga which was concentrated in the lower half of Three Mile Bay. In September of 2018, there were two blue-green algal blooms which occurred in the same area, but were more extensive covering most of Three Mile Bay and parts of the greater lake. The first of these blooms was certified as toxin producing, the second was not tested, but presumed likely also be toxic. Note that the Ministry of the Environment policy towards blue-green algal blooms is "MOE regards any cyanobacterial (blue-green algae) bloom as potentially toxic, whether or not toxins are detected in the water upon testing"[11]

Green Algal Blooms

The first algal bloom of the year started in late June and continued until the end of September. The filamentous green algae (Sirogonium), grew in large patches along the shoreline. Nutrients, such as phosphorus, supporting this alga comes from both the sediments as well as dissolved in lake water.

Viewed from underwater, the algae mass forms very large volumes extending from just below the surface of the lake all the way down to the lake floor. Other aquatic plants become enveloped within the growing mass. Over time, the algae die, collapses into itself and falls to the bottom of the lake.

Blooms such as the ones pictured below were common in 2019, as in previous years, all along the western shore of White Lake and also in other areas and along island shorelines and Three Mile Bay. This bloom was essentially lake-wide and similar to blooms which occurred in 2017 and 2018 at the same location

[11] Algal Blooms in Ontario, Canada: Increase in reports since 1994; J.G. Winter, A.M. DeSellas, R. Fletcher, L. Heintsch, A. Morley, L. Nakamoto, and K. Utsumi (all Ontario Ministry of the Environment scientists); *Lake and Reservoir Management*, 27:107-114, 2011.

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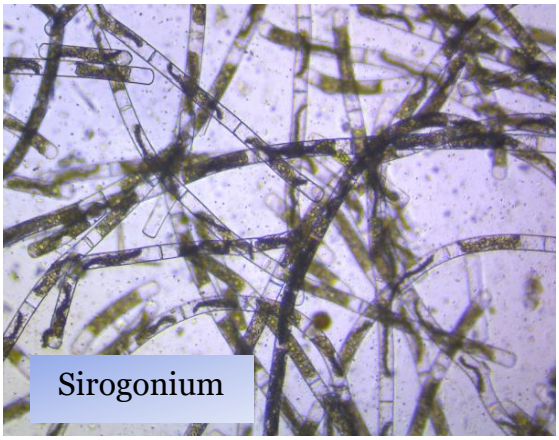
Three Mile Bay – July 1, 2019

Waba Island – August 17, 2019

The algae responsible for these blooms is Sirogonium, one of a large family of filamentous green algae found in White Lake. Blooms of filamentous green algae are stimulated by the presence of zebra mussels in White Lake. Zebra mussels concentrate nutrients from deeper parts of the lake and deposit them in shoreline areas where they thrive. Warmer daytime water temperatures, abundant light and nutrients, provide ideal conditions for the propagation of filamentous green algae along shorelines.


Sirogonium

Even with the onset of cooler weather in late September and October, another filamentous green alga of the Zygnema genus thrives where Sirogonium was present earlier in the year. The algae resemble bright green garlands draped over aquatic plant and persists right up to ice formation on the surface of the lake.


Western Shore – October 19, 2019

Blue-Green Algal Blooms

Blue-green algal blooms are not benign and so warrant special attention. When these blooms occur, they can create a public health hazard and anyone using the lake should be apprised of the seriousness of this issue.

This year, White Lake hosted one blue-green algal bloom. The bloom occurred in the Eastern half of Three Mile Bay and lasted for over a month starting in mid-September.

Although we had identified the blue-green algae as *Microcystis*, we did not report it to the Ministry of the Environment or to our local Health Unit. This is because the bloom did not result in a surface scum which signals the large-scale death and decay of the algae. Microcystin toxins are usually released at this stage of the algal bloom.

Instead, the very intense algal bloom filled the water column in this part of the lake. The water was visibly opaque and full of clusters of blue-green algae. The photos below are underwater photos of the affected waters. A comparison photo showing how the water should look at this time of year is provided for comparison purposes. The identifying photomicrograph of the algae itself is also provided.

Example of Clear Water Conditions

Microcystis: Three Mile Bay 2019

It is possible that local conditions such as wind, temperature, etc. moderated this blue-green algal bloom preventing it from developing further before it has a chance to dissipate.

In 2018, there were two such blooms in Three Mile Bay, one of which was determined to be toxic and the other, although not tested, was potentially toxic as well. It may be no coincidence that these blooms took place on the most altered shoreline on White Lake.

Note that monitoring the extent and longevity of an algal bloom requires much time and effort. Although we try to provide current up to date information, we would need more volunteer help to provide a complete picture of any algal bloom. For blue-green blooms, the Leeds, Grenville and Lanark District Health Unit provides a useful guide for individuals to use in assessing when water becomes safe to use after a toxic bloom is identified.

Keep in mind that the "Ministry of the Environment regards any cyanobacterial (blue-green algae) bloom as potentially toxic, whether or not toxins are detected in the water upon testing". See literature reference above.

Crowded Zebra Mussel Neighbourhood

White Lake Algal Blooms 2018

This year four algal blooms were recorded. The first bloom was from green algae occurring at a number of different isolated sites on White Lake. Because these blooms were derived from two different species of filamentous green algae, we are counting these separate occurrence as two blooms.

There were also two separate blue-green algal blooms. The first blue-green algal bloom contained microcystin toxins at a concentration of 25 ppb (parts per billion). This concentration greatly exceeds the limit for drinking water (1.5 ppb) and also exceeds the limit of 20 ppb for recreational use. The second blue-green algal bloom was reported to the Ministry of the Environment but was not tested by the MOE since it is currently limiting each lake to one sampling per year. The collection and analysis of one sample costs nearly $1,000 and the MOE does not have the resources to follow up on every report. However, the bloom was registered at the Health Unit and classified as *Microcystis* blue-green algae based on photographs of the bloom and photomicrographs of the algae itself which we submitted to the MOE. It is very likely that the second bloom, which was as extensive as the first, was also laden with toxic microcystins. It is worth noting that our Environment Volunteers have correctly identified the type and species of all algal blooms which have been documented since 2013.

Green Algal Blooms

The first algal bloom of the season occurred on or about June 10, 2018. This bloom was found in a more remote part of White Lake but was very heavy and extensive in the area of Long Lake Creek East all the way from the creek itself to the point where it met the outflow or Darling Round Lake. This species of green algae is relatively simple to identify because as it dies and decomposes it floats to the surface to form large masses which are often referred to as 'elephant snot'. It is also easy to identify under the microscope.

The second location where this bloom occurred was near Sunset Bay extending in patches for about 1 km from the boat launch. The bloom was most intense near the estuary of Boundary Creek. It was evident that wind and wave action were in the process of dissipating the floating masses of algae when it was observed.

The second green algal bloom started in mid-August and continued until the end of September. These filamentous green algae (Sirogonium), grew in large patches along the shoreline. Nutrients, such as phosphorus, supporting this alga comes from sediments as well as dissolved in lake water, as well as other sources as discussed above.

Viewed from underwater, the algae mass forms very large volumes extending from just below the surface of the lake all the way down to the lake floor. Other aquatic plants become enveloped within the growing mass. Over time, the algae die, collapses into itself and remains attached to standing aquatic plants resembling bright green garland.

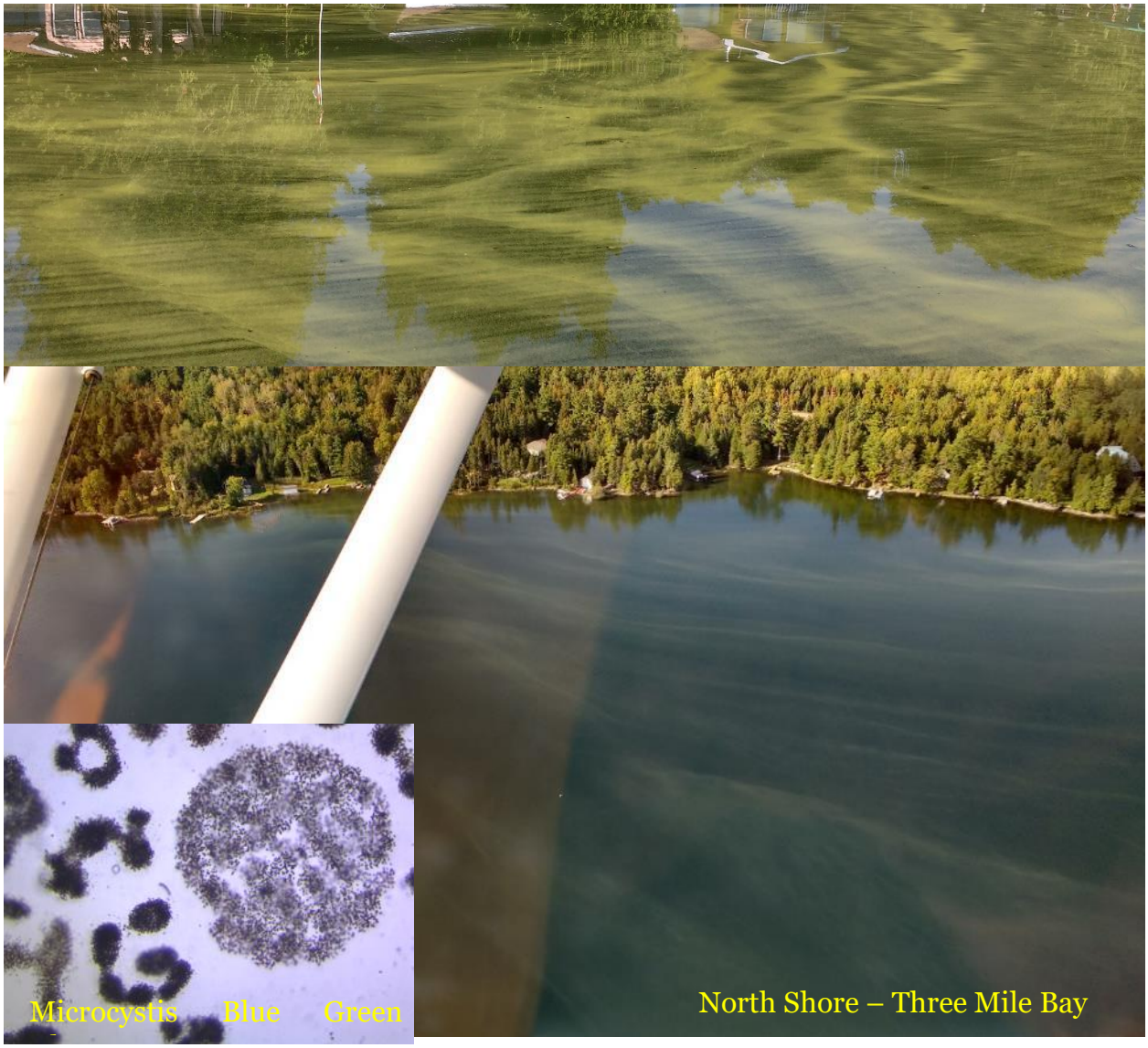
Blooms such as the one pictured above were common in 2018 all along the western shore of White Lake and also in other areas and along island shorelines. This bloom was essentially lake-wide and follows a similar bloom which occurred in 2017.

Blooms of filamentous green algae are a consequence of the presence of zebra mussels in White Lake. Zebra mussels concentrate nutrients from deeper parts of the lake and deposit them in shoreline areas where they thrive. Warmer daytime water temperatures, abundant light and nutrients, provide ideal conditions for the propagation of filamentous green algae along shorelines

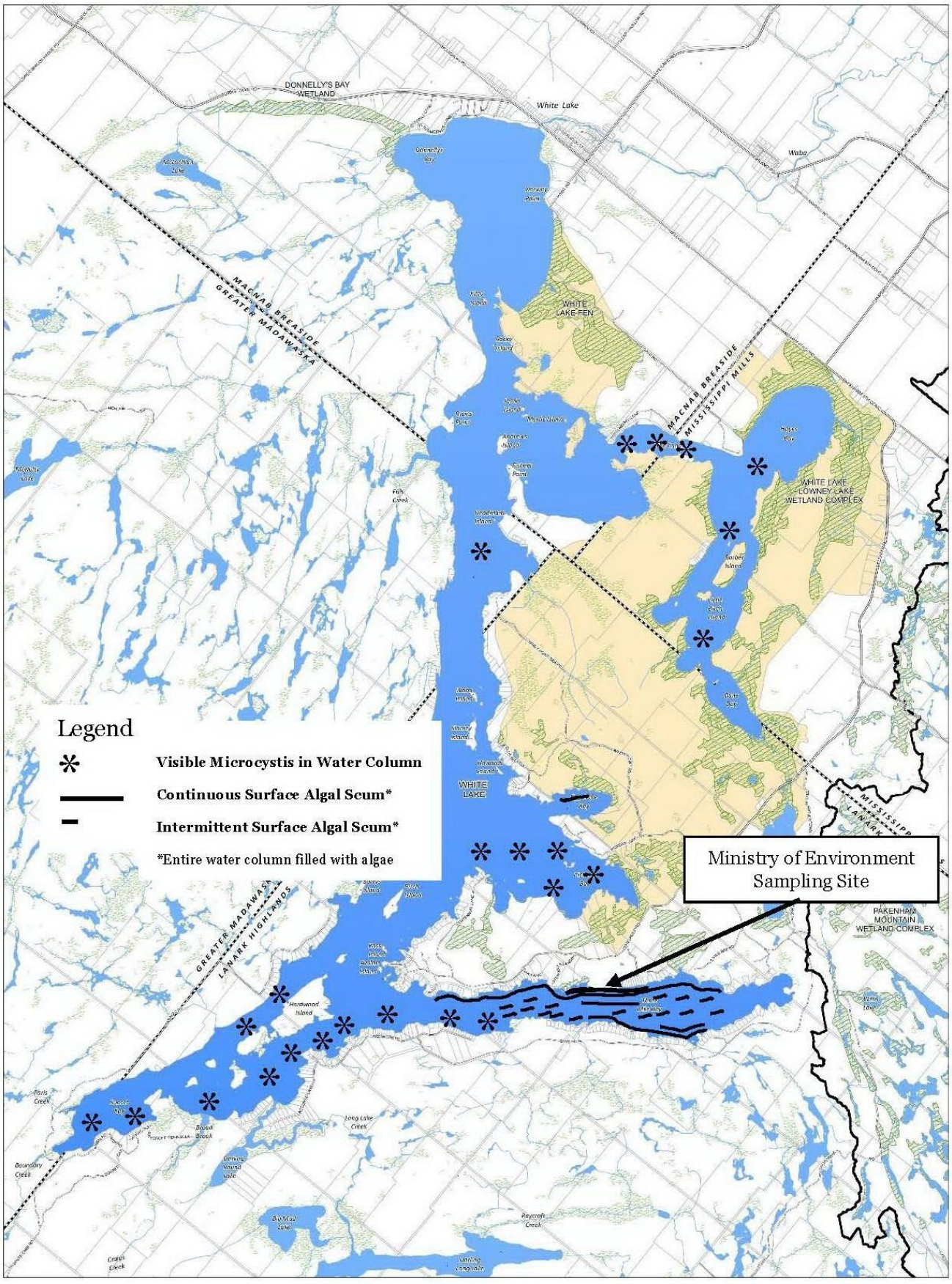
Blue-Green Algal Blooms

Blue-green algal blooms are not benign and so warrant special attention. When these blooms occur, they can create a public health hazard and anyone using the lake should be apprised of the seriousness of this issue. This year, White Lake hosted two blue-green algal blooms. It may be no coincidence that these blooms took place on the most altered shoreline on White Lake.

The first bloom was observed on September 13, 2018. The photos below show the nature of the bloom and its appearance both close up and from above in a float plane.



Extent of September 13, 2018 Microcystis Blue Green Algal Bloom



The map above shows the extent and distribution of the September 13, 2018 *Microcystis* blue-green algal bloom. The algal bloom was most intense on the north shore of Three Mile Bay, but was present right across to the south side of the bay. In most of Three Mile Bay colonies of *Microcystis* were clearly visible from the surface of the lake all the way down to the lake bed.

In another part of the lake, a much smaller but similar bloom was present on the north shore of Thumbnail Bay. Elsewhere (*), smaller populations of *Microcystis* were observed, but these had not yet reproduced to the point of producing surface scum. The bloom lasted approximately 10 days at which point the algae had dissipated.

A second blue-green algal bloom was observed on October 10, 2018. Using microscopy, we identified this bloom as *Microcystis*. The occurrence of this algal bloom was reported to the Ministry of the Environment. An incident number was assigned, but the MOE declined to return to White Lake for another round of sampling and analysis. Citing costs, the MOE informed us that they are limiting samplings to one per year per lake.

Although we have no data to show that the bloom was toxic, it is highly likely that it was considering that the nature of this bloom was the same as the September 13, 2018 bloom and occurred at the same location.

We know from samplings along the north shore of Three Mile Bay that this bloom was as extensive as the September 13, 2018 bloom.

This bloom persisted in the water column for several weeks after surface scum dissipated. Filtered water samples showed that even after three weeks *Microcystis* not only dominated the algae profile in lake water, it was in fact the only algae present! Note that zebra mussels promote the growth of *Microcystis* blue-green algae.

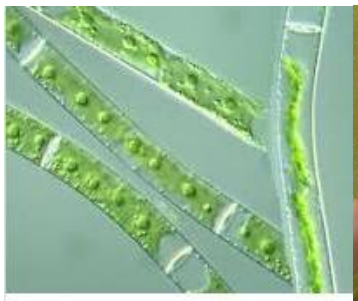
White Lake Algal Blooms 2017

Early in the summer of 2017, we received a number of enquiries from cottagers about patches or blobs of algae either on the floor of the lake or free-floating and drifting with the wind. Sometimes, a large mat of algae ended up on the shoreline.

We could attribute this lake-wide bloom to the unusually wet spring and early summer weather we experienced. Alternatively, this algal bloom could also be one of the predicted consequences of having zebra mussels in White Lake. Which we believe is likely the case.

Environment Volunteers sampled many of these algal masses and found, through microscopic examination, that they were all green filamentous algae. These algae are all naturally occurring and are harmless in the sense that they do not produce dangerous toxins. At worst, they are a nuisance especially when they concentrate on your shoreline and begin to rot.

Time will tell if this is an isolated occurrence or if these algal blooms return each year. Very little can be done about these blooms. However, there are some actions we can take to ensure that these blooms are minimized. This can be done primarily by reducing our impact on the lake. In particular, maintaining a healthy shoreline, respecting setbacks for building projects, maintaining septic systems and reducing boat wakes and other disturbances to the shoreline and near-shoreline sediments. All of these actions will reduce the amount of nutrients entering the lake at the very locations where zebra mussels are active.

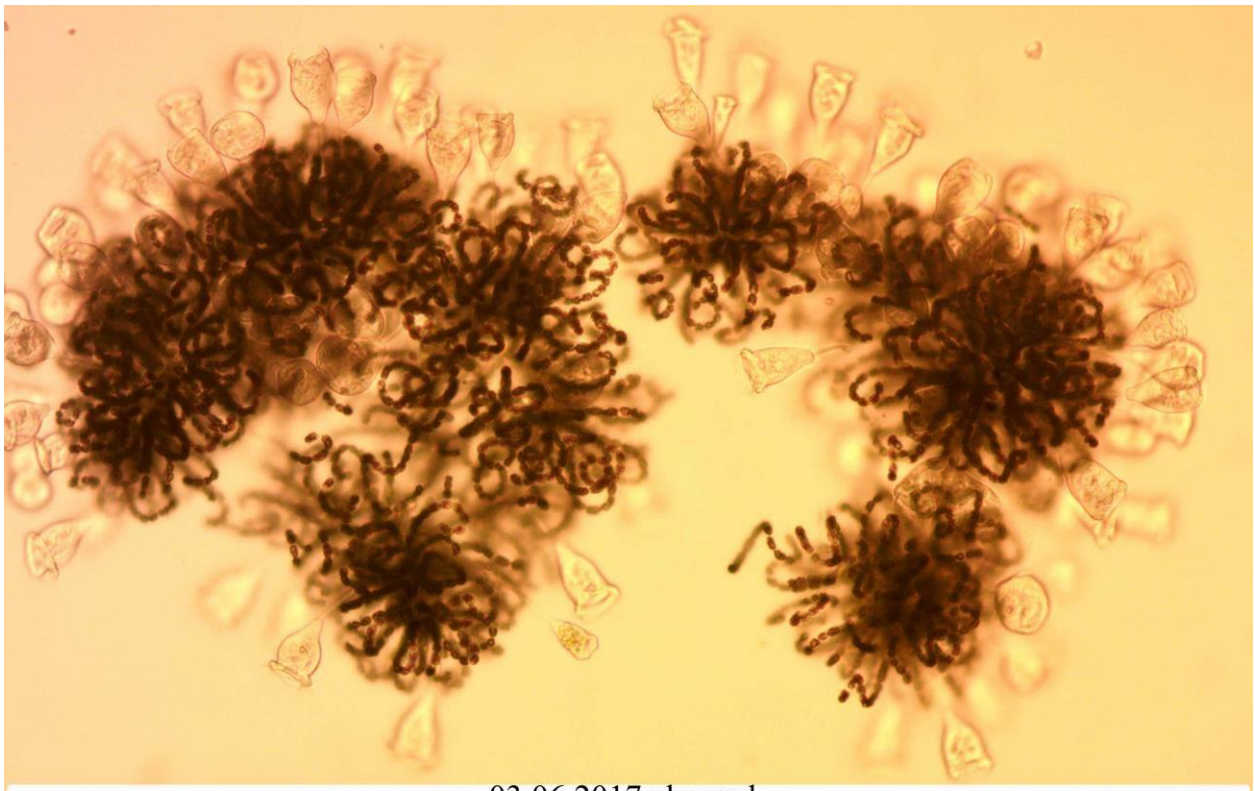


Mougeotia

Sirogonium

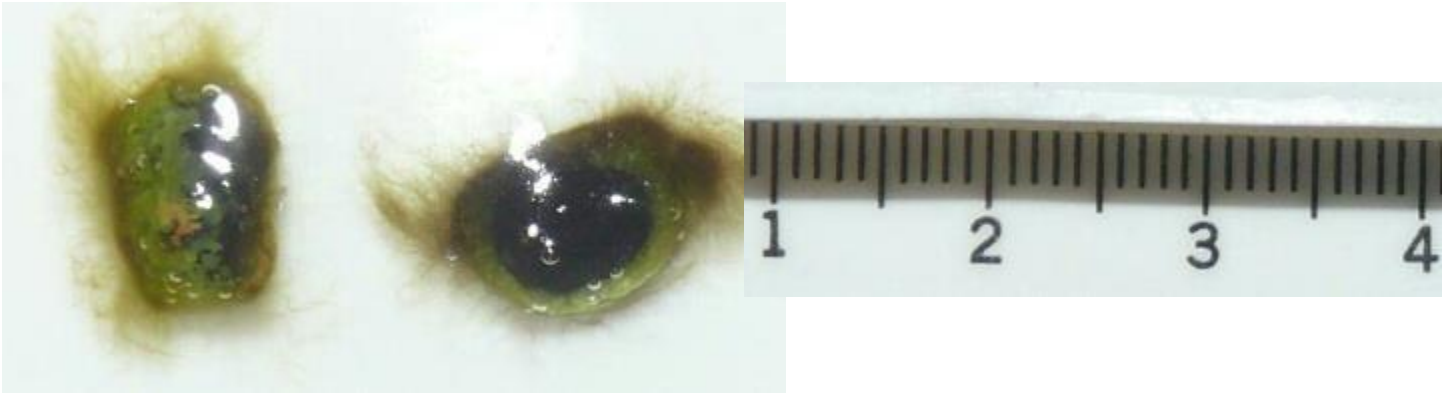
It should be noted that on June 29, 2017 a private citizen did alert the Leeds, Grenville and Lanark Health Unit of a possible blue-greed algal bloom located in the Three Mile Bay area. Two samples were taken by officials and sent for analysis. Luckily, this sample did not contain any toxins nor did it contain any blue-green algae. The sample was found to contain diatoms, golden-brown algae and green algae. All of these species are common in White Lake.

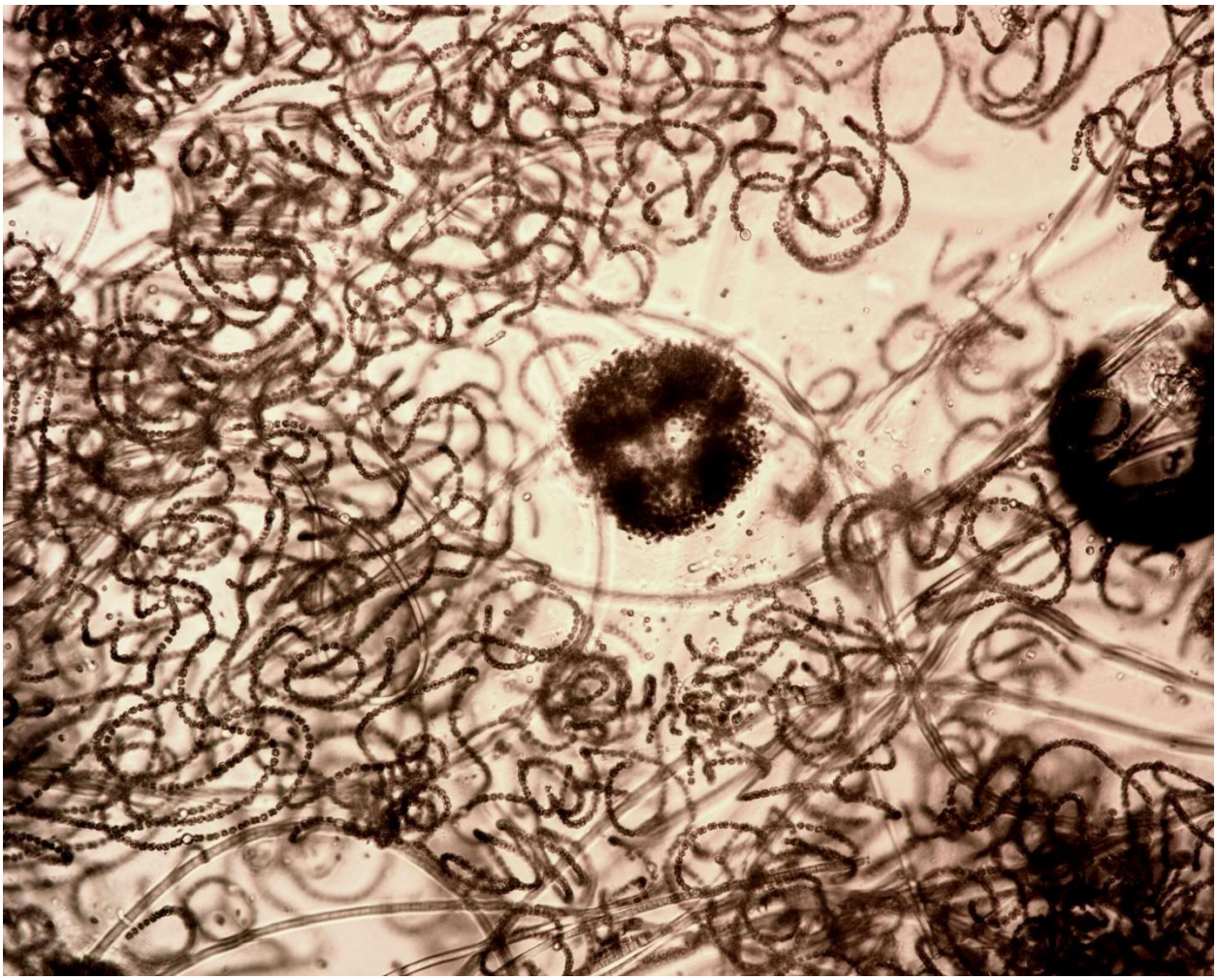
It is well known that the presence of zebra mussels in lakes can promote the growth of Microcystis and Anabaena blue-green algae. Although there were no blooms of these algae in White Lake during the 2017 summer season, they were detected in water everywhere in the lake we sampled. Below is a photo taken on June 3, 2017. The photo shows Anabaena blue-green algae with attached vorticella.



03 06 2017 channel
anabaena & vorticella

Characteristic floating algal masses (pictured below) appeared on August 28, 2017 in Three Mile Bay, near Hardwood Island, Pickerel Bay, and Hayes Bay. The photomicrograph again shows the presence of microcystins and Anabaena blue green algae





Above is a photomicrograph of the algal mass retrieved from the lake surface on August 28, 2017.

None of the above observed algal blooms progressed into a full-blown bloom requiring the collection of samples for analysis for toxins. The water column itself was not significantly contaminated with visible algae. However, it is likely that conditions leading to a much larger and more dangerous algal bloom were narrowly averted by factors such as local atmospheric conditions.

White Lake Algal Blooms 2016

The following three photos were taken on Hayes Bay on June 26, 2016. This algal bloom was observed only at this location and nowhere else on the lake.

The same floating masses were observed on October 7, 2016, this time on the western shore of the lake. Microscopic analysis showed that the mass was composed of microcystins and Anabaena blue-green algae.

None of the above observed algal blooms progressed into a full-blown bloom requiring the collection of samples for analysis for toxins. The water column itself was not significantly contaminated with visible algae. However, it is likely that conditions leading to a much larger and more dangerous algal bloom were narrowly averted by factors such as local atmospheric conditions.

White Lake Algal Blooms 2015

On October 5, 2015 White Lake experienced a significant blue-green algal bloom. The extent of the bloom covered most of the lake. Although surface accumulation of the algae was not as great as in 2014, the entire water column from the surface to depth contained large quantities of Anabaena blue green algae (see micrographs below). Samples of this algal bloom were taken on October 7th by a representative of the Ministry of the Environment and Climate Change and analyzed for toxins. The analysis for microcystins (class of toxic compounds) in this sample found a concentration of less than 0.05 ppb (nanograms per millilitre). This concentration is below the Ontario Drinking Water Quality Standards limit of 1.5 ppb indicating that the lake water was safe to use.

Below are photos of Anabaena blue-green algae on White Lake.

Western Shore

North Shore of Three Mile Bay

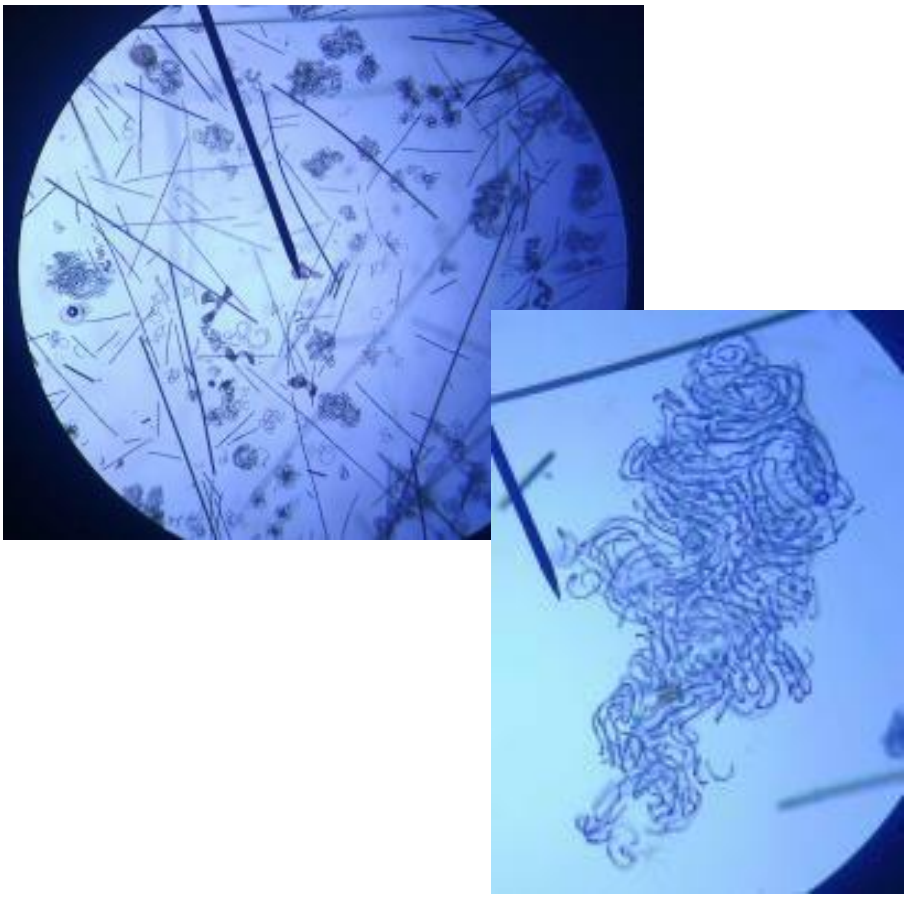


Photo micrograph of Anabaena blue-green algae (magnified, inset)

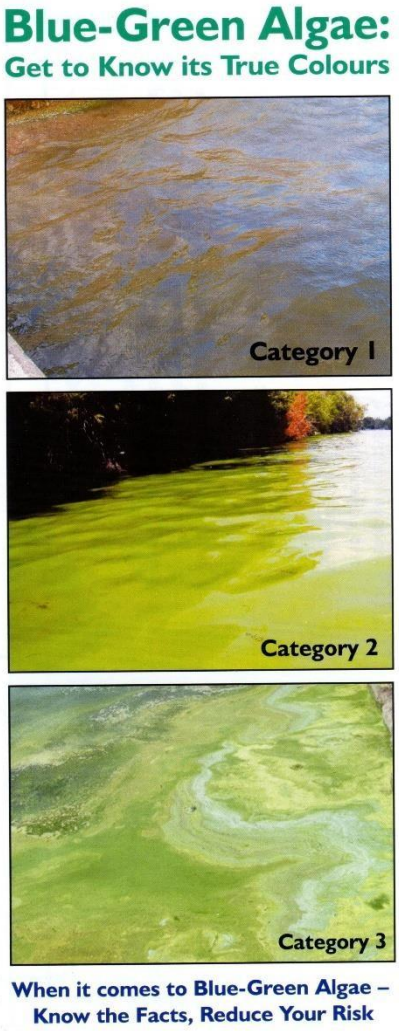
White Lake Algal Blooms 2014

In September of 2014, White Lake experienced a significant blue-green algal bloom. The extent of the bloom covered the entire lake with the exception of parts of Sunset Bay. Samples were taken of this algal bloom by a representative of the Ministry of the Environment and Climate Change and analyzed for toxins. The analysis for microcystin toxin in this sample found a concentration level of 39.46ppb (nanograms per millilitre). This concentration far exceeds the Ontario Drinking Water Quality Standards limit of 1.5ppb. Below are photos of the bloom taken during an overflight of the lake by airplane.

Photo micrograph of Anabaena blue-green algae

White Lake Algal Blooms 2013

On September 28, 2013 was recorded the first verified blue-green algae bloom on White Lake. The event was not localized to a small portion of the lake. The extent of the bloom was verified by boat and by float plane. The algal bloom covered most of the surface of White Lake and lasted over a week. Its appearance changed depending on weather conditions, location and water depth. Samples were taken by Environment Volunteers and by an Environmental Officer from the Ontario Ministry of the Environment. The sample collected at the height of the algal bloom was (by MNRCC Technicians), was found to contain Anabaena blue-green algae (confirming what we determined by field microscopy). This is a potentially toxin-producing blue-green algae known to produce microcystins and anatoxins, compounds poisonous to humans. However, analytical results were negative or below the detection limit for these toxins. When comparing photos of our algal bloom with those published in the literature, it was clear that the bloom we observed was a category 2 bloom. It is recommended that during a category 2 bloom that water from the lake not be used for drinking or swimming.



Algal Bloom, Western Shore White Lake: Sept., 2013