Algal Blooms – 2021

This year three 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 taxa in different parts of the lake. The first blue-green bloom was recorded on September 16 and the second 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"[1]

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

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 large patches along the shoreline. Nutrients, such as phosphorus, supporting this alga comes from sediments, and shoreline runoff where shorelines are disturbed, as well as 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 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

[1] 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.

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.

In addition to the blooms near altered shorelines, 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.

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.

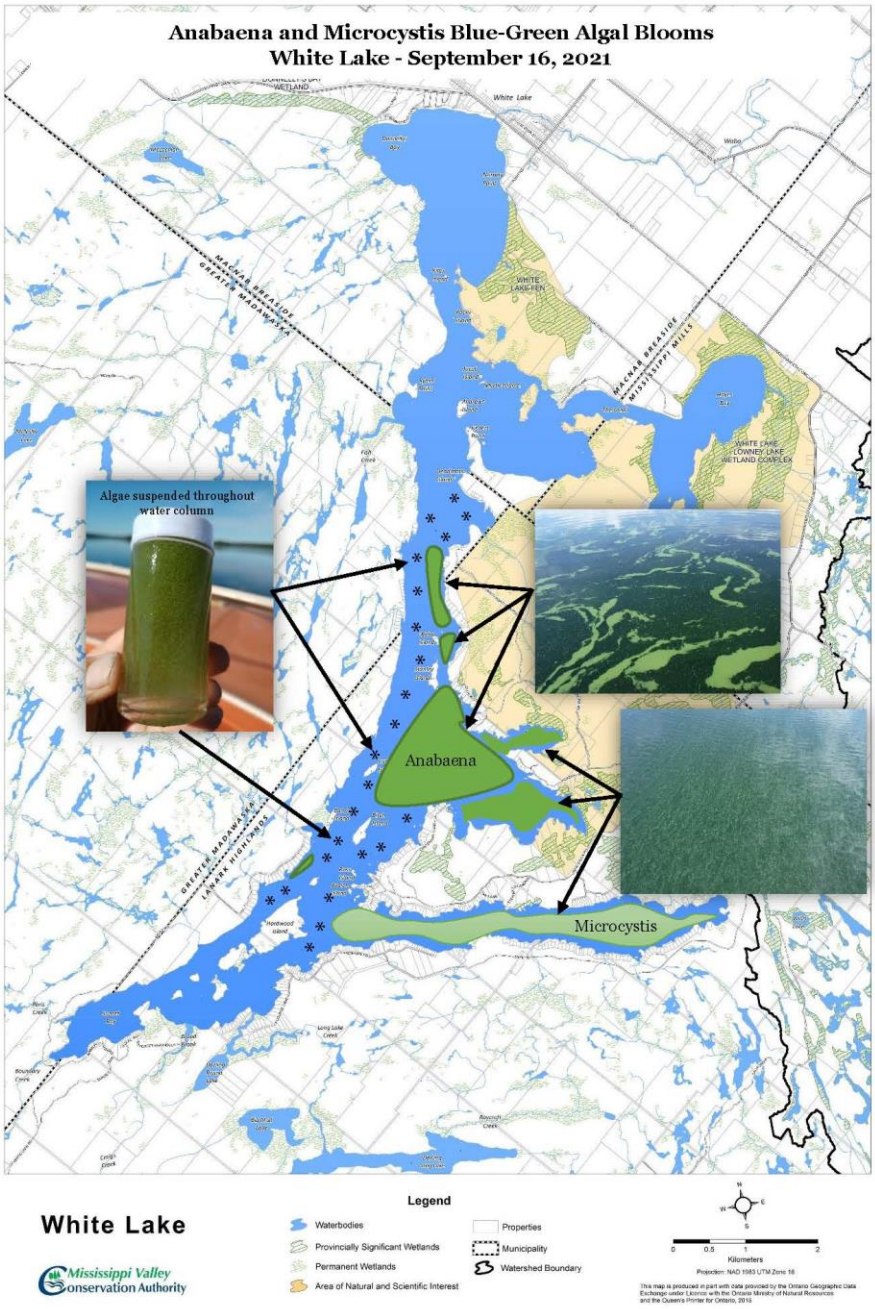
This year, White Lake hosted two different blue-green algal blooms. Each of these blooms simultaneously occurred twice; the first on September 16, and the second on October 8, 2021. The two types of algal blooms were: anabaena (now called Dolichospermum), and microcystis. The anabaena bloom occurred in the main body of the lake (deepest water), Pickerel Bay and areas along the Eastern shoreline going North. 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. 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.

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. 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.

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 above 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 remerged 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. 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 heavily populated and used parts 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 sampling was done. 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 each bloom, whether tested or not, 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 is a photo of a wind-driven accumulation of dying or dead ababaena blue-green algae. It is during this phase of the life of blue-green algal that high concentrations of microcystin toxins can be released into the water column.