Algae Monitoring Program

2024 Final Report

JULY 2025

Muskoka Watershed Council

ALGAE SUB-COMMITTEE

Executive Summary

Muskoka Watershed Council established the Algae Sub-committee in April 2017 to investigate the development of a citizen science algae monitoring program to build an understanding of algae and algal blooms in Muskoka. Recent confirmation of blue-green algal blooms in area lakes, and a growing impression among the public that algae are more abundant than they used to be, have contributed to a growing concern about the future impacts of algal blooms in Muskoka.

Algae are an essential component of lake ecosystems and should always be present, but without information on the occurrence of algae in our lakes, or on how abundances vary through the seasons, among years, or across lakes, mechanisms or management procedures to control lake algae cannot be devised. This program is a first step in building that needed information.

Modelled closely on the Cyanobacteria Monitoring Collaborative's (CMC) algae monitoring program, the Algae Sub-committee devised a pilot project that was undertaken on a limited number of lakes in Muskoka in 2019 and 2021. Following the successful conclusion of the pilot project, the MWC Algae Monitoring Program was opened to additional interested organizations. Sixteen organizations participated in the program and provided data in 2024.

The objectives of the Algae Monitoring Program are to:

- Expand phytoplankton monitoring to interested lake associations across Muskoka as an addition to their existing water quality efforts,
- Collaborate with selected lake associations on additional algal sampling to address specific issues of prevalence and/or causation of algal nuisance blooms,
- Develop information materials and presentations on algae for delivery to lake associations and others,
- Communicate these efforts to other lake associations across Muskoka, and
- Evaluate the program in 2026 to consider updating or expanding it in future years.

This report presents the data collected and analysed in 2024. Within a year, it is now apparent that a simple relationship between risk of a bloom and algal abundance, as measured by pigment fluorescence in frozen water samples, will not exist. Our 16 lakes differ in average levels of phycocyanin fluorescence through the late summer and fall suggesting they carry different average abundances of blue-green algae. But, as in previous years, the three lakes with confirmed blue-green algae blooms in 2024 did not show similar patterns of average fluorescence, nor of trends through the season leading up to and through the time of the bloom.

This year, we have examined the pattern in phycocyanin abundance (an index of blue-green algae abundance) across years for the five lakes for which we have most data. The analysis is limited by early termination of sampling in a couple of the lakes, but lakes do show some internal consistency in pattern of seasonal variation in phycocyanin fluorescence. The consistent difference among lakes in level of fluorescence is also notable.

Blue-green algal bloom occurrence seems likely to be determined by a number of factors specific to a lake, the time of year, and the weather at that lake. Abundance of blue-green algae in the weeks prior to a bloom is just one factor. Further years' data should help clarify these results. No blooms of other types of algae were reported, and levels of chlorophyll *a* fluorescence were more consistent among lakes and through the sampling period than was the case for phycocyanin fluorescence. At present, we believe the fluorescence data for chlorophyll *a* are going to be of limited use because the fluorometer being used is not sensitive enough to this pigment for the generally low levels of algal abundance in our lakes.

Acknowledgements

No citizen science monitoring program can exist without the citizen scientists. MWC would like to thank the many volunteers from the 16 Lake Associations that participated in 2024. These citizen scientists donated their time, their ideas, and their enthusiasm to collect, store, and analyse water samples and are helping MWC discover and solve issues related to the protocol and equipment. Without their efforts MWC would have learned nothing about algae over the years since 2019.

MWC would also like to thank all who have participated on the Algae Sub-committee. While it meets relatively infrequently now that the program is up and running, this group still provides valuable input on the annual reports and on any modifications made to the methods being used.

We are particularly grateful for the scientific expertise provided by Claire Holeton, Dr. Andrew Paterson and Dr. Jim Rusak, who assisted MWC in adapting the CMC protocol for use in Muskoka area lakes and provided ongoing guidance.

Contents

Introduction

The phytoplankton, or mid-water algae, are a diverse group of microscopic, single-celled or colonial, photosynthesizing organisms that are found at the base of every lake food web. Through photosynthesis, they use solar energy, carbon dioxide and water to build organic molecules that allow for their own growth and provide food to zooplankton, and ultimately to fish and other animals. In the process of photosynthesis, they generate significant amounts of oxygen that is released to the atmosphere. Every second breath you take provides you with oxygen originally placed into the atmosphere by phytoplankton in lakes and oceans.

Unfortunately, on occasion, conditions can be particularly favorable for algal growth and reproduction. At these times, algal populations can become quite large, resulting in a visible scum on the lake surface. These algal blooms can develop over just a few days and can disappear just as fast as algal cells die and decompose. Severe blooms can deplete a lake of oxygen when decomposing, leading to fish kills and other serious disruptions to the lake ecosystem. They can also prove noxious, in appearance as well as odor, degrading our enjoyment of our lakes. In rare instances, the bloom-causing species produce toxins that can cause serious health risks to people and animals drinking or bathing in the water.

The identification of phytoplankton is a demanding, specialized task, as is the task of determining phytoplankton abundance by counting cells in water samples. Fortunately, photosynthesis requires specific pigments that also happen to be fluorescent molecules. By measuring absorbance due to fluorescence at a given wavelength, it is possible to quantify the amount of a specific pigment in a water sample. This value is a reliable index of the abundance in the sample of phytoplankton containing that pigment.

The pigment, chlorophyll *a*, is present in the cells of all algae that occur in Muskoka area lakes; the pigment, phycocyanin, is present in all cells of cyanobacteria or blue-green algae. By quantifying fluorescence of chlorophyll *a* in a water sample, it should be possible to provide an index of the amount of all phytoplankton species combined (including blue-green algae). Similarly, by quantifying fluorescence of phycocyanin, it should be possible to provide an index for the amount of blue-green algal species present in that water sample. This is the approach being used in this program.

Objectives

Muskoka Watershed Council initiated this program to gain a greater understanding of algae by harnessing the efforts of volunteers to collect data on the distribution, abundance and seasonal cycles of phytoplankton across Muskoka area lakes so that, over time, it may be possible to identify conditions favoring algal blooms, detect trends in phytoplankton abundance, and provide management advice. Monitoring at species level, tracking the abundance of individual species of algae, while ideal, is well beyond the capacity of a routine, citizen-led monitoring program. During the open water season, the overall abundance of phytoplankton will sometimes be made up predominantly of certain algal species while at other times the abundance will be predominantly of different algal species. Tracking abundance of individual species would require microscopic counting and identification of algal cells in water samples. Instead, this program aims to monitor all algae combined, and all blue-green algae combined, using fluorometric techniques.

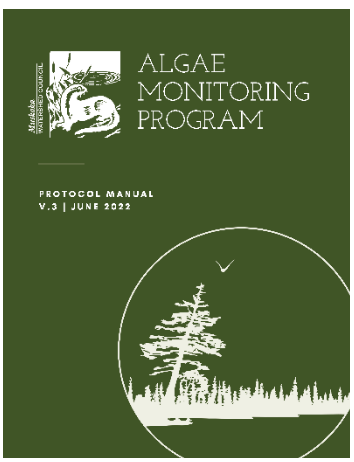
Following the successful completion of a pilot project in 2019 and 2021, the MWC Algae Monitoring Program was opened to interested organizations. The objectives of the program are to:

- Expand phytoplankton monitoring to interested lake associations across Muskoka as an addition to their existing water quality efforts,
- Collaborate with selected lake associations on additional algal sampling to address specific issues of prevalence and/or causation of algal nuisance blooms,
- Develop information materials and presentations on algae for delivery to lake associations and others,
- Communicate these efforts to other lake associations across Muskoka, and
- Evaluate the program in 2026 to consider updating or expanding it in future years.

Background

The MWC Algae Monitoring Program is being undertaken in recognition of the growing concern across Muskoka regarding potentially toxic algal blooms on our lakes. While blooms remain rare in Muskoka, and toxic blooms even rarer, this concern is understandable given the potential for serious health risks, and more generally the aesthetic and environmental consequences of algal blooms. As well, climate change seems likely to exacerbate problem algal blooms across Muskoka. At present, there is only limited information on algae in our lakes, yet it seems possible that the army of dedicated citizen scientists who currently monitor water quality across Muskoka could make a significant contribution towards building a richer database concerning local algal populations.

In designing the sampling program, we relied extensively on the experience of a group operating across the New England states to track the incidence of blue-green algal blooms. With leadership provided by the University of New Hampshire and the U.S. Environmental Protection Agency and drawing upon a 30+ year history leading citizen science monitoring of lake water quality, the 'Cyanobacteria Monitoring Collaborative' (CMC) provides a web-based program to aid citizen groups exploring blue-green algae.



While the CMC protocol formed the basis of MWC's procedures for collecting algae samples, on the advice of the scientists on MWC's Algae Sub-committee, some modifications were made to consider the different environmental conditions present in Muskoka.

The MWC Algae Monitoring Program Monitoring Protocol Manual (v3) (https://www.dropbox.com/s/h6ssb1r4ohzujm8/AlgaeMonitoringProgram-Manual_v.3-June2022.pdf?dl=0) contains detailed instructions on the collection and analysis of algae samples for both offshore and nearshore samples.

Results

The data collected during the 2024 sampling season are available in Figures 1-6, and the 16 tables in Appendix 1. The fluorometer (FluoroQuik™ Phycocyanin & Chlorophyll-a Dual-Channel Fluorometer (FQD-PC-CHL/IV-RATIO-C)) outputs data as phycocyanin (PC), chlorophyll *a* (CHL), and the ratio PC:CHL. This ratio has been found useful by lake biologists because it emphasizes changes in the relative proportions of blue-green algae to other algae and can indicate when algae with phycocyanin are dominating the community. Fluorescence results should be considered as indices of abundance rather than actual abundances of the algae.

All analyses of the fluorescence data have used the means of three subsamples taken from each of the frozen, stored and then thawed, water samples as the best estimate of fluorescence of that water sample. These means are the values reported in Appendix 1.

In 2024, triplicate sampling took place in most lakes on a sampling date between 27 July and 16 August. By collecting three successive samples of water from the lake and analysing them separately, three estimates of the phycocyanin and chlorophyll a fluorescence are obtained. These estimates permit determining the precision/accuracy of the field and lab protocol for that lake. Triplicate sampling was done successfully on 13 lakes. On a 14th lake, duplicate samples were taken, giving a weaker estimate of variability.

Analysis of these data showed considerable differences in precision among lakes with results from some lakes being far more precise than others. If precision of estimated phycocyanin values is expressed in terms of the 95% confidence limit (CL95 – the amount greater or less than an estimate within which the true value will fall 95% of the time) the triplicate data revealed 95% confidence limits that were anywhere from 1% to as much as 80% of the measured value – that is, the true value could be as much as 80% above or below the measured value. Those are extreme cases, but for nearshore samples, confidence limits for phycocyanin were greater than 10% of the estimated fluorescence on 10 of 14 lakes, while confidence limits for phycocyanin in offshore samples were greater than 10% of the estimated fluorescence on six lakes. The confidence limits (CL95) for phycocyanin and chlorophyll *a* are reported in the captions to Appendix Tables 1-16.

Trends in Algal Abundances Through the Season

Figures 1-6 present graphs of phycocyanin fluorescence (Figs. 1-3) and chlorophyll *a* fluorescence (Figs. 4-6) for the 16 lakes sampled in 2024. Notice in viewing Figures 1-3 that the phycocyanin fluorescence values vary greatly among lakes (the vertical axes on the individual plots are very different) and sampling has extended over different time periods (horizontal axes also differ). The average levels of fluorescence and the details of the trend through time vary among lakes. In Figures 4-6, differences among lakes in chlorophyll *a* fluorescence are less pronounced. Using a standard vertical axis for all figures would have made it difficult to show the fluctuations through time for many lakes, especially for chlorophyll *a*.

The fluorescence recorded and plotted in Figures 1-6 is not a direct measure of the number of algal cells in the water. Across all lakes, fluorescence values for phycocyanin are much greater than fluorescence values for chlorophyll *a*, but that does not mean that blue-green algae were more abundant than algae of other types. Fluorescence of a pigment such as phycocyanin or chlorophyll *a* depends on the wavelength of light used to stimulate it. The fluorometer being used in this project is designed specifically for the field detection of blue-green algal blooms. It uses a single wavelength of light for chlorophyll *a*, and another single wavelength for phycocyanin. The wavelength used for phycocyanin produces high levels of fluorescence when phycocyanin is present in the sample; the wavelength used for chlorophyll *a* produces somewhat lower levels of fluorescence for typical abundances of chlorophyll *a* in our lakes. With these caveats, let's look at Figures 1-6.

Blue-Green Algae

Fluorescence of phycocyanin is an index of the abundance of blue-green algae in a water sample. Figures 1-3 show that phycocyanin fluorescence levels vary, often markedly, through the sampling period for all lakes. Blue-green algae are present at every sample date, but their abundances vary seasonally in every lake.

The seasonal trends from lake to lake are not the same. In most lakes, offshore and nearshore sites show similar seasonal patterns, while in a few (i.e. Fairy, Ril) they differ. In some lakes (i.e. Mary), blue-green algae appear to have peak abundance early in the season. In others (i.e. Muldrew, Three Mile), blue-green algae appear to have become more abundant towards the end of the sampling period. In others (i.e. Six Mile, Stewart, Vernon), there is no obvious increasing or decreasing trend in blue-green algal fluorescence. In addition, as already noted, there are big differences among lakes in the levels of fluorescence – blue-green algae appear to be more abundant in some lakes than others.

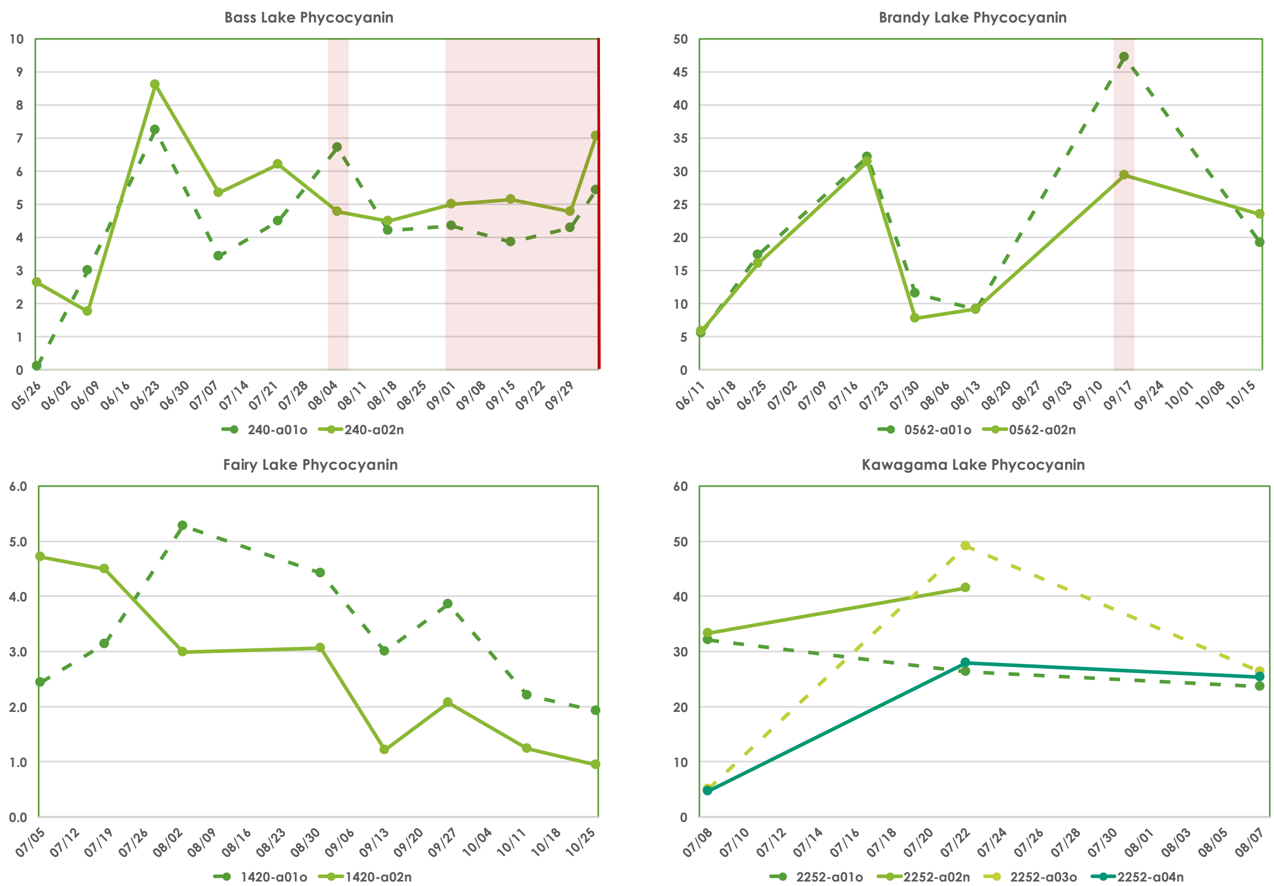


Figure 1: *Plots showing the level of phycocyanin fluorescence at offshore and nearshore sites for each sampling date on each of Bass Lake, Brandy Lake, Fairy Lake and Kawagama Lake. Offshore sites have ID codes ending in* ***o****; nearshore sites have ID codes ending in* ***n****. In some lakes more than one* ***o*** *or* ***n*** *site were sampled. Note that the axes on the individual plots are scaled differently – these lakes differ substantially in their average levels of phycocyanin fluorescence and have been sampled over different periods. Level of fluorescence is an index of blue-green algal abundance, not a direct measure of algal cell abundance in the sample. Data plotted are in Appendix 1, Tables A1 to A4. The plots for Bass Lake and Brandy Lake include a background tint showing the period commencing with the sighting of a bloom. The presence of the background tint does not mean a bloom was visible during that entire period (see text for details). The red line is the date SMDHU posted an advisory confirming a cyanobacterial bloom.*

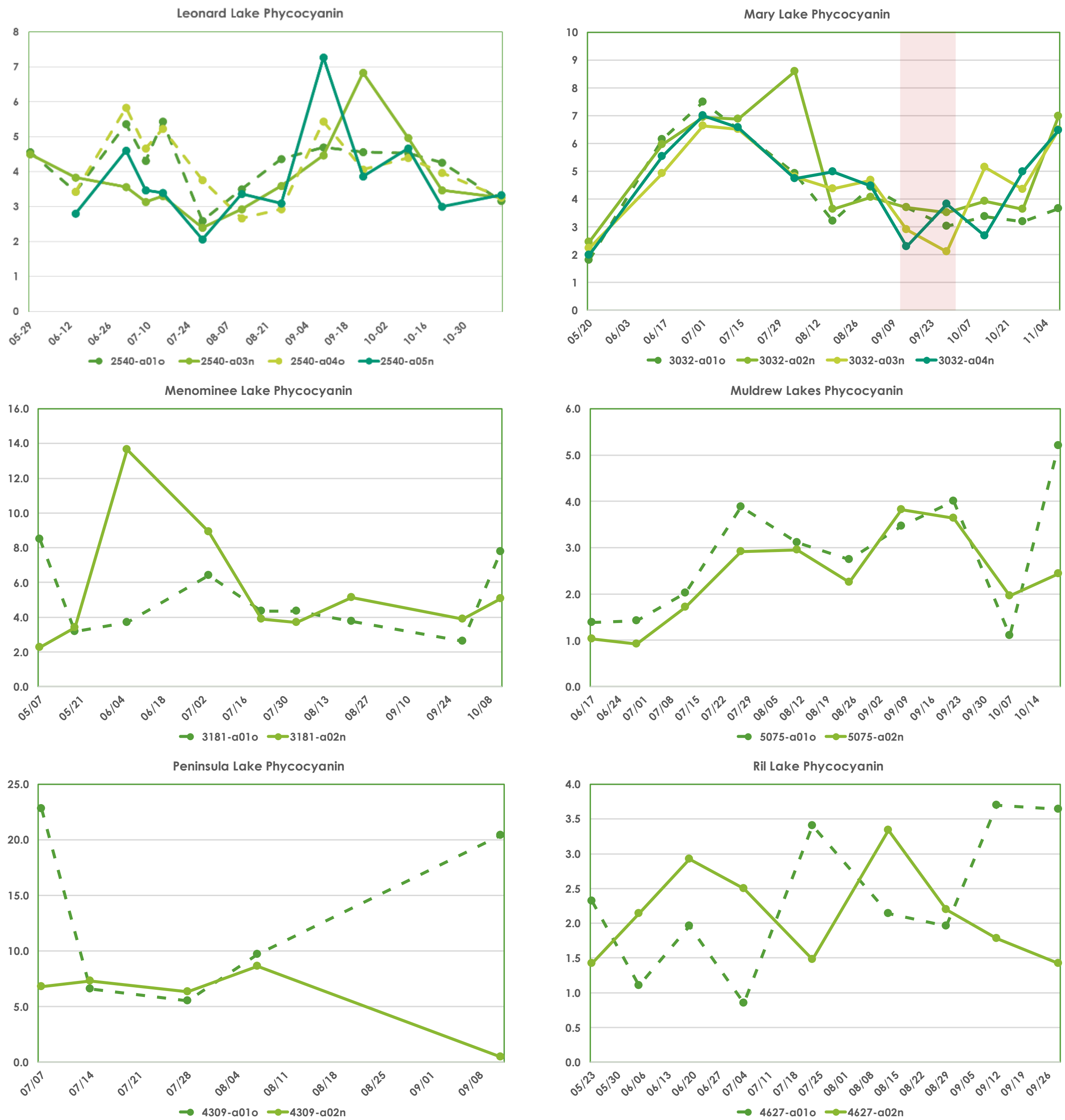


Figure 2: *Plots showing the level of phycocyanin fluorescence at offshore and nearshore sites for each sampling date on each of. Leonard Lake, Mary Lake, Menominee Lake, Muldrew Lakes, Peninsula Lake and Ril Lake. Offshore sites have ID codes ending in* ***o****; nearshore sites have ID codes ending in* ***n****. Note that the axes on the individual plots are scaled differently – these lakes differ substantially in their average levels of phycocyanin fluorescence and have been sampled over different periods. Level of fluorescence is an index of blue-green algal abundance, not a direct measure of algal cell abundance in the sample. Data plotted are in Appendix 1, Tables A5 to A10. The plot for Mary Lake includes a background tint showing the period commencing with the sighting of a bloom. The presence of the background tint does not mean a bloom was visible during that entire period (see text for details).*

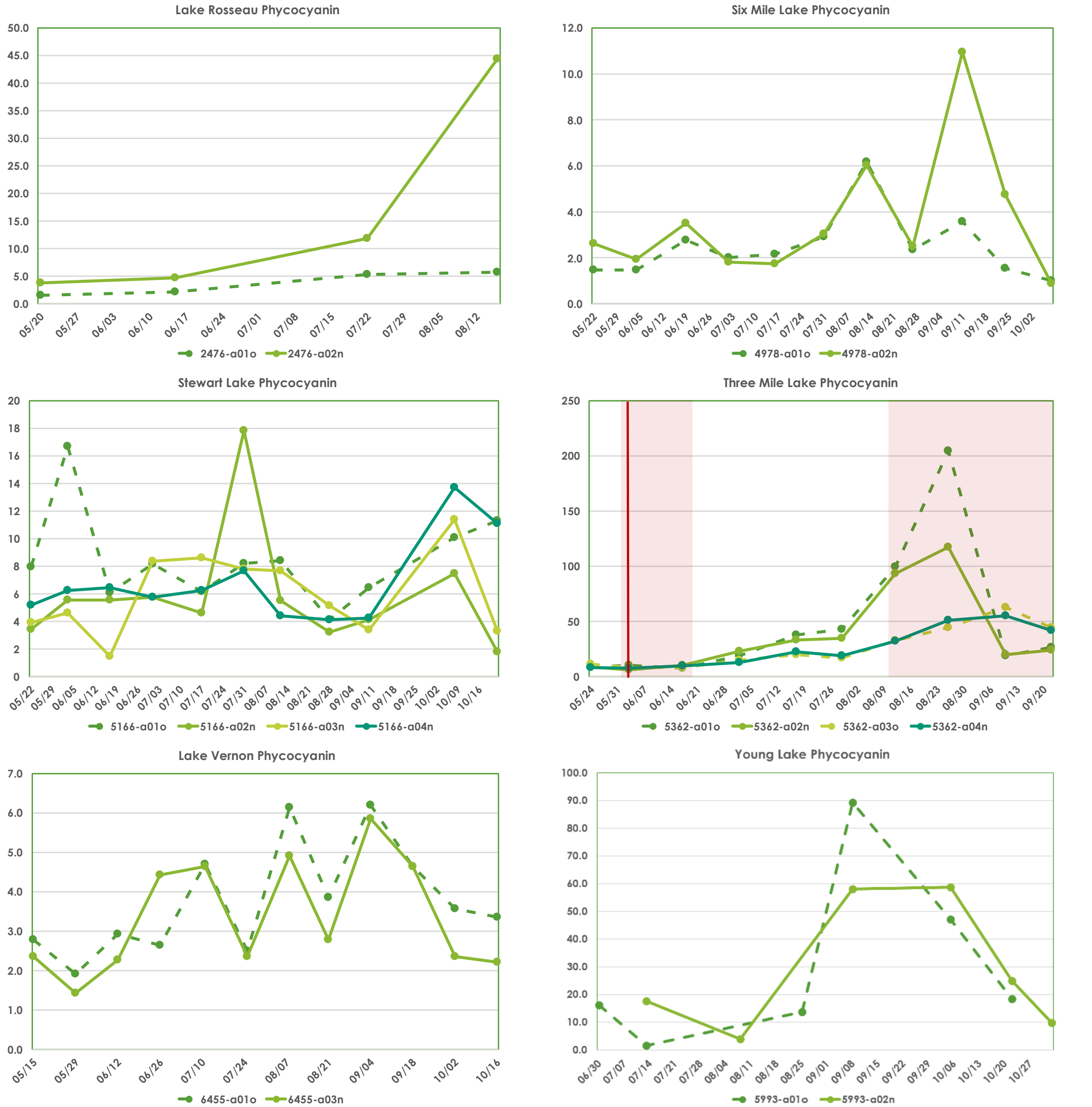


Figure 3: *Plots showing the level of phycocyanin fluorescence at offshore and nearshore sites for each sampling date on each of Lake Rosseau, Six Mile Lake, Stewart Lake, Three Mile Lake, Lake Vernon and Young Lake. Offshore sites have ID codes ending in* ***o****; nearshore sites have ID codes ending in* ***n****. In some lakes more than one* ***o*** *or* ***n*** *site were sampled. Note that the axes on the individual plots are scaled differently – these lakes differ substantially in their average levels of phycocyanin fluorescence and have been sampled over different periods. Level of fluorescence is an index of blue-green algal abundance, not a direct measure of algal cell abundance in the sample. Data plotted are in Appendix 1, Tables A11 to A16. The plot for Three Mile Lake includes a background tint showing the period commencing with the sighting of a bloom. The presence of the background tint does not mean a bloom was visible during that entire period (see text for details). The red line is the date SMDHU posted an advisory confirming a cyanobacterial bloom. The bloom was not resolved before the end of the sampling period.*

All Algae

Chlorophyll *a* fluorescence is an index of total algal abundance including blue-green algae. Figures 4-6 summarize fluorescence values for all 16 sampled lakes through the sampling period. In contrast to the results for phycocyanin, chlorophyll *a* fluorescence shows little or perhaps a slight downward trend through the sampling season on all lakes. Temporal variation was seldom above 50%, usually much less. In addition, there is much more consistency among lakes in fluorescence levels for chlorophyll *a*. Most lakes show fluorescence of less than 1.0, with Brandy Lake and Bass Lake maxing out at 2.8 and no other lakes exceeding 1.8.

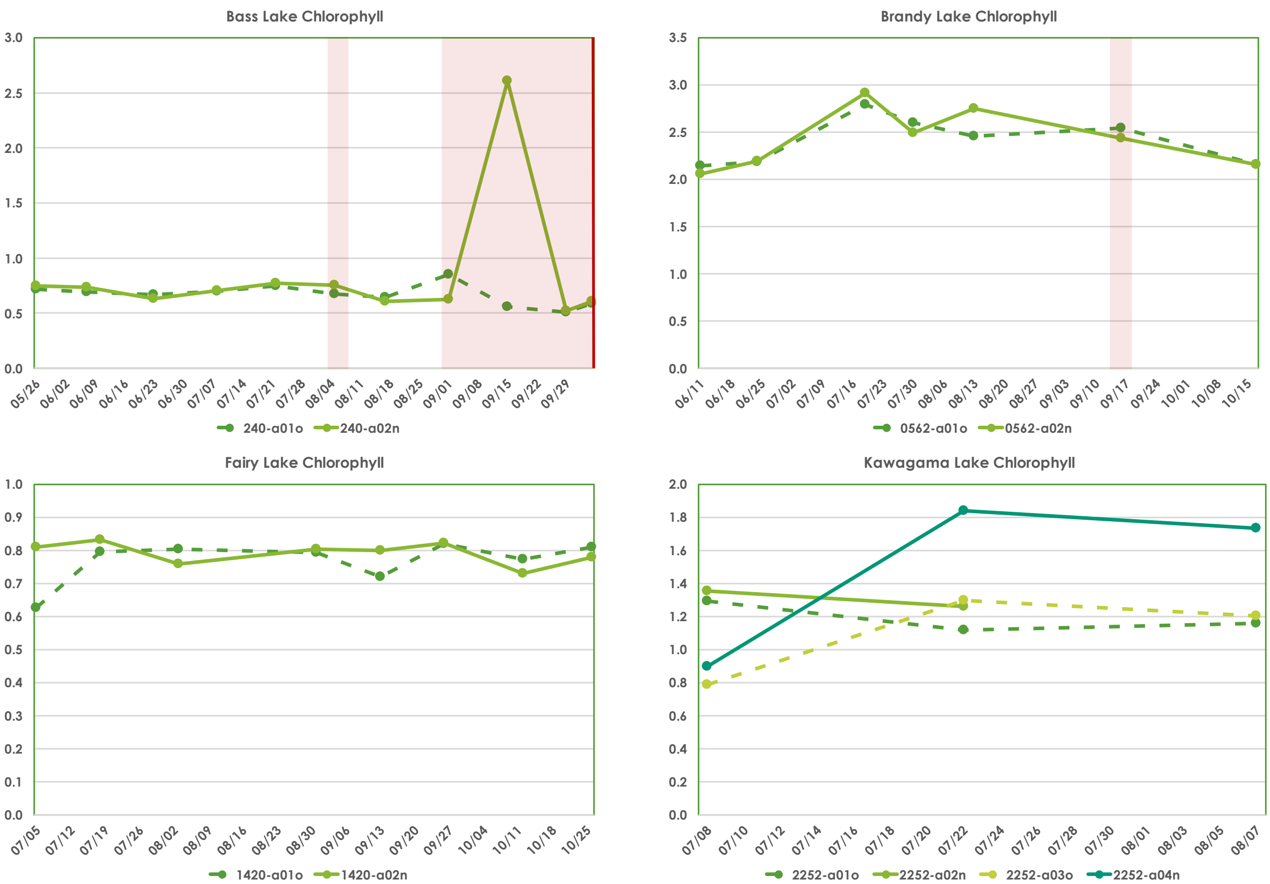


Figure 4: *Plots showing the level of chlorophyll a fluorescence at offshore and nearshore sites for each sampling date on each of Bass Lake, Brandy Lake, Fairy Lake and Kawagama Lake. Offshore sites have ID codes ending in **o**; nearshore sites have ID codes ending in **n**. In some lakes more than one **o** or **n** site were sampled. Note that the axes on the individual plots are scaled differently – these lakes differ substantially in their average levels of chlorophyll a fluorescence and have been sampled over different periods. Level of fluorescence is an index of algal abundance, not a direct measure of algal cell abundance in the sample. Data plotted are in Appendix 1, Tables A1 to A4. The plots for Bass Lake and Brandy Lake include a background tint showing the period commencing with the sighting of a bloom. The presence of the background tint does not mean a bloom was visible during that entire period (see text for details). The red line is the date SMDHU posted an advisory confirming a cyanobacterial bloom.*

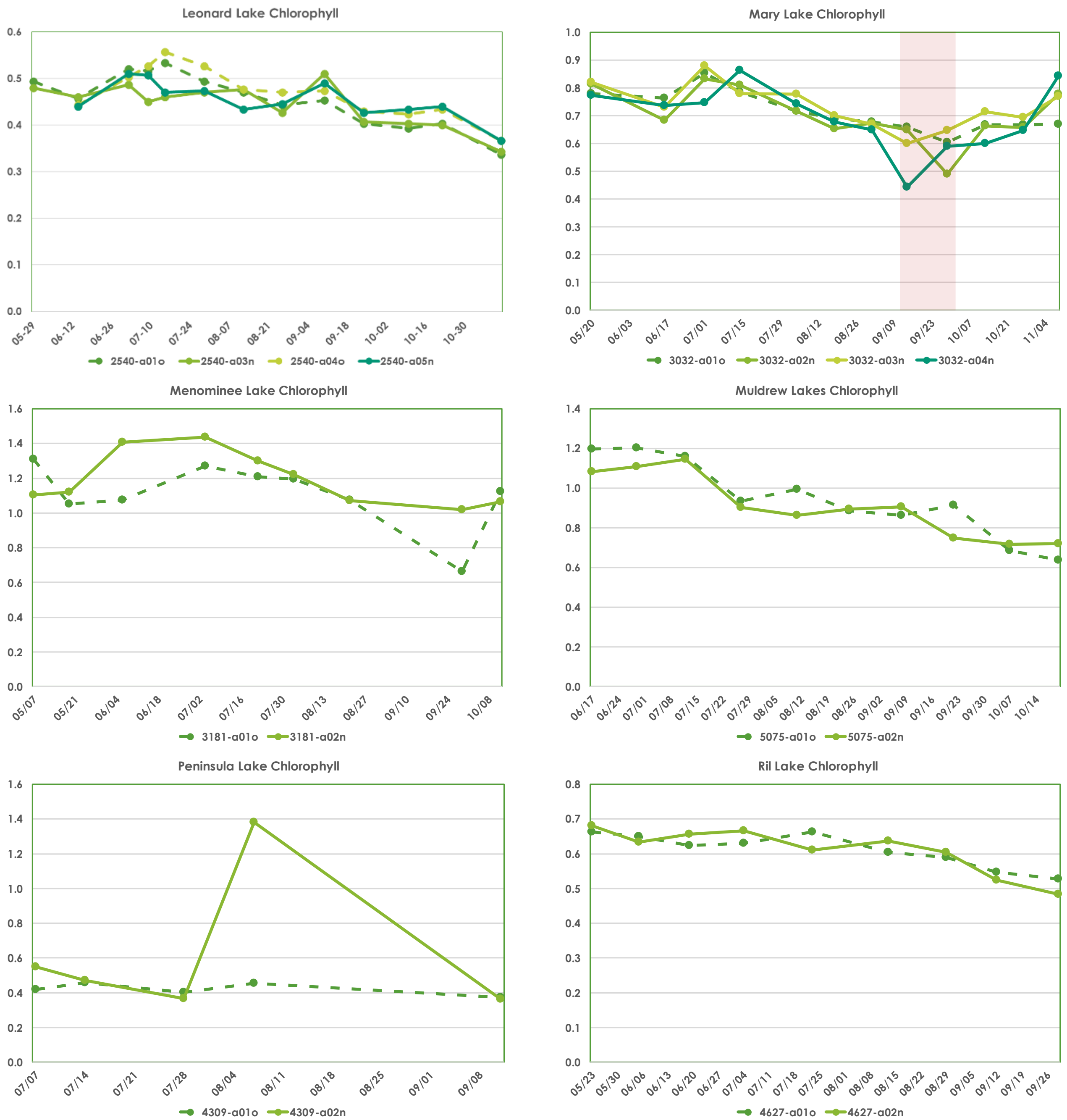


Figure 5: *Plots showing the level of chlorophyll a fluorescence at offshore and nearshore sites for each sampling date on each of Leonard Lake, Mary Lake, Menominee Lake, Muldrew Lakes, Peninsula Lake and Ril Lake. Offshore sites have ID codes ending in* ***o****; nearshore sites have ID codes ending in* ***n****. Note that the axes on the individual plots are scaled differently – these lakes differ substantially in their average levels of chlorophyll a fluorescence and have been sampled over different periods. Level of fluorescence is an index of algal abundance, not a direct measure of algal cell abundance in the sample. Data plotted are in Appendix 1, Tables A5 to A10. The plot for Mary Lake includes a background tint showing the period commencing with the sighting of a bloom. The presence of the background tint does not mean a bloom was visible during that entire period (see text for details).*

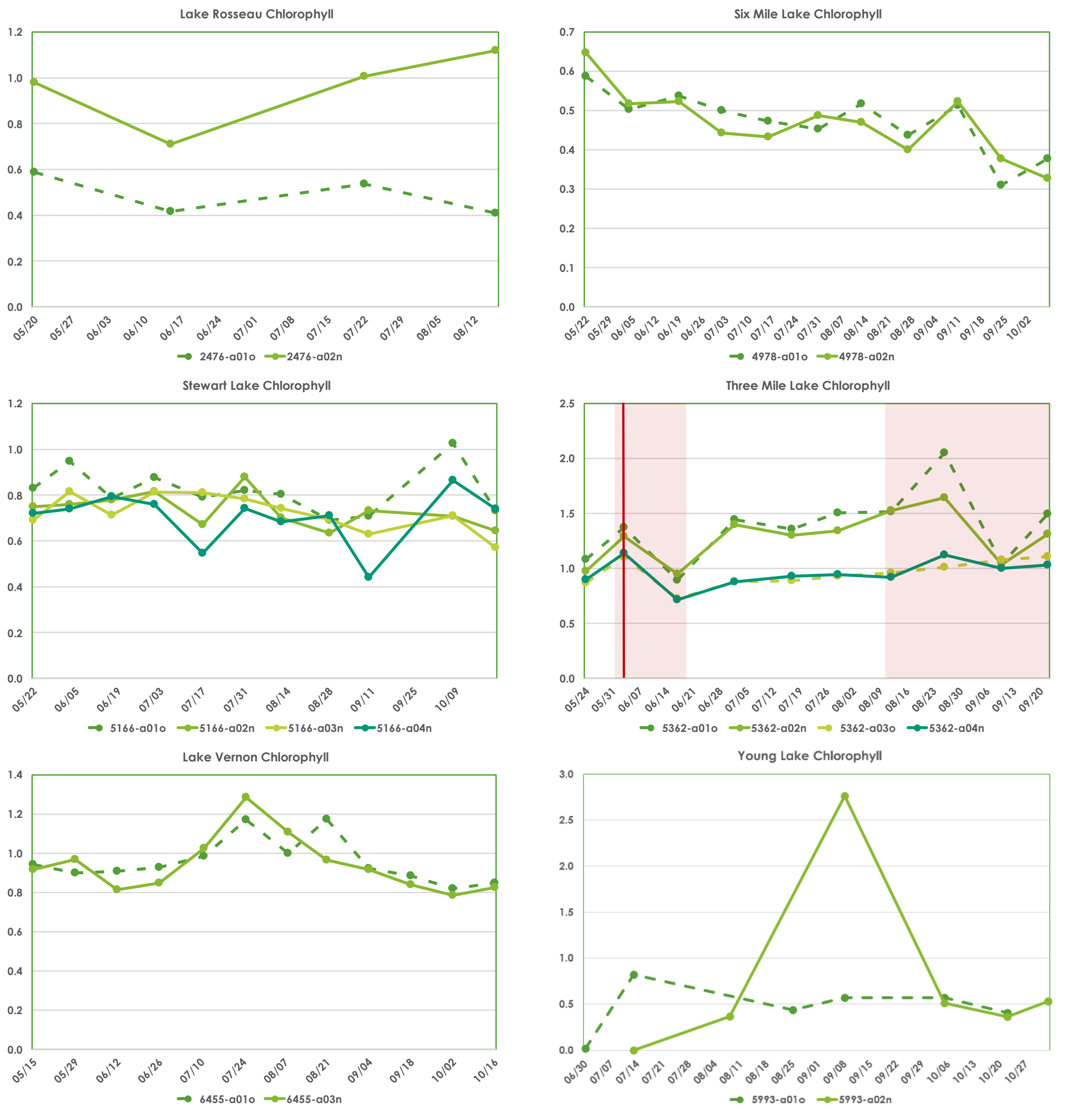


Figure 6: *Plots showing the level of chlorophyll a fluorescence at offshore and nearshore sites for each sampling date on each of Lake Rosseau, Six Mile Lake, Stewart Lake, Three Mile Lake, Lake Vernon and Young Lake. Offshore sites have ID codes ending in **o**; nearshore sites have ID codes ending in **n**. In some lakes more than one **o** or **n** site were sampled. Note that the axes on the individual plots are scaled differently – these lakes differ substantially in their average levels of chlorophyll a fluorescence and have been sampled over different periods. Level of fluorescence is an index of algal abundance, not a direct measure of algal cell abundance in the sample. Data plotted are in Appendix 1, Tables A11 to A16. The plot for Three Mile Lake includes a background tint showing the period commencing with the sighting of a bloom. The presence of the background tint does not mean a bloom was visible during that entire period (see text for details). The red line is the date SMDHU posted an advisory confirming a cyanobacterial bloom. The bloom was not resolved before the end of the sampling period.*

These data suggest that total algal abundance does not vary much through the season, nor very greatly from lake to lake. What does vary is the relative proportion of blue-green algae to other types of algae. Blue-green algae are proportionately much more abundant in some lakes at some times than at others.

Chlorophyll *a* fluorescence levels in previous years for the lakes sampled also revealed little evidence of any trend through the sampling period in each year, and the level of fluorescence was again mostly around 1.0.

Summary on Seasonal Trends in Fluorescence Results

It is too early to draw any firm conclusions concerning the temporal trends, average levels, or differences among lakes or years in the fluorescence data.

The results obtained since inception of this program, however, do suggest that a simplistic notion that algal abundances through the season might be used to infer whether a lake is likely to experience a blue-green algal bloom is unlikely to be confirmed. Once again this year, algal populations experienced different patterns of change in abundance from lake to lake but results so far do not suggest it will be easy to identify lakes prone to algal blooms. It seems likely that it would be necessary to monitor other factors – local weather, water chemistry, or other factors – to identify conditions promoting a bloom. The possibility remains that this may not be possible because the rate at which algal populations can grow under favorable conditions may mean that triggering conditions need be present for only a short period prior to a bloom becoming evident.

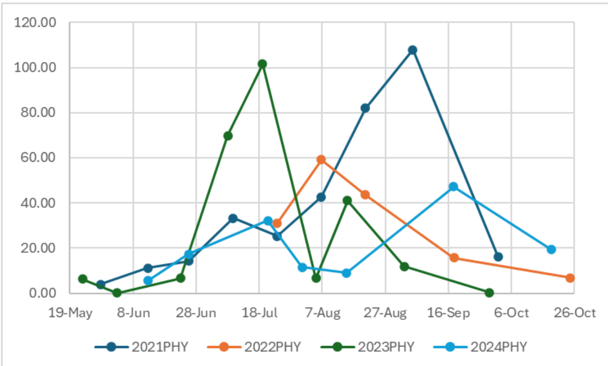
Variation Across Years for Blue-green Algae Abundance in Five Lakes

Lake Association volunteers at Leonard Lake, Peninsula Lake, Lake Rosseau and Three Mile Lake have sampled algal abundance starting in 2019, and those at Brandy Lake commenced in 2021. For these five lakes we now have data sufficient for a preliminary assessment of whether patterns in apparent abundance through the sampling period is similar from year to year.

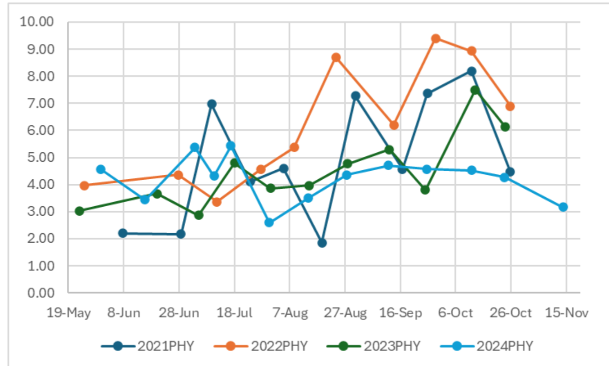
Phycocyanin fluorescence for the open water sampling site in each of these five lakes are plotted through the sampling season for each of 2021 through 2024 in Figure 7.

Brandy Lake showed excursions to high values of fluorescence in 2021 (early September) and 2023 (mid July) but otherwise revealed only a slight increase through the season each year. Leonard Lake showed lower levels of fluorescence overall and a general slight increase through the season. Three Mile Lake showed generally flat and similar levels through each year except for large increases associated with blooms in 2022 (September), 2023 (October), and 2024 (August). Otherwise, fluorescence levels in Three Mile Lake are comparable to those in Brandy Lake while fluorescence in the other three lakes is somewhat lower. Data for Peninsula Lake and Lake Rosseau are less coherent across years. Both show higher fluorescence in 2022 than in other years (but quite different levels to each other). Fluorescence levels were quite low through 2021 and 2023 in Peninsula Lake, and through 2021 and 2024 in Lake Rosseau.

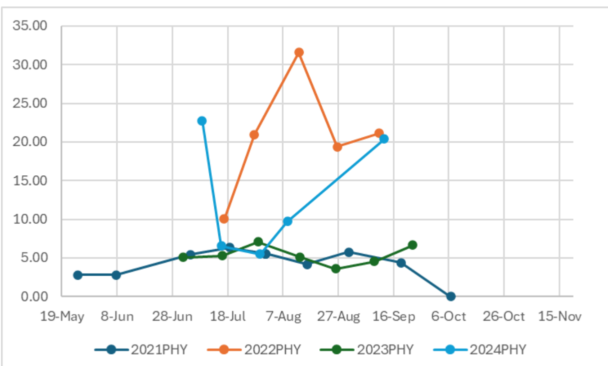
Brandy Lake



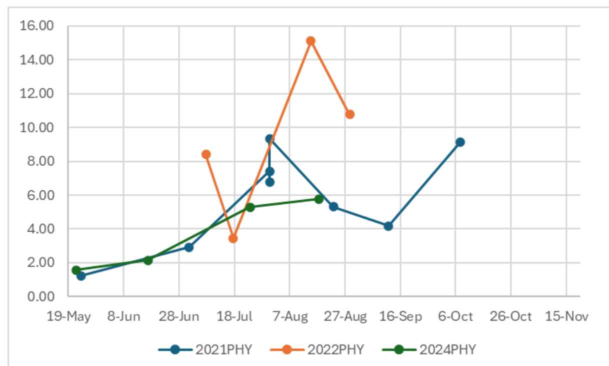
Leonard Lake



Peninsula Lake



Lake Rosseau



Three Mile Lake

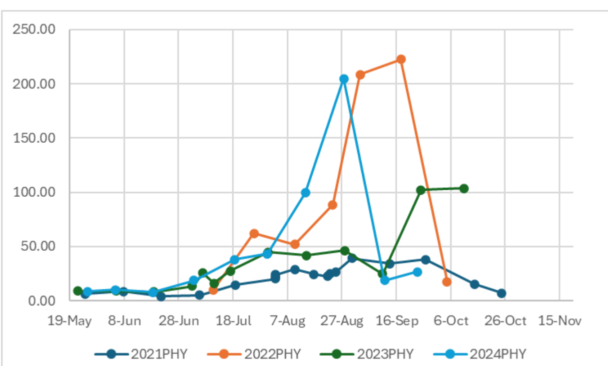


Figure 7: *Plots showing variation in Phycocyanin fluorescence through the sampling season for each of 2021 through 2024 for five lakes. Note that vertical axes differ markedly among plots with fluorescence showing marked excursions in Brandy Lake and Three Mile Lake. Data were not obtained successfully in Lake Rosseau in 2023.*

Recorded and Confirmed Blooms in 2024

In 2024, program participants on four lakes recorded visible blooms on the Algae Field Sheet (Brandy, Bass, Mary and Three Mile). Six lakes reported suspected blooms to the Ministry of the Environment, Conservation and Parks (MECP), with two of these confirmed as blooms (Bass and Three Mile). Typically the Simcoe Muskoka District Health Unit posts bloom advisories on their website at https://www.simcoemuskokahealth.org/Topics/SafeWater/bluegreenalgae_copy1.aspx, however the confirmed bloom for Bass Lake was not included.

Lake	Recorded Visible Bloom on the Field Sheet	Suspected Bloom Reported to MECP	Bloom Confirmed by MECP	Advisory Issued by SMDHU	Advisory Resolved
Bass	05-Aug	02-Aug	No		
Bass	01-Sep	31-Aug	No		
Bass	15-Sep	07-Oct	Yes	24-Oct	Unknown
Bass	05-Oct				
Brandy	16-Sep				
Mary	14-Sep	14-Sep	No		
Mary	29-Sep	16-Sep	No		
Peninsula	No	14-Sep	No		
South Muldrew	No	15-Sep	No		
Three Mile	03-Jun	03-Jun	Yes	10-Jun	10-Jun-2025
Three Mile	17-Jun				
Three Mile	12-Aug				
Three Mile	26-Aug				
Three Mile	10-Sep				
Three Mile	22-Sep				
Young	No	09-Sep	No		

When a member of the public suspects an algal bloom, the following steps are usually taken:

1. The bloom is reported to the MECP for testing and confirmation (https://www.ontario.ca/page/report-pollution-and-spills). An inspector from the Barrie MECP office is dispatched to the site within a couple of days to collect a sample.
2. If microscopic analysis of the sample reveals species of blue-green algae to be present and if algal density is such to constitute a bloom, the Simcoe Muskoka District Health Unit (SMDHU) issues a public advisory warning of a blue-green algae bloom for the lake and the sample is further analyzed for toxicity.
3. Regardless of whether toxicity is detected, the bloom status remains in place until later in the season when SMDHU declares the bloom resolved following additional sampling from the MECP.

There are inevitable delays in these inspection/evaluation procedures. The initial sighting of an apparent bloom precedes the public notice of a toxic bloom by 2-3 days, sometimes more, and the announcement by SMDHU that the bloom has been resolved often comes weeks or months after any visible evidence of algae has disappeared. This situation becomes more problematic if a lake is exhibiting transient blooms.

Discussion and Conclusions

Effectiveness of the Procedures Followed

All 16 lake associations enrolled in the program were able to submit data in 2024, however some collection dates were more irregular than others and ended in August instead of going further into the fall. In addition, some analysis data were discarded due to fluorometer errors.

As recommended in the 2023 Annual Report, for most lakes triplicate samples were collected and analyzed for each site at the beginning of August.

Final decisions on any changes to the protocol and program design will be made before our planned training refresher workshop in spring 2025. The protocol for analyzing samples will have some minor adjustments and the protocol for collecting triplicate samples will be added back in to the manual.

Patterns in Algae Abundance Through the Season and Across Lakes

With data available from 16 lakes this year, the impression gained in previous years that there would be substantial variation in pattern of fluctuations in abundance (as measured by fluorescence) was confirmed. We will need more years of data from these lakes to see if there are consistent patterns of either average abundance of blue-green algae or trend through time for individual lakes. That lakes differ substantially in abundance of blue-green algae through the season is interesting and raises questions about the factors responsible, but abundance through the season does not, at least with data now in hand, seem to predict the likelihood of a lake experiencing an algal bloom.

Blooms of algae other than blue-green algae, which tend to occur earlier in the summer months, have not yet been recorded on participating lakes. As well, the lower levels of fluorescence of chlorophyll *a* which the FluoroQuik™ instrument records, relative to the levels of fluorescence of phycocyanin, may make detection of trends in total algal abundance more difficult. Since the major concern around algal blooms is the risk of blue-green algal blooms, that is a minor problem for this program.

Lessons Learned and Plans for 2025

Any relationship between risk of blue-green algal blooms and patterns of abundance in lakes or through the season is not going to be simple. We will require additional years of data and a greater number of lakes in the program to build a dataset likely to permit the teasing out of such patterns.

The procedures and the sampling protocol, as well as the analytical methodology, appear to be amenable to being executed by volunteer citizen scientists with minimal in-season guidance. There is a need for an annual training/refresher workshop each spring to keep lake association volunteers up to date with the methodology and attending to the small but important details in applying the methods. There is also a need to stress to lake associations and directly to volunteer teams that the program needs sampling to continue as late into the fall as possible and that backup volunteers be available to assist if the primary volunteer is unavailable to collect samples. While it is difficult to anticipate all details that should be recorded, the experience in 2023 suggests volunteers should record, and report, the details of any sightings of a bloom, reporting of that bloom and subsequent follow-up by MECP and SMDHU. Data publicly available on the websites of those agencies are quite limited, and our understanding of bloom occurrence, and potentially of its relationship to prior blue-green algae abundance derived from the fluorescence records, requires a bit more information than we have asked for (whether a bloom was present or absent at each sampling date).

Given the overall success, it is recommended that the Algae Monitoring Program be opened up to additional Muskoka area lake associations for the 2025 sampling season with the following considerations:

- The number of new lake associations able to participate in 2025 be capped at approximately three (about three new pairs of offshore/nearshore monitoring locations). This assumes the 16 participating lake associations will be continuing.
- The program will continue to be subscription-based, at a cost of $250 per year per association for up to four (2 pairs) of sites. This subscription fee will be used to cover the cost of coordinating the Algae Monitoring Program, providing training, QA/QC of analytical procedures and results, managing the data, and developing an annual report and story map for permanent online access to the data.
- Lake Associations are required to purchase a "Sampling Kit" when they join the Algae Monitoring Program at a cost of approximately $250. The Sampling Kit includes the equipment needed to collect the water samples for analysis, including a composite sampler, Secchi disc, 20-meter calibrated line, thermometer, 500 ml and 125 ml bottles, clipboard, pencil, protocol manual and a supply of sample labels. Costs for replacement items for lake associations already enrolled will be determined on a cost recovery basis.
- Lake Associations will continue to carry out fluorometric analysis of the water samples themselves and submit the data online to MWC using the online forms developed for that purpose. To accomplish this, lake associations will have the option of purchasing an "Analysis Kit" that includes a fluorometer and associated equipment, thermometer, thawing basin and heater. The Analysis Kit is a one-time cost of approximately $3,000. MWC will continue to have an Analysis Kit available for lake associations to borrow for short periods of time (7 days) to analyze their respective water samples. Because samples are frozen, analysis of accumulated samples need only be done perhaps twice per year.
- Lake Associations will be required to submit all data by November 15th so the annual report can be produced in a timely manner. This did not happen in 2024 and caused significant delays.
- The Algae Monitoring Program is evaluated annually; following the 2026 season a more detailed evaluation will be made.

Appendix 1: Fluorometric Data Collected by Lake During Routine Sampling

Table A1. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Bass Lake in 2024 for the nearshore (240-a02n) and offshore (240-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±1.05 (offshore) and ±0.81 (near) and for CHL is ±0.04 (offshore) and ±0.01 (near).

Bass Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
240-a01o	2024-05-26	No	No	0.10	0.72	0.14
240-a01o	2024-06-07	No	No	3.00	0.69	4.31
240-a01o	2024-06-23	No	No	7.25	0.67	10.87
240-a01o	2024-07-08	No	No	3.42	0.70	4.91
240-a01o	2024-07-22	No	No	4.50	0.75	6.02
240-a01o	2024-08-05	Yes	No	6.71	0.67	9.91
240-a01o	2024-08-17	No	No	4.21	0.65	6.51
240-a01o	2024-09-01	No	Yes	4.35	0.85	5.09
240-a01o	2024-09-15	No	No	3.85	0.56	6.87
240-a01o	2024-09-29	No	No	4.28	0.51	8.44
240-a01o	2024-10-05	No	Yes	5.42	0.59	9.21
240-a02n	2024-05-26	No	No	2.63	0.75	3.56
240-a02n	2024-06-07	No	No	1.77	0.74	2.51
240-a02n	2024-06-23	No	No	8.61	0.63	14.66
240-a02n	2024-07-08	No	No	5.35	0.70	7.60
240-a02n	2024-07-22	No	No	6.21	0.77	8.02
240-a02n	2024-08-05	Yes	Yes	4.78	0.75	6.32
240-a02n	2024-08-17	No	No	4.50	0.61	7.37
240-a02n	2024-09-01	No	Yes	5.00	0.63	7.97
240-a02n	2024-09-15	No	Yes	5.14	2.61	8.47
240-a02n	2024-09-29	No	No	4.78	0.52	9.19
240-a02n	2024-10-05	No	Yes	7.07	0.61	11.58

Table A2. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Brandy Lake in 2024 for the nearshore (0562-a02n) and offshore (0562-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±0.10 (offshore) and ±4.04 (near) and for CHL is ±0.03 (offshore) and ±0.10 (near).

Brandy Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
0562-a01o	2024-06-11	No	No	5.56	2.15	2.59
0562-a01o	2024-06-24	No	No	17.33	2.19	7.93
0562-a01o	2024-07-19	No	No	32.17	2.79	11.51
0562-a01o	2024-07-30	No	No	11.52	2.60	4.43
0562-a01o	2024-08-13	Yes	No	9.10	2.46	3.69
0562-a01o	2024-09-16	No	Yes	47.27	2.54	18.60
0562-a01o	2024-10-17	No	No	19.22	2.16	8.88
0562-a02n	2024-06-11	No	No	5.86	2.06	2.86
0562-a02n	2024-06-24	No	No	16.04	2.19	7.33
0562-a02n	2024-07-19	No	No	31.48	2.92	10.74
0562-a02n	2024-07-30	No	No	7.78	2.49	3.11
0562-a02n	2024-08-13	Yes	No	9.16	2.75	3.78
0562-a02n	2024-09-16	No	Yes	29.36	2.44	12.15
0562-a02n	2024-10-17	No	No	23.44	2.16	10.86

Table A3. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Fairy Lake in 2024 for the nearshore (1420-a02n) and offshore (1420-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±1.21 (offshore) and ±1.12 (near) and for CHL is ±0.11 (offshore) and ±0.02 (near).

Fairy Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
1420-a01o	2024-07-05	No	No	2.44	0.63	3.90
1420-a01o	2024-07-18	No	No	3.14	0.80	3.93
1420-a01o	2024-08-03	Yes	No	5.28	0.80	6.54
1420-a01o	2024-08-31	No	No	4.42	0.79	5.56
1420-a01o	2024-09-13	No	No	3.00	0.72	4.16
1420-a01o	2024-09-26	No	No	3.85	0.82	4.69
1420-a01o	2024-10-12	No	No	2.21	0.77	2.86
1420-a01o	2024-10-26	No	No	1.93	0.81	2.38
1420-a02n	2024-07-05	No	No	4.71	0.81	5.81
1420-a02n	2024-07-18	No	No	4.49	0.83	5.38
1420-a02n	2024-08-03	Yes	No	2.99	0.76	3.94
1420-a02n	2024-08-31	No	No	3.07	0.80	3.80
1420-a02n	2024-09-13	No	No	1.21	0.80	1.51
1420-a02n	2024-09-26	No	No	2.07	0.82	2.51
1420-a02n	2024-10-12	No	No	1.23	0.73	1.68
1420-a02n	2024-10-26	No	No	0.95	0.78	1.22

Table A4. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Kawagama Lake in 2024 for the nearshore (2252-a02n, 2252-a04n) and offshore (2252-a01o, 2252-a03o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±3.97 (offshore) and ±2.39 (near) and for CHL is ±0.15 (offshore) and ±0.02 (near).

Kawagama Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
2252-a01o	2024-07-08	No	No	32.13	1.29	24.71
2252-a01o	2024-07-22	No	No	26.29	1.12	23.41
2252-a01o	2024-08-07	Yes	No	23.62	1.16	20.21
2252-a02n	2024-07-08	No	No	33.32	1.36	24.52
2252-a02n	2024-07-22	No	No	41.47	1.26	34.59
2252-a03o	2024-07-08	No	No	5.07	0.79	6.44
2252-a03o	2024-07-22	No	No	49.13	1.30	40.83
2252-a03o	2024-08-07	Yes	No	26.36	1.20	21.53
2252-a04n	2024-07-08	No	No	4.71	0.90	5.25
2252-a04n	2024-07-22	No	No	27.91	1.84	15.15
2252-a04n	2024-08-07	Yes	No	25.38	1.73	14.65

Table A5. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Leonard Lake in 2024 for the nearshore (2540-a03n, 2540-a05n) and offshore (2540-a01o, 2540-a04o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Triplicates were not taken.

Leonard Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
2540-a01o	2024-05-29	No	No	4.57	0.49	9.33
2540-a01o	2024-06-14	No	No	3.43	0.46	7.33
2540-a01o	2024-07-02	No	No	5.37	0.52	10.33
2540-a01o	2024-07-09	No	No	4.32	0.52	8.33
2540-a01o	2024-07-15	No	No	5.43	0.53	10.17
2540-a01o	2024-07-29	No	No	2.60	0.49	5.37
2540-a01o	2024-08-12	No	No	3.50	0.47	7.43
2540-a01o	2024-08-26	No	No	4.37	0.44	9.97
2540-a01o	2024-09-10	No	No	4.70	0.45	10.50
2540-a01o	2024-09-24	No	No	4.57	0.40	11.33
2540-a01o	2024-10-10	No	No	4.53	0.39	11.53
2540-a01o	2024-10-22	No	No	4.27	0.40	10.63
2540-a01o	2024-11-12	No	No	3.17	0.34	9.43
2540-a03n	2024-05-29	No	No	4.50	0.48	9.33
2540-a03n	2024-06-14	No	No	3.83	0.46	8.67
2540-a03n	2024-07-02	No	No	3.57	0.49	7.67
2540-a03n	2024-07-09	No	No	3.13	0.45	6.97
2540-a03n	2024-07-15	No	No	3.30	0.46	7.30
2540-a03n	2024-07-29	No	No	2.40	0.47	5.10
2540-a03n	2024-08-12	No	No	2.93	0.48	6.20
2540-a03n	2024-08-26	No	No	3.60	0.43	8.47

Leonard Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
2540-a03n	2024-09-10	No	No	4.47	0.51	8.87
2540-a03n	2024-09-24	No	No	6.83	0.41	16.30
2540-a03n	2024-10-10	No	No	4.97	0.40	12.33
2540-a03n	2024-10-22	No	No	3.47	0.40	8.67
2540-a03n	2024-11-12	No	No	3.27	0.34	9.43
2540-a04o	2024-06-14	No	No	3.43	0.44	7.67
2540-a04o	2024-07-02	No	No	5.83	0.50	11.67
2540-a04o	2024-07-09	No	No	4.67	0.53	8.93
2540-a04o	2024-07-15	No	No	5.23	0.56	9.53
2540-a04o	2024-07-29	No	No	3.77	0.53	7.23
2540-a04o	2024-08-12	No	No	2.67	0.48	5.70
2540-a04o	2024-08-26	No	No	2.93	0.47	6.33
2540-a04o	2024-09-10	No	No	5.43	0.47	11.53
2540-a04o	2024-09-24	No	No	4.07	0.43	9.57
2540-a04o	2024-10-10	No	No	4.40	0.42	10.43
2540-a04o	2024-10-22	No	No	3.97	0.43	9.07
2540-a04o	2024-11-12	No	No	3.27	0.37	8.83
2540-a05n	2024-06-14	No	No	2.80	0.44	6.67
2540-a05n	2024-07-02	No	No	4.60	0.51	9.00
2540-a05n	2024-07-09	No	No	3.47	0.51	6.90
2540-a05n	2024-07-15	No	No	3.40	0.47	7.27
2540-a05n	2024-07-29	No	No	2.07	0.47	4.37
2540-a05n	2024-08-12	No	No	3.37	0.43	7.80
2540-a05n	2024-08-26	No	No	3.10	0.45	7.10
2540-a05n	2024-09-10	No	No	7.27	0.49	14.57
2540-a05n	2024-09-24	No	No	3.87	0.43	9.03
2540-a05n	2024-10-10	No	No	4.67	0.43	10.80
2540-a05n	2024-10-22	No	No	3.00	0.44	6.97
2540-a05n	2024-11-12	No	No	3.33	0.37	9.07

Table A6. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Mary Lake in 2024 for the nearshore (3032-a02n, 3032-a03n, 3032-a04n) and offshore (3032-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±0.21 (offshore) and ±0.73 (near) and for CHL is ±0.01 (offshore) and ±0.01 (near).

Mary Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
3032-a01o	2024-05-20	No	No	1.79	0.78	2.29
3032-a01o	2024-06-16	No	No	6.14	0.76	8.03
3032-a01o	2024-07-01	No	No	7.48	0.85	8.77
3032-a01o	2024-07-14	No	No	6.51	0.79	8.27
3032-a01o	2024-08-04	Yes	No	4.91	0.72	6.85
3032-a01o	2024-08-18	No	No	3.20	0.69	4.64
3032-a01o	2024-09-01	No	No	4.42	0.68	6.53
3032-a01o	2024-09-14	No	Yes	3.69	0.66	5.66
3032-a01o	2024-09-29	No	Yes	3.02	0.60	5.00

Mary Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
3032-a01o	2024-10-13	No	No	3.37	0.67	5.20
3032-a01o	2024-10-27	No	No	3.19	0.67	4.75
3032-a01o	2024-11-09	No	No	3.66	0.67	5.60
3032-a02n	2024-05-20	No	No	2.46	0.81	3.02
3032-a02n	2024-06-16	No	No	5.95	0.68	8.63
3032-a02n	2024-07-01	No	No	6.94	0.83	8.32
3032-a02n	2024-07-14	No	No	6.87	0.81	8.49
3032-a02n	2024-08-04	Yes	No	8.59	0.72	11.97
3032-a02n	2024-08-18	No	No	3.63	0.65	5.55
3032-a02n	2024-09-01	No	No	4.05	0.67	6.01
3032-a02n	2024-09-14	No	Yes	3.69	0.65	5.66
3032-a02n	2024-09-29	No	Yes	3.50	0.49	7.15
3032-a02n	2024-10-13	No	No	3.92	0.66	5.86
3032-a02n	2024-10-27	No	No	3.63	0.66	5.56
3032-a02n	2024-11-09	No	No	6.98	0.78	8.76
3032-a03n	2024-05-20	No	No	2.22	0.82	2.71
3032-a03n	2024-06-16	No	No	4.91	0.73	6.73
3032-a03n	2024-07-01	No	No	6.63	0.88	7.53
3032-a03n	2024-07-14	No	No	6.51	0.78	8.34
3032-a03n	2024-08-04	Yes	No	4.79	0.78	6.18
3032-a03n	2024-08-18	No	No	4.36	0.70	6.23
3032-a03n	2024-09-01	No	No	4.67	0.67	6.96
3032-a03n	2024-09-14	No	Yes	2.89	0.60	4.81
3032-a03n	2024-09-29	No	Yes	2.10	0.65	3.29
3032-a03n	2024-10-13	No	No	5.15	0.71	7.17
3032-a03n	2024-10-27	No	No	4.34	0.69	6.13
3032-a03n	2024-11-09	No	No	6.50	0.77	8.33
3032-a04n	2024-05-20	No	No	1.97	0.77	2.58
3032-a04n	2024-06-16	No	No	5.53	0.74	7.50
3032-a04n	2024-07-01	No	No	6.99	0.75	9.36
3032-a04n	2024-07-14	No	No	6.57	0.86	7.60
3032-a04n	2024-08-04	Yes	No	4.73	0.74	6.36
3032-a04n	2024-08-18	No	No	4.98	0.68	7.36
3032-a04n	2024-09-01	No	No	4.48	0.65	6.89
3032-a04n	2024-09-14	No	Yes	2.28	0.44	5.29
3032-a04n	2024-09-29	No	Yes	3.81	0.59	6.46
3032-a04n	2024-10-13	No	No	2.67	0.60	4.48
3032-a04n	2024-10-27	No	No	4.98	0.65	7.58
3032-a04n	2024-11-09	No	No	6.47	0.84	7.43

Table A7. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Menominee Lake in 2024 for the nearshore (3181-a02n) and offshore (3181-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±1.14 (offshore) and ±0.87 (near) and for CHL is ±0.07 (offshore) and ±0.07 (near).

Menominee Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
3181-a01o	2024-05-07	No	No	8.50	1.31	6.46
3181-a01o	2024-05-19	No	No	3.16	1.05	3.01
3181-a01o	2024-06-06	No	No	3.70	1.07	3.44
3181-a01o	2024-07-04	No	No	6.40	1.27	5.02
3181-a01o	2024-07-22	No	No	4.36	1.21	3.61
3181-a01o	2024-08-03	Yes	No	4.36	1.20	3.63
3181-a01o	2024-08-22	No	No	3.76	1.07	3.47
3181-a01o	2024-09-29	No	No	2.62	0.66	2.80
3181-a01o	2024-10-12	No	No	7.78	1.12	6.92
3181-a02n	2024-05-07	No	No	2.26	1.10	2.04
3181-a02n	2024-05-19	No	No	3.40	1.12	3.03
3181-a02n	2024-06-06	No	No	13.66	1.41	9.67
3181-a02n	2024-07-04	No	No	8.92	1.44	6.17
3181-a02n	2024-07-22	No	No	3.88	1.30	2.99
3181-a02n	2024-08-03	Yes	No	3.70	1.22	3.02
3181-a02n	2024-08-22	No	No	5.14	1.07	4.80
3181-a02n	2024-09-29	No	No	3.88	1.02	3.80
3181-a02n	2024-10-12	No	No	5.07	1.06	4.75

Table A8. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Muldrew Lakes in 2024 for the nearshore (5075-a02n) and offshore (5075-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±0.46 (offshore) and ±0.01 (near) and for CHL is ±0.04 (offshore) and ±0.05 (near).

Muldrew Lakes						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
5075-a01o	2024-06-17	No	No	1.38	1.20	1.13
5075-a01o	2024-06-29	No	No	1.42	1.20	1.18
5075-a01o	2024-07-12	No	No	2.02	1.16	1.73
5075-a01o	2024-07-27	Yes	No	3.88	0.93	4.15
5075-a01o	2024-08-11	No	No	3.12	0.99	3.25
5075-a01o	2024-08-25	No	No	2.74	0.89	3.09
5075-a01o	2024-09-08	No	No	3.46	0.86	4.00
5075-a01o	2024-09-22	No	No	4.00	0.91	4.37
5075-a01o	2024-10-07	No	No	1.10	0.69	1.60
5075-a01o	2024-10-20	No	No	5.20	0.64	8.19
5075-a02n	2024-06-17	No	No	1.03	1.08	0.90
5075-a02n	2024-06-29	No	No	0.92	1.11	0.83
5075-a02n	2024-07-12	No	No	1.72	1.15	1.49
5075-a02n	2024-07-27	Yes	No	2.92	0.90	3.23
5075-a02n	2024-08-11	No	No	2.95	0.86	3.18
5075-a02n	2024-08-25	No	No	2.26	0.89	2.52
5075-a02n	2024-09-08	No	No	3.82	0.91	4.21
5075-a02n	2024-09-22	No	No	3.64	0.75	4.87
5075-a02n	2024-10-07	No	No	1.96	0.72	2.73
5075-a02n	2024-10-20	No	No	2.44	0.72	3.43

Table A9. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Peninsula Lake in 2024 for the nearshore (4309-a02n) and offshore (4309-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±1.92 (offshore) and ±0.82 (near) and for CHL is ±0.03 (offshore) and ±0.51 (near).

Peninsula Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
4309-a01o	2024-07-07	No	No	22.78	0.42	83.66
4309-a01o	2024-07-14	No	No	6.57	0.46	14.37
4309-a01o	2024-07-28	No	No	5.50	0.40	13.72
4309-a01o	2024-08-07	Yes	No	9.71	0.45	21.47
4309-a01o	2024-09-11	No	No	20.40	0.37	52.31
4309-a02n	2024-07-07	No	No	6.78	0.55	12.35
4309-a02n	2024-07-14	No	No	7.28	0.47	15.73
4309-a02n	2024-07-28	No	No	6.35	0.37	17.34
4309-a02n	2024-08-07	Yes	No	8.64	1.38	5.86
4309-a02n	2024-09-11	No	No	0.47	0.36	1.22

Table A10. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Ril Lake in 2024 for the nearshore (4627-a02n) and offshore (4627-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±0.18 (offshore) and ±0.03 (near) and for CHL is ±0.02 (offshore) and ±0.02 (near).

Ril Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
4627-a01o	2024-05-23	No	No	2.32	0.66	3.49
4627-a01o	2024-06-05	No	No	1.10	0.65	1.68
4627-a01o	2024-06-19	No	No	1.96	0.62	3.14
4627-a01o	2024-07-04	No	No	0.85	0.63	1.34
4627-a01o	2024-07-23	No	No	3.40	0.66	5.11
4627-a01o	2024-08-13	Yes	No	2.14	0.60	3.54
4627-a01o	2024-08-29	No	No	1.96	0.59	3.31
4627-a01o	2024-09-12	No	No	3.70	0.55	6.80
4627-a01o	2024-09-29	No	No	3.64	0.53	6.90
4627-a02n	2024-05-23	No	No	1.42	0.68	2.08
4627-a02n	2024-06-05	No	No	2.14	0.63	3.37
4627-a02n	2024-06-19	No	No	2.92	0.66	4.43
4627-a02n	2024-07-04	No	No	2.50	0.67	3.75
4627-a02n	2024-07-23	No	No	1.48	0.61	2.42
4627-a02n	2024-08-13	Yes	No	3.34	0.64	5.25
4627-a02n	2024-08-29	No	No	2.20	0.60	3.65
4627-a02n	2024-09-12	No	No	1.78	0.52	3.40
4627-a02n	2024-09-29	No	No	1.42	0.48	2.96

Table A11. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Lake Rosseau in 2024 for the nearshore (2476-a02n) and offshore (2476-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±0.25 (offshore) and ±2.32 (near) and for CHL is ±0.01 (offshore) and ±0.04 (near).

Lake Rosseau						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
2476-a01o	2024-05-20	No	No	1.57	0.59	2.66
2476-a01o	2024-06-15	No	No	2.16	0.42	5.16
2476-a01o	2024-07-22	No	No	5.29	0.54	10.44
2476-a01o	2024-08-16	Yes	No	5.77	0.41	13.94
2476-a02n	2024-05-20	No	No	3.82	0.98	3.87
2476-a02n	2024-06-15	No	No	4.68	0.71	6.58
2476-a02n	2024-07-22	No	No	11.82	1.01	11.73
2476-a02n	2024-08-16	Yes	No	44.39	1.12	39.63

Table A12. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Six Mile Lake in 2024 for the nearshore (4978-a02n) and offshore (4978-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±1.23 (offshore) and ±0.89 (near) and for CHL is ±0.05 (offshore) and ±0.01 (near).

Six Mile Lake						
Site	Date	Triplicate?	Bloom?	PC	CHL	PC:CHL
4978-a01o	2024-05-22	No	No	1.47	0.59	2.51
4978-a01o	2024-06-04	No	No	1.47	0.50	2.84
4978-a01o	2024-06-19	No	No	2.77	0.54	5.13
4978-a01o	2024-07-02	No	No	2.02	0.50	4.03
4978-a01o	2024-07-16	No	No	2.15	0.47	4.53
4978-a01o	2024-07-31	No	No	2.91	0.45	6.41
4978-a01o	2024-08-13	Yes	No	6.18	0.52	11.96
4978-a01o	2024-08-27	No	No	2.36	0.44	5.39
4978-a01o	2024-09-11	No	No	3.59	0.51	7.10
4978-a01o	2024-09-24	No	No	1.54	0.31	4.91
4978-a01o	2024-10-08	No	No	1.00	0.38	2.65
4978-a02n	2024-05-22	No	No	2.63	0.65	3.94
4978-a02n	2024-06-04	No	No	1.95	0.52	3.77
4978-a02n	2024-06-19	No	No	3.52	0.52	6.75
4978-a02n	2024-07-02	No	No	1.81	0.44	4.08
4978-a02n	2024-07-16	No	No	1.74	0.43	4.02
4978-a02n	2024-07-31	No	No	3.04	0.49	6.26
4978-a02n	2024-08-13	Yes	No	6.04	0.47	12.85
4978-a02n	2024-08-27	No	No	2.49	0.40	6.22
4978-a02n	2024-09-11	No	No	10.96	0.52	20.92
4978-a02n	2024-09-24	No	No	4.75	0.38	12.69
4978-a02n	2024-10-08	No	No	0.89	0.33	2.73

Table A13. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Stewart Lake in 2024 for the nearshore (5166-a02n, 5166-a03n, 5166-a04n) and offshore (5166-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±4.14 (offshore) and ±3.49 (near) and for CHL is ±0.11 (offshore) and ±0.08 (near).

Stewart Lake						
Site	Date	Triplicate?	Bloom?	PC	CHL	PC:CHL
5166-a01o	2024-05-22	No	No	7.97	0.83	8.86
5166-a01o	2024-06-03	No	No	16.68	0.95	16.37
5166-a01o	2024-06-17	No	No	6.11	0.79	7.76
5166-a01o	2024-07-01	No	No	8.16	0.88	9.30
5166-a01o	2024-07-17	No	No	6.18	0.79	7.80
5166-a01o	2024-07-31	No	No	8.22	0.82	9.95
5166-a01o	2024-08-12	Yes	No	8.43	0.80	10.45
5166-a01o	2024-08-28	No	No	4.13	0.69	5.97
5166-a01o	2024-09-10	No	No	6.45	0.71	9.00
5166-a01o	2024-10-08	No	No	10.07	1.03	11.76

Stewart Lake						
5166-a01o	2024-10-22	No	No	11.30	0.73	15.40
5166-a02n	2024-05-22	No	No	3.45	0.75	4.60
5166-a02n	2024-06-03	No	No	5.56	0.76	7.32
5166-a02n	2024-06-17	No	No	5.57	0.78	7.13
5166-a02n	2024-07-01	No	No	5.77	0.82	7.14
5166-a02n	2024-07-17	No	No	4.61	0.67	6.88
5166-a02n	2024-07-31	No	No	17.84	0.88	20.17
5166-a02n	2024-08-12	Yes	No	5.50	0.70	7.85
5166-a02n	2024-08-28	No	No	3.25	0.63	5.13
5166-a02n	2024-09-10	No	No	4.13	0.73	5.63
5166-a02n	2024-10-08	No	No	7.47	0.71	10.56
5166-a02n	2024-10-22	No	No	1.82	0.64	2.83
5166-a03n	2024-05-22	No	No	3.92	0.69	5.68
5166-a03n	2024-06-03	No	No	4.61	0.82	5.64
5166-a03n	2024-06-17	No	No	1.47	0.71	2.06
5166-a03n	2024-07-01	No	No	8.36	0.81	10.33
5166-a03n	2024-07-17	No	No	8.63	0.81	10.67
5166-a03n	2024-07-31	No	No	7.82	0.78	9.88
5166-a03n	2024-08-12	Yes	No	7.68	0.74	10.32
5166-a03n	2024-08-28	No	No	5.16	0.69	7.42
5166-a03n	2024-09-10	No	No	3.38	0.63	5.37
5166-a03n	2024-10-08	No	No	11.37	0.71	16.02
5166-a03n	2024-10-22	No	No	3.32	0.57	5.83
5166-a04n	2024-05-22	No	No	5.19	0.72	7.21
5166-a04n	2024-06-03	No	No	6.25	0.74	8.44
5166-a04n	2024-06-17	No	No	6.45	0.79	8.13
5166-a04n	2024-07-01	No	No	5.77	0.76	7.59
5166-a04n	2024-07-17	No	No	6.25	0.55	10.85
5166-a04n	2024-07-31	No	No	7.68	0.74	10.30
5166-a04n	2024-08-12	Yes	No	4.40	0.68	6.44
5166-a04n	2024-08-28	No	No	4.13	0.71	5.82
5166-a04n	2024-09-10	No	No	4.27	0.44	6.69
5166-a04n	2024-10-08	No	No	13.72	0.86	14.84
5166-a04n	2024-10-22	No	No	11.10	0.74	15.16

Table A14. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Three Mile Lake in 2024 for the nearshore (5362-a02n, 5362-a04n) and offshore (5362-a01o, 5362-a03o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±4.61 (offshore) and ±3.61 (near) and for CHL is ±0.02 (offshore) and ±0.03 (near).

Three Mile Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
5362-a01o	2024-05-24	No	No	8.69	1.08	8.04
5362-a01o	2024-06-03	No	No	10.07	1.37	7.33
5362-a01o	2024-06-17	No	Yes	7.69	0.89	8.62
5362-a01o	2024-07-02	No	No	18.92	1.45	13.07
5362-a01o	2024-07-17	No	No	38.00	1.36	27.94
5362-a01o	2024-07-29	No	No	43.15	1.50	28.70
5362-a01o	2024-08-12	Yes	No	99.69	1.51	65.87
5362-a01o	2024-08-26	No	Yes	204.69	2.05	99.85
5362-a01o	2024-09-10	No	Yes	19.00	1.04	18.26
5362-a01o	2024-09-22	No	Yes	26.61	1.49	17.81
5362-a02n	2024-05-24	No	No	8.76	0.97	9.00
5362-a02n	2024-06-03	No	No	6.07	1.29	4.71
5362-a02n	2024-06-17	No	Yes	10.30	0.95	10.82
5362-a02n	2024-07-02	No	No	22.84	1.40	16.36
5362-a02n	2024-07-17	No	No	33.46	1.30	25.68
5362-a02n	2024-07-29	No	No	35.00	1.34	26.10
5362-a02n	2024-08-12	Yes	Yes	93.53	1.53	61.24
5362-a02n	2024-08-26	No	Yes	117.18	1.64	71.31
5362-a02n	2024-09-10	No	Yes	20.07	1.04	19.35
5362-a02n	2024-09-22	No	Yes	24.30	1.31	18.56
5362-a03o	2024-05-24	No	No	11.23	0.87	12.89
5362-a03o	2024-06-03	No	No	8.30	1.11	7.50
5362-a03o	2024-06-17	No	Yes	8.07	0.73	11.11
5362-a03o	2024-07-02	No	No	14.92	0.88	17.06
5362-a03o	2024-07-17	No	No	19.76	0.89	22.28
5362-a03o	2024-07-29	No	No	16.84	0.93	18.27
5362-a03o	2024-08-12	Yes	No	32.61	0.96	33.93
5362-a03o	2024-08-26	No	No	44.22	1.01	43.78
5362-a03o	2024-09-10	No	Yes	63.00	1.08	58.45
5362-a03o	2024-09-22	No	Yes	44.30	1.11	40.02
5362-a04n	2024-05-24	No	No	8.15	0.90	9.09
5362-a04n	2024-06-03	No	Yes	7.76	1.14	6.81
5362-a04n	2024-06-17	No	Yes	9.76	0.72	13.61
5362-a04n	2024-07-02	No	No	12.92	0.88	14.66
5362-a04n	2024-07-17	No	No	22.69	0.93	24.41
5362-a04n	2024-07-29	No	No	19.07	0.94	20.21
5362-a04n	2024-08-12	Yes	No	32.15	0.92	34.89
5362-a04n	2024-08-26	No	No	51.07	1.12	45.45
5362-a04n	2024-09-10	No	Yes	55.15	1.00	55.15
5362-a04n	2024-09-22	No	Yes	41.92	1.03	40.56

Table A15. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Lake Vernon in 2024 for the nearshore (6455-a03n) and offshore (6455-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Precision (CL95) for PC is ±0.17 (offshore) and ±2.05 (near) and for CHL is ±0.06 (offshore) and ±0.05 (near).

Lake Vernon						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
6455-a01o	2024-05-15	No	No	2.78	0.94	2.98
6455-a01o	2024-05-29	No	No	1.92	0.90	2.15
6455-a01o	2024-06-12	No	No	2.92	0.91	3.20
6455-a01o	2024-06-26	No	No	2.64	0.93	2.84
6455-a01o	2024-07-11	No	No	4.71	0.99	4.77
6455-a01o	2024-07-25	No	No	2.50	1.17	2.13
6455-a01o	2024-08-08	Yes	No	6.14	1.00	6.13
6455-a01o	2024-08-21	No	No	3.85	1.17	3.28
6455-a01o	2024-09-04	No	No	6.21	0.92	6.73
6455-a01o	2024-09-18	No	No	4.64	0.89	5.23
6455-a01o	2024-10-02	No	No	3.57	0.82	4.35
6455-a01o	2024-10-16	No	No	3.35	0.85	3.94
6455-a03n	2024-05-15	No	No	2.36	0.92	2.57
6455-a03n	2024-05-29	No	No	1.43	0.97	1.46
6455-a03n	2024-06-12	No	No	2.28	0.81	2.82
6455-a03n	2024-06-26	No	No	4.43	0.85	5.19
6455-a03n	2024-07-11	No	No	4.64	1.03	4.52
6455-a03n	2024-07-25	No	No	2.35	1.29	1.83
6455-a03n	2024-08-08	Yes	No	4.92	1.11	4.43
6455-a03n	2024-08-21	No	No	2.78	0.97	2.87
6455-a03n	2024-09-04	No	No	5.85	0.92	6.38
6455-a03n	2024-09-18	No	No	4.64	0.84	5.52
6455-a03n	2024-10-02	No	No	2.35	0.79	2.99
6455-a03n	2024-10-16	No	No	2.21	0.83	2.68

Table A16. Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Young Lake in 2024 for the nearshore (5993-a02n) and offshore (5993-a01o) sites, as well as the ratio of phycocyanin to chlorophyll *a* (PC:CHL). All readings are averages of three subsamples analysed. This relative fluorescence is correlated to the amount of algae (CHL) and cyanobacteria (PC), but is not equivalent to the concentration of pigments or cells. Triplicate data could not be used to determine precision.

Young Lake						
Site	**Date**	**Triplicate?**	**Bloom?**	**PC**	**CHL**	**PC:CHL**
5993-a01o	2024-06-30	No	No	16.11	0.02	233.33
5993-a01o	2024-07-13	No	No	1.54	0.82	3.35
5993-a01o	2024-08-25	No	No	13.65	0.44	33.05
5993-a01o	2024-09-08	No	No	89.32	0.57	156.70
5993-a01o	2024-10-05	No	No	47.09	0.57	84.39
5993-a01o	2024-10-22	No	No	18.43	0.41	45.41
5993-a02n	2024-07-13	No	No	17.66	0.00	0.00
5993-a02n	2024-08-08	Yes	No	3.85	0.37	0.82
5993-a02n	2024-09-08	No	No	58.05	2.76	76.53
5993-a02n	2024-10-05	No	No	58.68	0.51	114.38
5993-a02n	2024-10-22	No	No	24.89	0.36	67.99
5993-a02n	2024-11-02	No	No	9.70	0.53	18.51