



# Algae Monitoring Program 2023 Final Report

MAY 2024



**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. Currently, 14 organizations participate in the program, with 12 providing data in 2023.

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 and decide whether to continue beyond that date.

This report presents the data collected and analysed in 2023. As more lakes are added, and as data is collected at each lake over multiple years, it is beginning to appear that a simple relationship between risk of a bloom and algal abundance, as measured by pigment fluorescence in frozen water sample, will not exist. Our 12 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 2023 did not show similar patterns of average fluorescence, nor of trends through the season leading up to and through the time of the bloom. Blue-green algae 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, of which blue-green algal abundance is just one. 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.

## Contents

Executive Summary .....	1
Introduction.....	3
Objectives .....	3
Background.....	4
Results.....	4
Trends in Algal Abundances Through the Season.....	5
Blue-Green Algae.....	5
All Algae .....	8
Summary on Seasonal Trends in Fluorescence Results.....	8
Average Levels of Phycocyanin Fluorescence in Late Summer and Fall.....	11
Recorded and Confirmed Blooms in 2023.....	11
Discussion and Conclusions .....	12
Effectiveness of the Procedures Followed .....	12
Patterns in Algae Abundance Through the Season and Across Lakes.....	12
Lessons Learned and Plans for 2024.....	13
Acknowledgements .....	14
Appendix 1: Fluorometric Data Collected by Lake During Routine Sampling .....	15

## 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 project.

## 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.

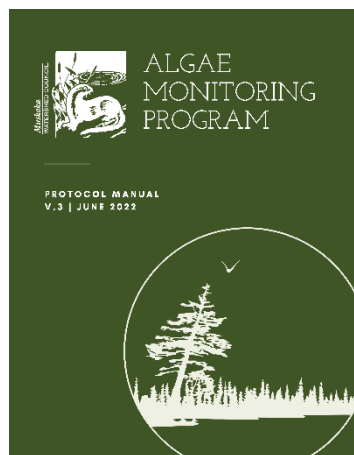
Following the successful completion of a pilot project in 2019 and 2021, the MWC Algae Monitoring Program was opened to interested organizations. The objectives of the program are to:

- Expand phytoplankton monitoring to interested lake associations across Muskoka as an addition to their existing water quality efforts,
- Develop information materials and presentations on algae for delivery to lake associations and others,
- Continue to collaborate with select lake associations on additional algal sampling to address specific issues of prevalence and/or causation of algal nuisance blooms,
- Evaluate the program in 2026 and decide whether to continue beyond that date, and
- Communicate these efforts to other lake associations across Muskoka.

## 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](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 2023 sampling season are available in Figures 1-4, and the 12 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.

### Trends in Algal Abundances Through the Season

Figures 1-4 present graphs of phycocyanin fluorescence (Figs. 1, 2) and chlorophyll *a* fluorescence (Figs. 3, 4) for the 12 lakes sampled in 2023. Notice in viewing Figures 1 and 2, that the phycocyanin fluorescence values vary greatly among lakes (the vertical axis 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 3 and 4, 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 Figs.1-4 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 generates 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*. With these caveats, let's look at Figures 1-4.

### Blue-Green Algae

Fluorescence of phycocyanin is an index of the abundance of blue-green algae in a water sample. Figures 1 and 2 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.

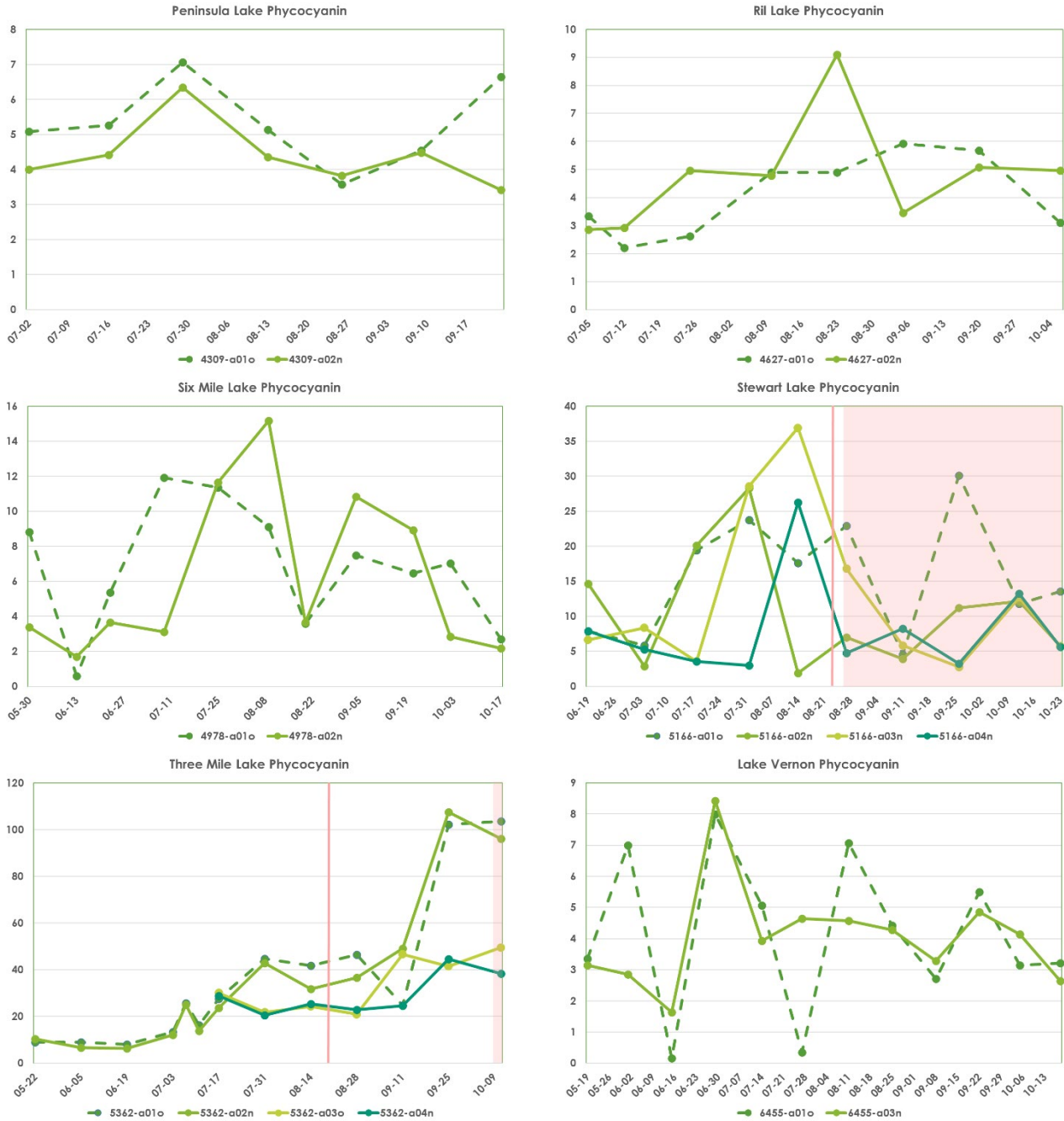
The seasonal trends from lake to lake are not the same. In most lakes (Brandy, Mary), offshore and nearshore sites show similar seasonal patterns, while in a few (Bass, Menominee) they differ. In some lakes (Brandy, Muldrew), blue-green algae appear to have peaked in abundance mid-season. In others (Leonard, Three Mile), blue-green algae appear to have become more abundant towards the end of the sampling period. In others (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.

For lakes that were sampled in previous years, the seasonal patterns also tend to differ among years, some more than others. With more years of data some lakes may show reliable year-to-year similarity in the seasonal trend in phycocyanin fluorescence and therefore in blue-green algae abundance.



**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, Leonard Lake, Mary Lake, Menominee Lake and Muldrew 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 A6. 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 2:** Plots showing the level of phycocyanin fluorescence at offshore and nearshore sites for each sampling date on each of Peninsula Lake, Ril Lake, Six Mile Lake, Stewart Lake, Three Mile Lake, and Lake Vernon. 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 A7 to A12. The plots for Stewart Lake and Three Mile Lake include a background tint showing the period commencing with the sighting of a bloom. The red line is the date SMDHU posted an advisory confirming a cyanobacterial bloom. In no case was the bloom resolved before the end of our sampling period, but the presence of the background tint does not mean a bloom was visible during that entire period (see text for details).



### All Algae

Chlorophyll *a* fluorescence is an index of total algal abundance including blue-green algae. Figures 3 and 4 summarize fluorescence values for all 12 sampled lakes through the sampling period. In contrast to the results for phycocyanin, chlorophyll *a* fluorescence shows little if any trend through the sampling season on any of the lakes (the slight downward trend in Six Mile Lake may be real). 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 maxing out at 2.8 and no other lakes exceeding 1.6.

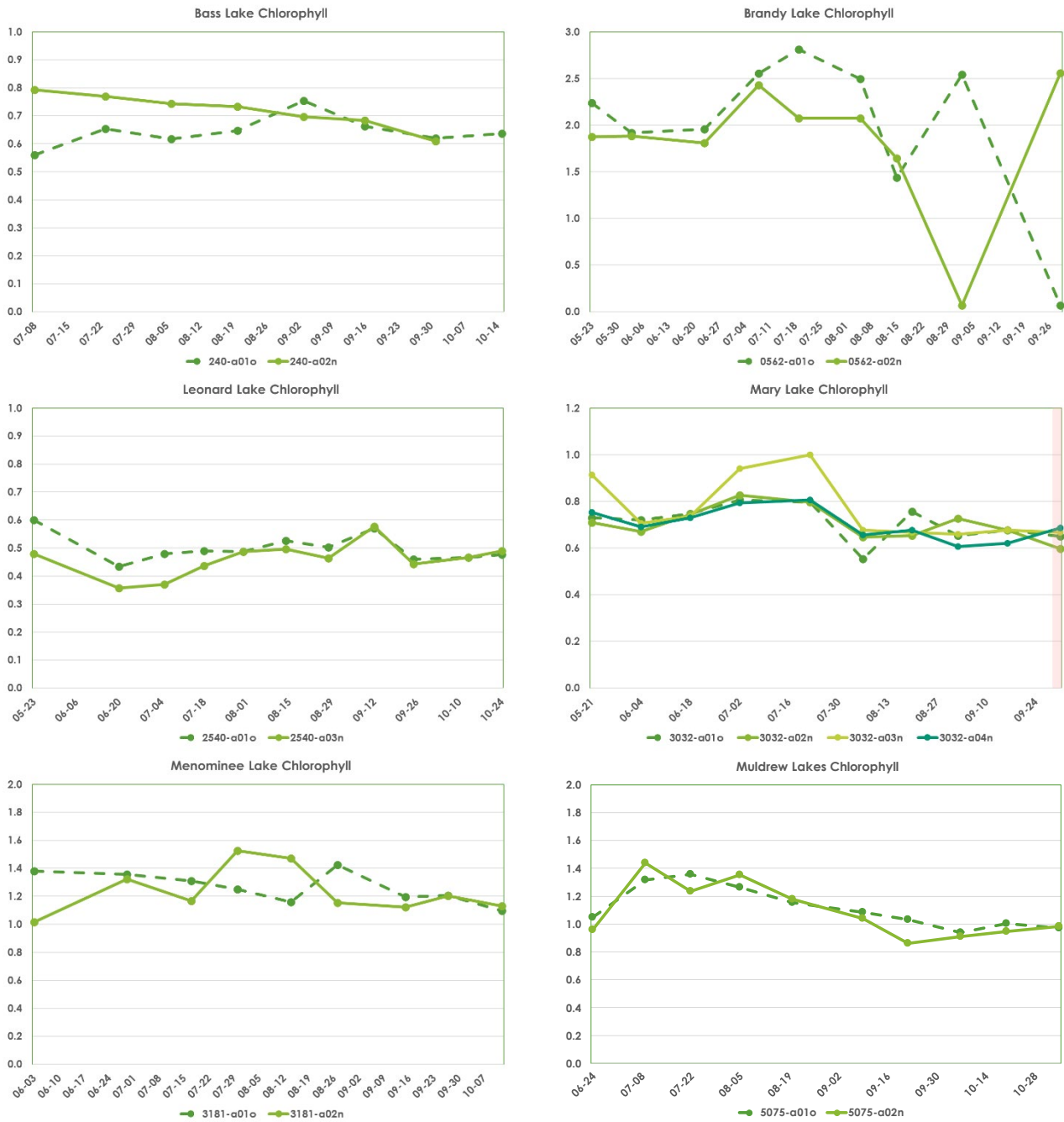
These data suggest that total algal abundance does not vary much through the season, nor very greatly from lake to lake. What does vary is the relative proportion of blue-green algae to other types of algae. Blue-green algae are proportionately much more abundant in some lakes at some times than at others.

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.

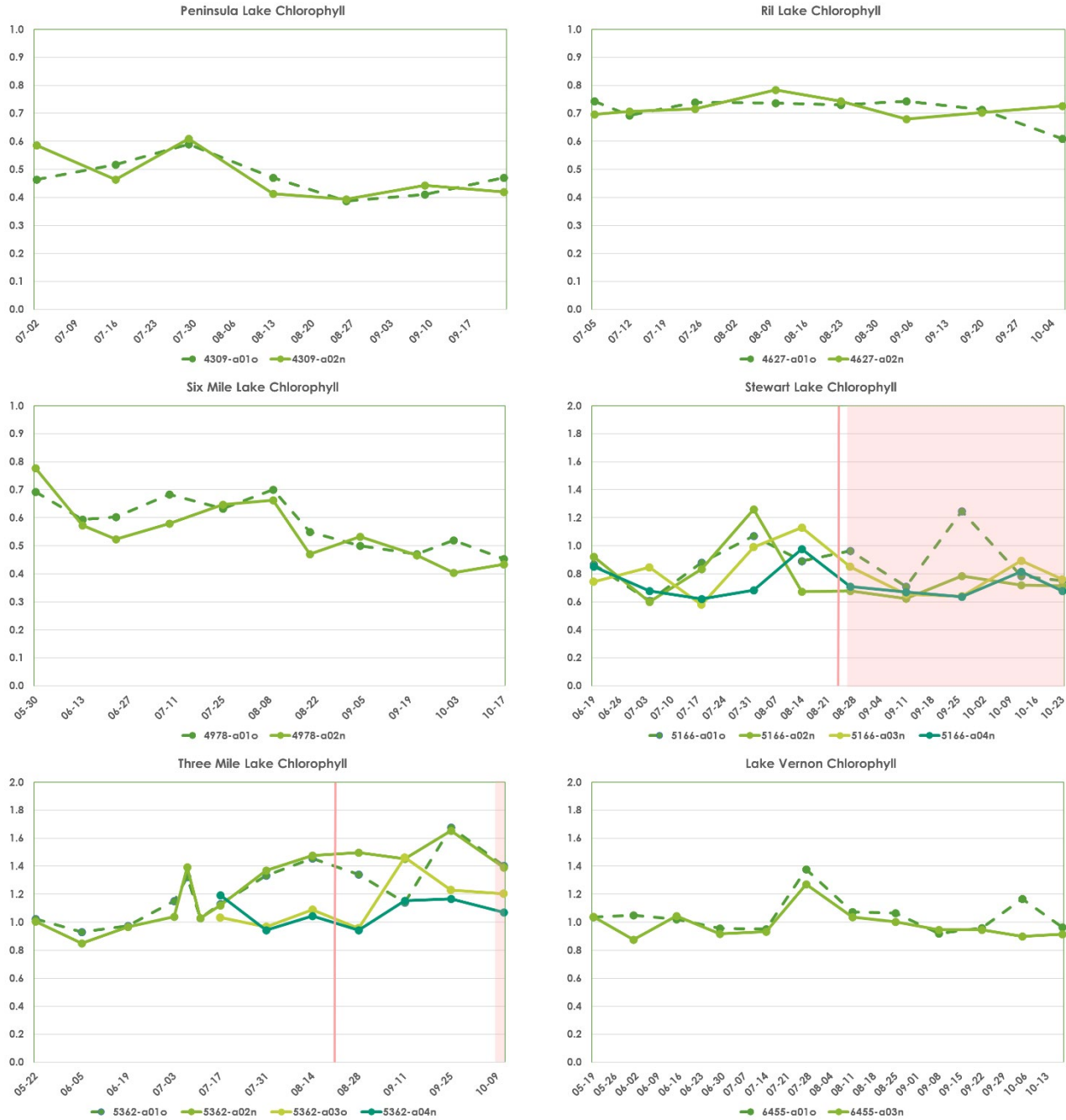
### Summary on Seasonal Trends in Fluorescence Results

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. A couple more years of monitoring will be needed before any definitive patterns start to emerge.

The results obtained to date, 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. 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 we will have to start monitoring other factors – local weather, water chemistry – to identify conditions promoting a bloom. We will consider introducing such additional monitoring in 2025.



**Figure 3:** Plots showing the level of chlorophyll a fluorescence at offshore and nearshore sites for each sampling date on each of Bass Lake, Brandy Lake, Leonard Lake, Mary Lake, Menominee Lake and Muldrew 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 in their average levels of chlorophyll a fluorescence and were 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 A6. 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).



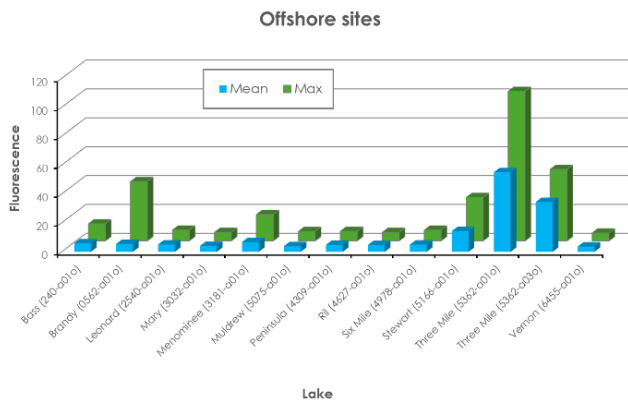
**Figure 4:** Plots showing the level of chlorophyll a fluorescence at offshore and nearshore sites for each sampling date on each of Peninsula Lake, Ril Lake, Six Mile Lake, Stewart Lake, Three Mile Lake, and Lake Vernon. Offshore sites have ID codes ending in **o**; nearshore sites have ID codes ending 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 in their average levels of chlorophyll a fluorescence and were 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 A7 to A12. The plots for Stewart Lake and Three Mile Lake include a background tint showing the period commencing with the sighting of a bloom. The red line is the date SMDHU posted an advisory confirming a cyanobacterial bloom. In no case was the bloom resolved before the end of our sampling period, but the presence of the background tint does not mean a bloom was visible during that entire period (see text for details).

### Average Levels of Phycocyanin Fluorescence in Late Summer and Fall

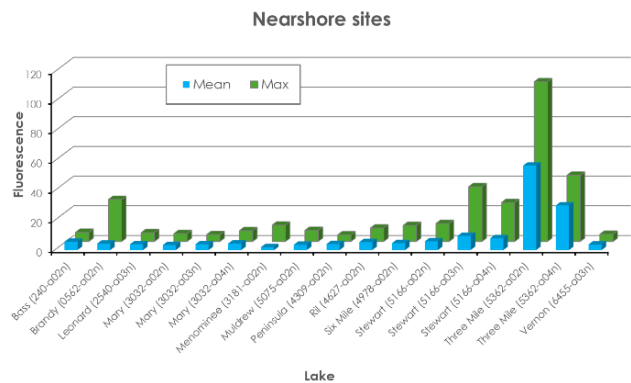
Blue-green algae typically bloom in late August through November in our lakes. To explore whether lakes that experienced blue-green algal blooms tended to exhibit higher levels of phycocyanin fluorescence during this time of year, we examined the mean and the maximum fluorescence values recorded for each sampled site, from August 13<sup>th</sup> to whenever sampling ceased on that lake. The results are in Figures 5 and 6 for offshore sites and nearshore sites respectively. Note that some lakes were sampled at more than one offshore or nearshore site.

There is considerable similarity between Figures 5 and 6. Mean values at the offshore site in each lake are close to mean values at nearshore sites in the same lake. Comparing mean values, the lakes appear to fall into two groups – Three Mile Lake and the rest, although Stewart Lake might be intermediate. An intermediate group of lakes was more apparent in 2022, with several lakes appearing more like Stewart Lake does this year.

A more detailed analysis, once we have three years of data for most lakes, which examines mean and range of values during this time of year may reveal some consistency among years in differences among lakes. Still, it is already apparent that blooms have occurred on lakes with high and with lower average values of phycocyanin fluorescence, so while such differences may be important in characterizing lakes, they do not seem likely to identify a class of lakes more prone to blooms.



**Figure 5:** Mean phycocyanin fluorescence and maximum phycocyanin fluorescence between 13 August and end of sampling period for all offshore sites on each lake.



**Figure 6:** Mean phycocyanin fluorescence and maximum phycocyanin fluorescence between 13 August and end of sampling period for all nearshore sites on each lake.

### Recorded and Confirmed Blooms in 2023

In 2023, program participants on three lakes recorded visible blooms on the Algae Field Sheet (Mary, Stewart and Three Mile Lakes). According to the Simcoe Muskoka District Health Unit ([https://www.simcoemuskokahealth.org/Topics/SafeWater/bluegreenalgae\\_copy1.aspx](https://www.simcoemuskokahealth.org/Topics/SafeWater/bluegreenalgae_copy1.aspx)), all three of these lakes had confirmed blooms as determined by the Ministry of the Environment, Conservation and Parks (MECP).

Lake	Date Advisory Issued	Date Resolved
Three Mile	16 Aug 2023	4 Dec 2023
Stewart (Southwest Shoreline)	22 Aug 2023	4 Dec 2023
Mary (Northwest Shoreline)	10 Oct 2023	10 May 24



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

Two of the 14 lake associations enrolled in the program were not able to submit data in 2023. On one lake this was due to personal difficulties faced by the volunteer tasked with collecting the samples, and samples were not collected. For the other lake, samples were collected but were not analyzed due to a power failure causing the frozen samples to thaw and degrade before analysis could be undertaken.

Based on the reasonable precision in the data collected in 2021, we did not include a collection of triplicate samples at any date in 2022 or 2023 to evaluate sampling precision. This will be reinstated in 2024 as it is a good quality control procedure. Final decisions on any changes to the protocol and program design will be made before our planned training refresher workshop in spring 2024.

### Patterns in Algae Abundance Through the Season and Across Lakes

With data available from 12 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, or trends through time, 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.

Our examination of average levels of phycocyanin fluorescence from August 13<sup>th</sup> onwards showed a less clear separation of lakes, except for Three Mile Lake, than in 2022. With another year of data in

2024, it will be possible to explore whether this simple measure can categorize lakes of different types. Limited data on bloom occurrence in 2022 and 2023 suggest, however, that any such categorization will not be correlated directly with the risk of algal blooms.

### Lessons Learned and Plans for 2024

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 2024 sampling season with the following considerations:

- The number of new lake associations able to participate in 2024 be capped at approximately three (about three new pairs of offshore/nearshore monitoring locations). This assumes the 14 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 two Analysis Kits 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 15<sup>th</sup> so the annual report can be produced in a timely manner. This did not happen in 2022 and 2023 and caused significant delays.
- The Algae Monitoring Program is evaluated annually; following the 2026 season a more detailed evaluation will be made before deciding whether to continue for a further period of years.

## Acknowledgements

MWC would 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 Dr. 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.

No citizen science monitoring program can exist without the citizen scientists, so MWC would like to thank the many volunteers from the 14 Lake Associations that participated in 2023. These citizen scientists donated their time, their ideas, and their enthusiasm to collect water samples and are helping MWC discover and solve issues related to the protocol and equipment.

## 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 2023 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.

Bass Lake					
Site	Date	Bloom?	PC	CHL	PC:CHL
240-a01o	2023-07-08	No	5.28	0.56	9.16
240-a01o	2023-07-23	No	7.00	0.65	10.72
240-a01o	2023-08-06	No	4.35	0.62	7.05
240-a01o	2023-08-20	No	6.00	0.65	9.26
240-a01o	2023-09-03	No	11.89	0.75	15.78
240-a01o	2023-09-16	No	3.78	0.66	5.70
240-a01o	2023-10-01	No	4.85	0.62	7.82
240-a01o	2023-10-15	No	5.71	0.64	8.97
240-a02n	2023-07-08	No	11.82	0.79	14.88
240-a02n	2023-07-23	No	15.27	0.77	19.59
240-a02n	2023-08-06	No	8.64	0.74	11.63
240-a02n	2023-08-20	No	5.35	0.73	7.29
240-a02n	2023-09-03	No	5.21	0.70	7.48
240-a02n	2023-09-16	No	6.21	0.68	9.06
240-a02n	2023-10-01	No	5.57	0.61	9.12



**Table A2.** Chlorophyll a (CHL) and phycocyanin (PC) data collected during routine sampling on Brandy Lake in 2023 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.

Brandy Lake					
Site	Date	Bloom?	PC	CHL	PC:CHL
0562-a01o	2023-05-23	No	6.28	2.24	2.80
0562-a01o	2023-06-03	No	0.10	1.92	0.05
0562-a01o	2023-06-23	No	6.71	1.96	3.42
0562-a01o	2023-07-08	No	69.93	2.55	27.37
0562-a01o	2023-07-19	No	101.62	2.81	36.12
0562-a01o	2023-08-05	No	6.71	2.50	2.69
0562-a01o	2023-08-15	No	41.05	1.44	28.24
0562-a01o	2023-09-02	No	11.82	2.54	4.63
0562-a01o	2023-09-29	No	0.34	0.07	10.18
0562-a02n	2023-05-23	No	2.99	1.87	1.59
0562-a02n	2023-06-03	No	0.10	1.88	0.05
0562-a02n	2023-06-23	No	4.14	1.81	2.28
0562-a02n	2023-07-08	No	87.35	2.43	35.93
0562-a02n	2023-07-19	No	56.08	2.07	27.05
0562-a02n	2023-08-05	No	43.86	2.07	20.93
0562-a02n	2023-08-15	No	28.26	1.65	17.23
0562-a02n	2023-09-02	No	0.22	0.07	3.59
0562-a02n	2023-09-29	No	13.02	2.56	5.08

**Table A3.** Chlorophyll a (CHL) and phycocyanin (PC) data collected during routine sampling on Leonard Lake in 2023 for the nearshore (2540-a03n) and offshore (2540-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.

Leonard Lake					
Site	Date	Bloom?	PC	CHL	PC:CHL
2540-a01o	2023-05-23	No	3.03	0.60	5.03
2540-a01o	2023-06-20	No	3.67	0.43	8.47
2540-a01o	2023-07-05	No	2.87	0.48	5.97
2540-a01o	2023-07-18	No	4.80	0.49	9.80
2540-a01o	2023-07-31	No	3.87	0.49	7.97
2540-a01o	2023-08-14	No	3.97	0.53	7.50
2540-a01o	2023-08-28	No	4.77	0.50	9.47
2540-a01o	2023-09-12	No	5.30	0.57	9.33
2540-a01o	2023-09-25	No	3.80	0.46	8.27
2540-a01o	2023-10-13	No	7.50	0.47	16.10
2540-a01o	2023-10-24	No	6.13	0.48	12.87
2540-a03n	2023-05-23	No	2.33	0.48	4.87
2540-a03n	2023-06-20	No	3.23	0.36	9.10
2540-a03n	2023-07-05	No	1.57	0.37	4.23
2540-a03n	2023-07-18	No	3.83	0.44	8.80
2540-a03n	2023-07-31	No	3.30	0.49	6.80
2540-a03n	2023-08-14	No	3.47	0.50	6.97
2540-a03n	2023-08-28	No	4.03	0.46	8.50
2540-a03n	2023-09-12	No	2.93	0.58	5.10
2540-a03n	2023-09-25	No	2.50	0.44	5.67
2540-a03n	2023-10-13	No	5.63	0.47	12.10
2540-a03n	2023-10-24	No	5.93	0.49	12.07

**Table A4.** Chlorophyll a (CHL) and phycocyanin (PC) data collected during routine sampling on Mary Lake in 2023 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.

Mary Lake					
Site	Date	Bloom?	PC	CHL	PC:CHL
3032-a01o	2023-05-21	No	1.30	0.73	1.78
3032-a01o	2023-06-04	No	1.67	0.72	2.32
3032-a01o	2023-06-18	No	5.65	0.75	7.56
3032-a01o	2023-07-02	No	8.47	0.81	10.52
3032-a01o	2023-07-22	No	7.24	0.80	9.08
3032-a01o	2023-08-06	No	2.71	0.55	4.88
3032-a01o	2023-08-20	No	5.95	0.76	7.87
3032-a01o	2023-09-02	No	3.69	0.65	5.64
3032-a01o	2023-09-16	No	4.20	0.68	6.17
3032-a01o	2023-10-01	Yes	3.14	0.65	4.81
3032-a02n	2023-05-21	No	0.85	0.71	1.19
3032-a02n	2023-06-04	No	1.73	0.67	2.59
3032-a02n	2023-06-18	No	3.63	0.74	4.88
3032-a02n	2023-07-02	No	7.42	0.83	8.98
3032-a02n	2023-07-22	No	7.48	0.80	9.46
3032-a02n	2023-08-06	No	3.57	0.65	5.51
3032-a02n	2023-08-20	No	1.79	0.65	2.74
3032-a02n	2023-09-02	No	4.48	0.73	6.17
3032-a02n	2023-09-16	No	5.34	0.68	7.89
3032-a02n	2023-10-01	Yes	2.89	0.60	4.84
3032-a03n	2023-05-21	No	1.79	0.91	1.96
3032-a03n	2023-06-04	No	1.91	0.71	2.68
3032-a03n	2023-06-18	No	5.16	0.74	6.99
3032-a03n	2023-07-02	No	5.57	0.94	5.64
3032-a03n	2023-07-22	No	5.77	1.00	5.77
3032-a03n	2023-08-06	No	4.18	0.68	6.17
3032-a03n	2023-08-20	No	4.04	0.67	5.40
3032-a03n	2023-09-02	No	4.12	0.66	6.23
3032-a03n	2023-09-16	No	4.63	0.68	6.55
3032-a03n	2023-10-01	Yes	2.96	0.67	4.43
3032-a04n	2023-05-21	No	2.47	0.75	3.26
3032-a04n	2023-06-04	No	2.28	0.69	3.30
3032-a04n	2023-06-18	No	5.65	0.73	7.74
3032-a04n	2023-07-02	No	7.62	0.79	9.35
3032-a04n	2023-07-22	No	7.67	0.81	9.50
3032-a04n	2023-08-06	No	2.24	0.66	3.36
3032-a04n	2023-08-20	No	2.01	0.68	2.87
3032-a04n	2023-09-02	No	7.30	0.61	10.03
3032-a04n	2023-09-16	No	6.94	0.62	11.17
3032-a04n	2023-10-01	Yes	3.69	0.69	5.37

**Table A5.** Chlorophyll a (CHL) and phycocyanin (PC) data collected during routine sampling on Menominee Lake in 2023 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.

Menominee Lake					
Site	Date	Bloom?	PC	CHL	PC:CHL
3181-a01o	2023-06-03	No	21.85	1.38	15.82
3181-a01o	2023-06-29	No	11.96	1.36	8.74
3181-a01o	2023-07-17	No	12.02	1.31	9.14
3181-a01o	2023-07-30	No	4.30	1.25	3.44
3181-a01o	2023-08-14	No	5.44	1.16	4.69
3181-a01o	2023-08-27	No	18.24	1.42	12.82
3181-a01o	2023-09-15	No	3.00	1.20	2.49
3181-a01o	2023-09-27	No	7.35	1.21	6.09
3181-a01o	2023-10-12	No	6.42	1.10	5.86
3181-a02n	2023-06-03	No	2.86	1.02	2.81
3181-a02n	2023-06-29	No	2.50	1.32	1.88
3181-a02n	2023-07-17	No	4.42	1.17	3.78
3181-a02n	2023-07-30	No	15.98	1.53	10.38
3181-a02n	2023-08-14	No	11.03	1.47	7.51
3181-a02n	2023-08-27	No	3.76	1.15	3.41
3181-a02n	2023-09-15	No	0.10	1.12	0.08
3181-a02n	2023-09-27	No	1.41	1.20	1.16
3181-a02n	2023-10-12	No	4.93	1.13	4.35



**Table A6.** Chlorophyll a (CHL) and phycocyanin (PC) data collected during routine sampling on Muldrew Lakes in 2023 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.

Muldrew Lakes					
Site	Date	Bloom?	PC	CHL	PC:CHL
5075-a01o	2023-06-24	No	2.92	1.05	2.78
5075-a01o	2023-07-09	No	3.86	1.32	2.92
5075-a01o	2023-07-22	No	3.50	1.36	2.57
5075-a01o	2023-08-05	No	4.78	1.26	3.78
5075-a01o	2023-08-20	No	6.56	1.15	5.68
5075-a01o	2023-09-09	No	6.10	1.08	5.62
5075-a01o	2023-09-22	No	3.10	1.03	3.01
5075-a01o	2023-10-07	No	3.46	0.94	3.69
5075-a01o	2023-10-20	No	3.22	1.00	3.20
5075-a01o	2023-11-04	No	2.86	0.97	2.94
5075-a02n	2023-06-24	No	1.85	0.96	1.86
5075-a02n	2023-07-09	No	3.50	1.44	2.42
5075-a02n	2023-07-22	No	5.85	1.24	4.72
5075-a02n	2023-08-05	No	4.49	1.35	3.32
5075-a02n	2023-08-20	No	7.49	1.18	6.34
5075-a02n	2023-09-09	No	4.78	1.04	4.59
5075-a02n	2023-09-23	No	2.56	0.86	2.97
5075-a02n	2023-10-07	No	2.98	0.91	3.27
5075-a02n	2023-10-20	No	2.32	0.95	2.45
5075-a02n	2023-11-04	No	3.04	0.98	3.09

**Table A7.** Chlorophyll a (CHL) and phycocyanin (PC) data collected during routine sampling on Peninsula Lake in 2022 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.

Peninsula Lake					
Site	Date	Bloom?	PC	CHL	PC:CHL
4309-a01o	2023-07-02	No	5.08	0.46	11.01
4309-a01o	2023-07-16	No	5.26	0.52	8.54
4309-a01o	2023-07-29	No	7.06	0.59	11.96
4309-a01o	2023-08-13	No	5.14	0.47	10.92
4309-a01o	2023-08-26	No	3.58	0.39	42.59
4309-a01o	2023-09-09	No	4.54	0.41	11.06
4309-a01o	2023-09-23	No	6.65	0.47	14.12
4309-a02n	2023-07-02	No	4.00	0.59	6.81
4309-a02n	2023-07-16	No	4.42	0.46	9.54
4309-a02n	2023-07-29	No	6.34	0.61	10.38
4309-a02n	2023-08-13	No	4.36	0.41	10.55
4309-a02n	2023-08-26	No	3.82	0.39	9.63
4309-a02n	2023-09-09	No	4.48	0.44	10.34
4309-a02n	2023-09-23	No	3.42	0.42	10.39

**Table A8.** Chlorophyll a (CHL) and phycocyanin (PC) data collected during routine sampling on Ril Lake in 2023 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.

Ril Lake					
Site	Date	Bloom?	PC	CHL	PC:CHL
4627-a01o	2023-07-05	No	3.34	0.74	4.49
4627-a01o	2023-07-12	No	2.20	0.69	3.17
4627-a01o	2023-07-25	No	2.62	0.74	3.54
4627-a01o	2023-08-10	No	4.90	0.74	6.64
4627-a01o	2023-08-23	No	4.90	0.73	6.71
4627-a01o	2023-09-05	No	5.92	0.74	7.96
4627-a01o	2023-09-20	No	5.68	0.71	7.95
4627-a01o	2023-10-06	No	3.10	0.61	5.08
4627-a02n	2023-07-05	No	2.86	0.70	4.10
4627-a02n	2023-07-12	No	2.92	0.71	4.11
4627-a02n	2023-07-25	No	4.96	0.72	6.91
4627-a02n	2023-08-10	No	4.78	0.78	6.09
4627-a02n	2023-08-23	No	9.10	0.74	12.24
4627-a02n	2023-09-05	No	3.46	0.68	5.08
4627-a02n	2023-09-20	No	5.08	0.70	7.22
4627-a02n	2023-10-06	No	4.96	0.73	6.81

**Table A9.** Chlorophyll a (CHL) and phycocyanin (PC) data collected during routine sampling on Six Mile Lake in 2023 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.

Six Mile Lake					
Site	Date	Bloom?	PC	CHL	PC:CHL
4978-a01o	2023-05-30	No	8.81	0.69	11.22
4978-a01o	2023-06-13	No	0.60	0.59	0.95
4978-a01o	2023-06-23	No	5.36	0.60	8.53
4978-a01o	2023-07-09	No	11.92	0.68	17.37
4978-a01o	2023-07-25	No	11.36	0.63	18.16
4978-a01o	2023-08-09	No	9.11	0.70	12.97
4978-a01o	2023-08-20	No	3.59	0.55	6.52
4978-a01o	2023-09-04	No	7.47	0.50	14.58
4978-a01o	2023-09-21	No	6.45	0.47	13.78
4978-a01o	2023-10-02	No	7.02	0.52	13.47
4978-a01o	2023-10-17	No	2.70	0.45	5.96
4978-a02n	2023-05-30	No	3.38	0.78	4.40
4978-a02n	2023-06-13	No	1.69	0.57	2.62
4978-a02n	2023-06-23	No	3.66	0.52	6.96
4978-a02n	2023-07-09	No	3.11	0.58	5.35
4978-a02n	2023-07-25	No	11.65	0.65	18.03
4978-a02n	2023-08-09	No	15.15	0.66	22.91
4978-a02n	2023-08-20	No	3.65	0.47	7.79
4978-a02n	2023-09-04	No	10.83	0.53	19.95
4978-a02n	2023-09-21	No	8.92	0.47	18.86
4978-a02n	2023-10-02	No	2.84	0.40	7.04
4978-a02n	2023-10-17	No	2.17	0.43	4.97

**Table A10.** Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Stewart Lake in 2023 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.

Stewart Lake					
Site	Date	Bloom?	PC	CHL	PC:CHL
5166-a01o	2023-06-19	No	7.89	0.87	8.97
5166-a01o	2023-07-04	No	5.84	0.61	5.37
5166-a01o	2023-07-18	No	19.42	0.88	22.05
5166-a01o	2023-08-01	No	23.76	1.07	21.84
5166-a01o	2023-08-14	No	17.63	0.89	19.75
5166-a01o	2023-08-27	Yes	22.93	0.96	23.78
5166-a01o	2023-09-11	Yes	4.54	0.71	6.38
5166-a01o	2023-09-26	Yes	30.09	1.25	24.01
5166-a01o	2023-10-12	Yes	11.79	0.78	14.90
5166-a01o	2023-10-23	Yes	13.58	0.75	18.01
5166-a02n	2023-06-19	No	14.67	0.92	15.84
5166-a02n	2023-07-04	No	2.90	0.60	4.83
5166-a02n	2023-07-18	No	20.11	0.83	23.36
5166-a02n	2023-08-01	No	28.30	1.26	22.14
5166-a02n	2023-08-14	No	1.88	0.67	2.80
5166-a02n	2023-08-27	Yes	7.00	0.68	10.89
5166-a02n	2023-09-11	Yes	3.92	0.62	6.30
5166-a02n	2023-09-26	Yes	11.24	0.78	14.11
5166-a02n	2023-10-12	Yes	12.13	0.72	16.61
5166-a02n	2023-10-23	Yes	5.77	0.71	8.09
5166-a03n	2023-06-19	No	6.65	0.74	8.94
5166-a03n	2023-07-04	No	8.36	0.85	9.86
5166-a03n	2023-07-18	No	3.59	0.58	6.18
5166-a03n	2023-08-01	No	28.57	0.99	27.99
5166-a03n	2023-08-14	No	36.90	1.13	32.60
5166-a03n	2023-08-27	Yes	16.81	0.85	19.43
5166-a03n	2023-09-11	Yes	5.84	0.65	8.93
5166-a03n	2023-09-26	Yes	2.77	0.64	4.32
5166-a03n	2023-10-12	Yes	12.68	0.89	14.19
5166-a03n	2023-10-23	Yes	5.77	0.76	7.59
5166-a04n	2023-06-19	No	7.89	0.85	9.23
5166-a04n	2023-07-04	No	5.29	0.68	7.82
5166-a04n	2023-07-18	No	3.58	0.62	5.78
5166-a04n	2023-08-01	No	2.99	0.68	3.89
5166-a04n	2023-08-14	No	26.23	0.98	26.36
5166-a04n	2023-08-27	Yes	4.74	0.71	6.69
5166-a04n	2023-09-11	Yes	8.23	0.67	12.07
5166-a04n	2023-09-26	Yes	3.25	0.64	5.09
5166-a04n	2023-10-12	Yes	13.23	0.82	16.11
5166-a04n	2023-10-23	Yes	5.63	0.68	8.32
5166-a01o	2023-06-19	Yes	7.89	0.87	8.97



**Table A11.** Chlorophyll *a* (CHL) and phycocyanin (PC) data collected during routine sampling on Three Mile Lake in 2023 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.

Three Mile Lake					
Site	Date	Bloom?	PC	CHL	PC:CHL
5362-a01o	2023-05-22	No	8.92	1.02	8.70
5362-a01o	2023-06-05	No	8.92	0.93	9.58
5362-a01o	2023-06-19	No	8.09	0.97	8.30
5362-a01o	2023-07-03	No	13.38	1.15	11.63
5362-a01o	2023-07-07	No	25.61	1.32	19.35
5362-a01o	2023-07-11	No	16.31	1.03	15.84
5362-a01o	2023-07-17	No	27.61	1.13	24.42
5362-a01o	2023-07-31	No	44.69	1.33	33.50
5362-a01o	2023-08-14	No	41.69	1.46	28.63
5362-a01o	2023-08-28	No	46.46	1.34	34.67
5362-a01o	2023-09-11	No	24.76	1.14	21.75
5362-a01o	2023-09-25	No	102.23	1.68	60.97
5362-a01o	2023-10-11	Yes	103.54	1.40	73.78
5362-a02n	2023-05-22	No	10.46	1.01	10.41
5362-a02n	2023-06-05	No	6.61	0.85	7.78
5362-a02n	2023-06-19	No	6.38	0.97	6.59
5362-a02n	2023-07-03	No	12.15	1.04	11.68
5362-a02n	2023-07-07	No	25.07	1.39	18.00
5362-a02n	2023-07-11	No	13.76	1.03	13.35
5362-a02n	2023-07-17	No	23.69	1.12	21.11
5362-a02n	2023-07-31	No	42.92	1.37	31.32
5362-a02n	2023-08-14	No	31.84	1.48	21.55
5362-a02n	2023-08-28	No	36.61	1.50	24.51
5362-a02n	2023-09-11	No	49.07	1.45	33.81
5362-a02n	2023-09-25	No	107.55	1.65	65.04
5362-a02n	2023-10-11	Yes	96.15	1.39	69.16
5362-a03o	2023-07-17	No	30.07	1.03	29.10
5362-a03o	2023-07-31	No	21.84	0.97	22.60
5362-a03o	2023-08-14	No	24.30	1.09	22.37
5362-a03o	2023-08-28	No	20.99	0.96	21.95
5362-a03o	2023-09-11	No	46.61	1.46	31.85
5362-a03o	2023-09-25	No	41.46	1.23	33.71
5362-a03o	2023-10-11	Yes	49.53	1.20	41.16
5362-a04n	2023-07-17	No	28.76	1.19	24.19
5362-a04n	2023-07-31	No	20.61	0.94	21.93
5362-a04n	2023-08-14	No	25.30	1.04	24.24
5362-a04n	2023-08-28	No	22.92	0.94	24.29
5362-a04n	2023-09-11	No	24.61	1.15	21.35
5362-a04n	2023-09-25	No	44.61	1.17	38.23
5362-a04n	2023-10-11	Yes	38.38	1.07	35.85

**Table A12.** Chlorophyll a (CHL) and phycocyanin (PC) data collected during routine sampling on Lake Vernon in 2023 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.

Lake Vernon					
Site	Date	Bloom?	PC	CHL	PC:CHL
6455-a01o	2023-05-19	No	3.35	1.04	3.21
6455-a01o	2023-06-01	No	7.00	1.05	6.59
6455-a01o	2023-06-15	No	0.16	1.02	0.15
6455-a01o	2023-06-29	No	7.99	0.96	5.99
6455-a01o	2023-07-14	No	5.07	0.95	5.33
6455-a01o	2023-07-27	No	0.34	1.38	0.24
6455-a01o	2023-08-11	No	7.07	1.07	6.58
6455-a01o	2023-08-25	No	4.42	1.07	4.14
6455-a01o	2023-09-08	No	2.71	0.92	2.93
6455-a01o	2023-09-22	No	5.49	0.96	5.70
6455-a01o	2023-10-05	No	3.14	1.17	2.68
6455-a01o	2023-10-18	No	3.21	0.96	3.33
6455-a03n	2023-05-19	No	3.14	1.04	3.01
6455-a03n	2023-06-01	No	2.85	0.88	3.25
6455-a03n	2023-06-15	No	1.64	1.04	1.58
6455-a03n	2023-06-29	No	8.42	0.92	9.02
6455-a03n	2023-07-14	No	3.92	0.93	4.19
6455-a03n	2023-07-27	No	4.64	1.27	3.64
6455-a03n	2023-08-11	No	4.57	1.04	4.40
6455-a03n	2023-08-25	No	4.28	1.00	4.26
6455-a03n	2023-09-08	No	3.28	0.95	3.47
6455-a03n	2023-09-22	No	4.86	0.95	5.11
6455-a03n	2023-10-05	No	4.14	0.90	4.59
6455-a03n	2023-10-18	No	2.64	0.91	2.89