2023 Cyanobacteria Monitoring Report

Government of Newfoundland & Labrador
Department of Environment & Climate Change
Water Resources Management Division

Newfoundland Labrador

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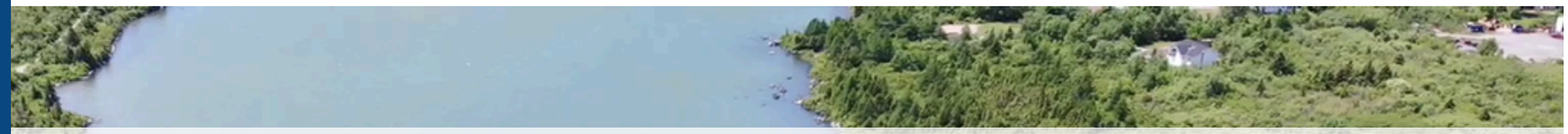
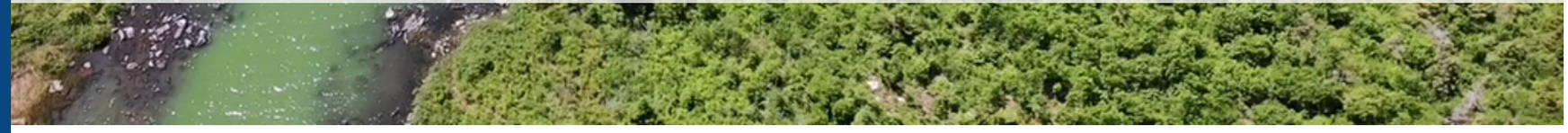


Cyanobacteria, or blue-green algae, are algae-like bacteria that occur naturally in many aquatic and terrestrial environments throughout the world. Cyanobacteria are naturally occurring and are considered one of the most ancient life forms on earth. Individual organisms are not visible to the human eye. Certain conditions can cause cyanobacteria populations to increase rapidly, and can result in dense accumulations of cells, commonly known as blooms. Cyanobacteria blooms can be easily observed and are often a distinct blue-green colour.

In temperate zones, blooms are most common in the summer and early fall, when surface waters are warmest. In addition to water temperature, a key factor contributing to the growth of blue-green algae and the formation of a bloom is the amount of available nutrients such as phosphorus and nitrogen.

Cyanobacteria can quickly dominate a waterscape and outcompete other key species. Many species of cyanobacteria can produce toxins, also known as cyanotoxins, which are harmful or potentially lethal to humans and animals. The most common cyanotoxins in Canadian waters are microcystins, a family of toxins that includes over 250 known variants. Health Canada has established separate guidelines for drinking and recreational waters regarding cyanobacterial cell counts and total microcystins. Total microcystins include toxins dissolved in the water as well as those contained within the cell of the cyanobacteria. These guidelines are used to help support cyanobacteria management in Newfoundland and Labrador. There are other toxins produced by cyanobacteria; unfortunately, testing for these toxins is not widely available.

The *Guidelines for Canadian Recreational Water Quality* recommends that total cyanobacteria cells do not exceed a density of 50,000 cells/mL and total microcystins do not exceed 10 µg/L for recreational waters involving primary contact recreation (swimming or other activities with direct exposure to water). Cyanobacteria and their toxins are a major concern for drinking water in Canada; however, in Newfoundland and Labrador no blooms have been reported in drinking water supplies. Health Canada's *Guidelines for Canadian Drinking Water Quality* recommend that the seasonal maximum acceptable concentration of total microcystin is 1.5 µg/L.



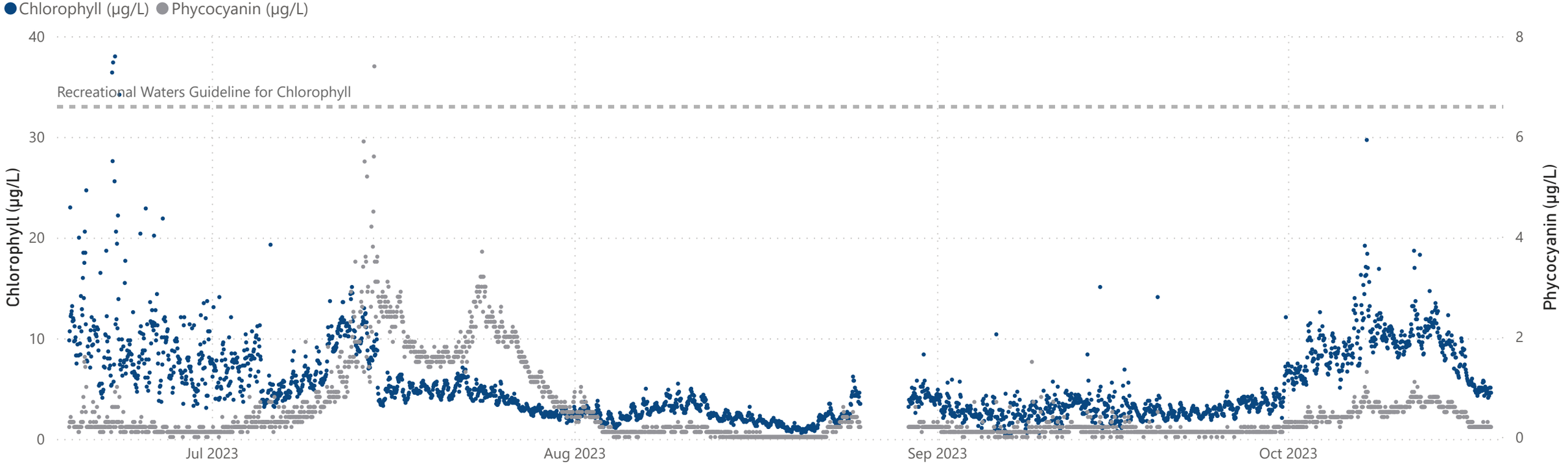
Chlorophyll & Phycocyanin

0.30	0.00
Min Chlorophyll (µg/L)	Min Phycocyanin (µg/L)
38.00	7.40
Max Chlorophyll (µg/L)	Max Phycocyanin (µg/L)
5.20	0.51
Average Chlorophyll (µg/L)	Average Phycocyanin (µg/L)

In 2023, there was only one confirmed report of a cyanobacteria bloom in Newfoundland and Labrador, which occurred in Forest Pond, which is located in the towns of Victoria and Salmon Cove. In June, an EXO^2 with temperature, turbidity, dissolved oxygen, specific conductivity, and BGA sensors were installed on a data collection buoy with near real-time capacity. Data from August 25th to 29th are missing due to sonde maintenance at this time.

Health Canada's *Guidelines for Canadian Recreational Water Quality* advises a maximum chlorophyll concentration of 33 µg/L. EXO^2 uses optical sensors to detect pigments in photosynthesizing cells (algae and cyanobacteria cells). Chlorophyll A is found in all photosynthesizing cells including green algae and cyanobacteria. Phycocyanin is predominately found in cyanobacteria cells. In July, the phycocyanin concentration began to rise from near zero levels, until peaking at 7.40 µg/L on July 14th. Concentrations then dropped and peaked again on July 24th. This corresponded with a visual report from a member of the public on Friday July 14th, 2023.

Chlorophyll (µg/L) and Phycocyanin (µg/L) in Forest Pond



Cyanobacteria, Algae, and Microcystin Grab Samples

Date	Cyanobacteria cells/mL	Total Cells/mL	Microcystin (µg/L)
6/23/2023	0	9	NA
7/17/2023	25000	28000	<0.15
7/21/2023	29800	34000	<0.15
7/25/2023	34300	36000	<0.15
8/1/2023	11700	14000	<0.15
8/7/2023	0	3800	<0.15
8/17/2023	0	1500	<0.15

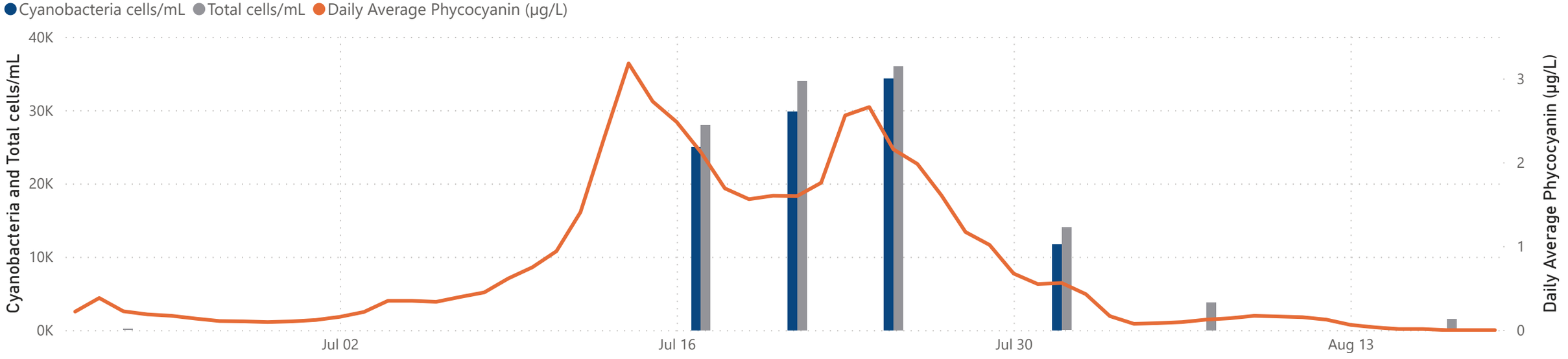
*The Method Detection Limit (minimum detectable concentration) for microcystin analysis is 0.15(µg/L).

Sample dates for Forest Pond are listed in the table to the left. The first sample was taken prior to any reported cyanobacteria blooms on June 23rd, 2023. At this time, no cyanobacteria cells were found and the total algal cell count was 9 cells/mL.

After reports of a bloom on Friday, July 14th, Government of Newfoundland and Labrador's Water Resources Management Division sampled on Monday July 17th. A bloom was confirmed; however, cell count levels did not exceed Health Canada's *Guidelines for Canadian Recreational Water Quality* (50,000 cells/mL). Samples were collected one to two times a week until the bloom subsided around the beginning of August. The sample with the highest concentration of cyanobacteria cells (34,300 cells/mL) was collected on July 25th 2023.

Forest Pond was also tested for microcystins, the most common cyanotoxin in Canadian waters, throughout the season. No samples returned values above the analysis' method detection limit of 0.15 µg/L. Health Canada's *Guidelines for Canadian Recreational Water Quality* for microcystins is 10 µg/L.

Cyanobacteria cell/mL, Total cells, mL and Phycocyanin (µg/L) in Forest Pond

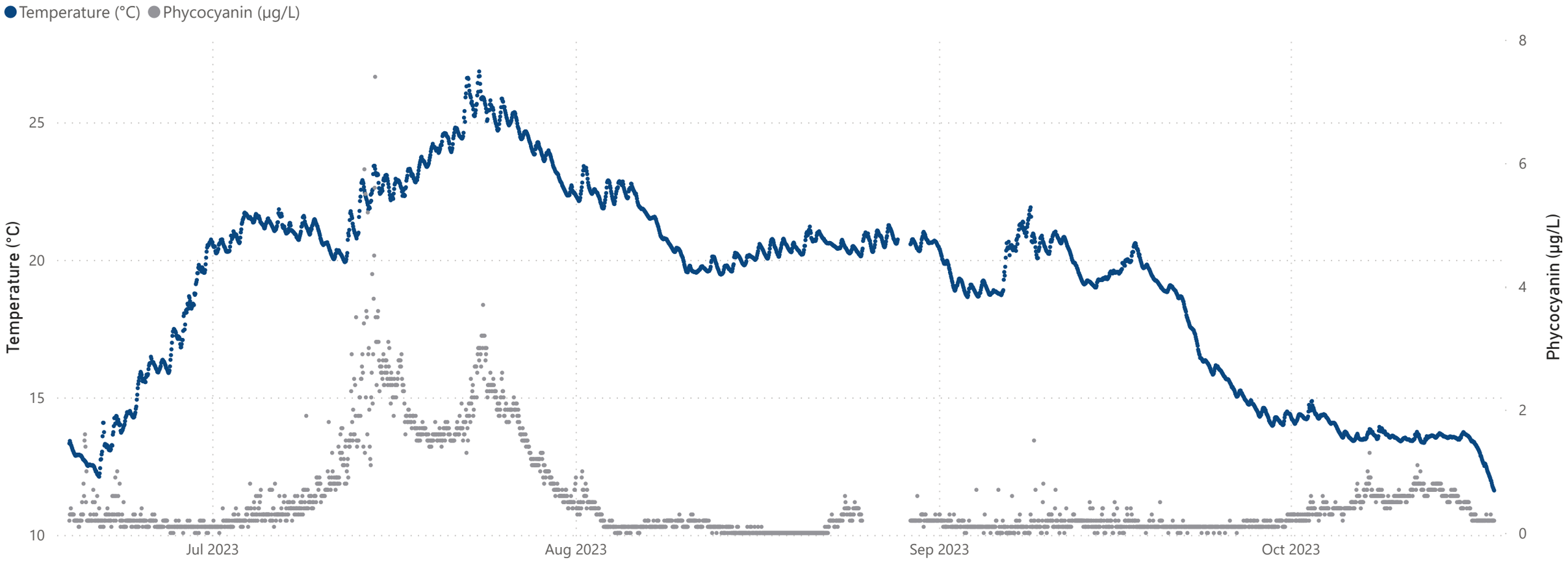


Temperature

11.62	26.85	19.14
Min Temperature (°C)	Max Temperature (°C)	Average Temperature (°C)

Many species of cyanobacteria thrive in warm waters, which is why cyanobacteria blooms are often associated with warm summers. During the 2023 Forest Pond Bloom, maximum phycocyanin levels occurred during the warmest period; Health Canada's Recreational Guidelines were not exceeded at this time nor throughout the season. The temperature sensor was located approximately one meter below the lake surface, where waters reached a maximum temperature of 26.85°C.

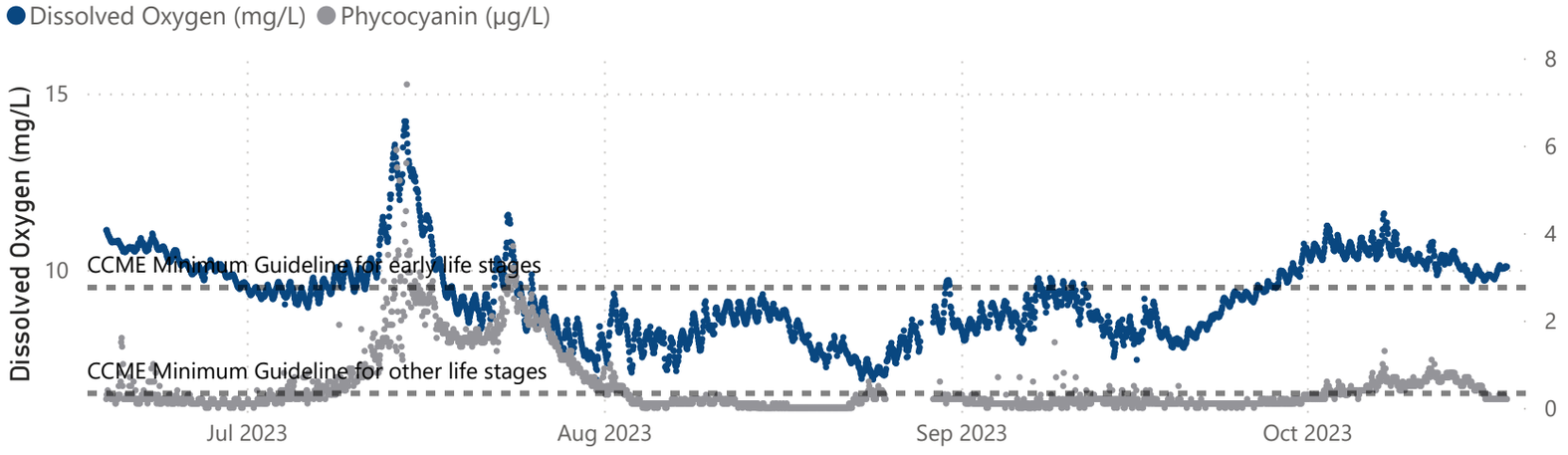
Temperature (°C) and Phycocyanin (µg/L) in Forest Pond



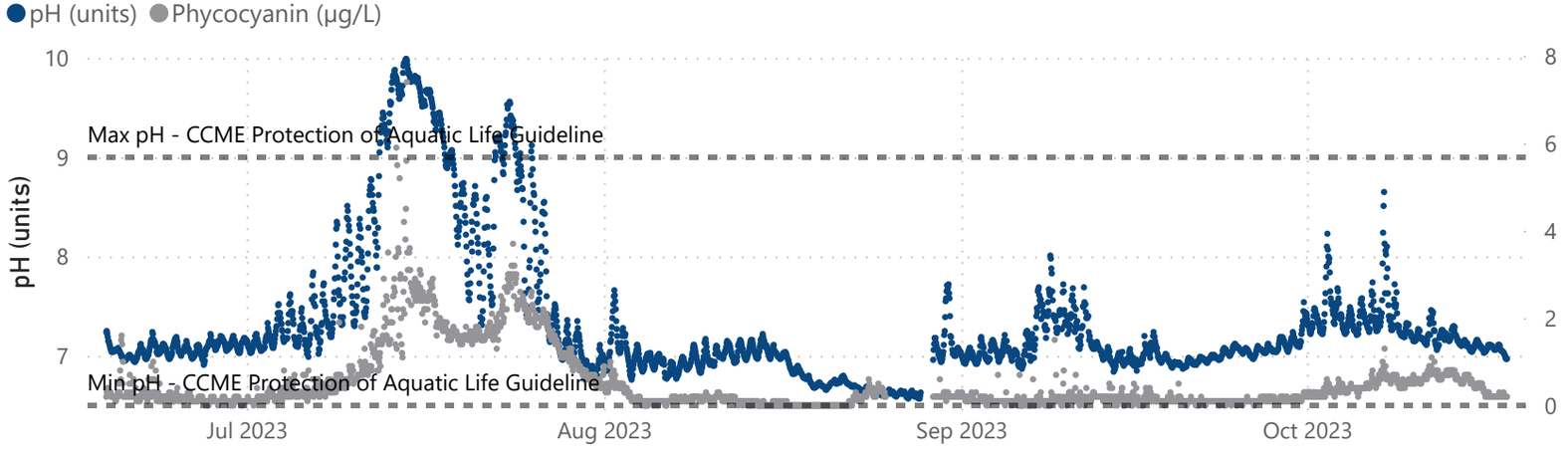
Dissolved Oxygen & pH

6.89	14.21	9.24	6.57	9.99	7.33
Min DO (mg/L)	Max DO (mg/L)	Average DO (mg/L)	Min pH	Max pH	Average pH

Dissolved Oxygen (mg/L) and Phycocyanin (µg/L) in Forest Pond



pH and Phycocyanin (µg/L) in Forest Pond

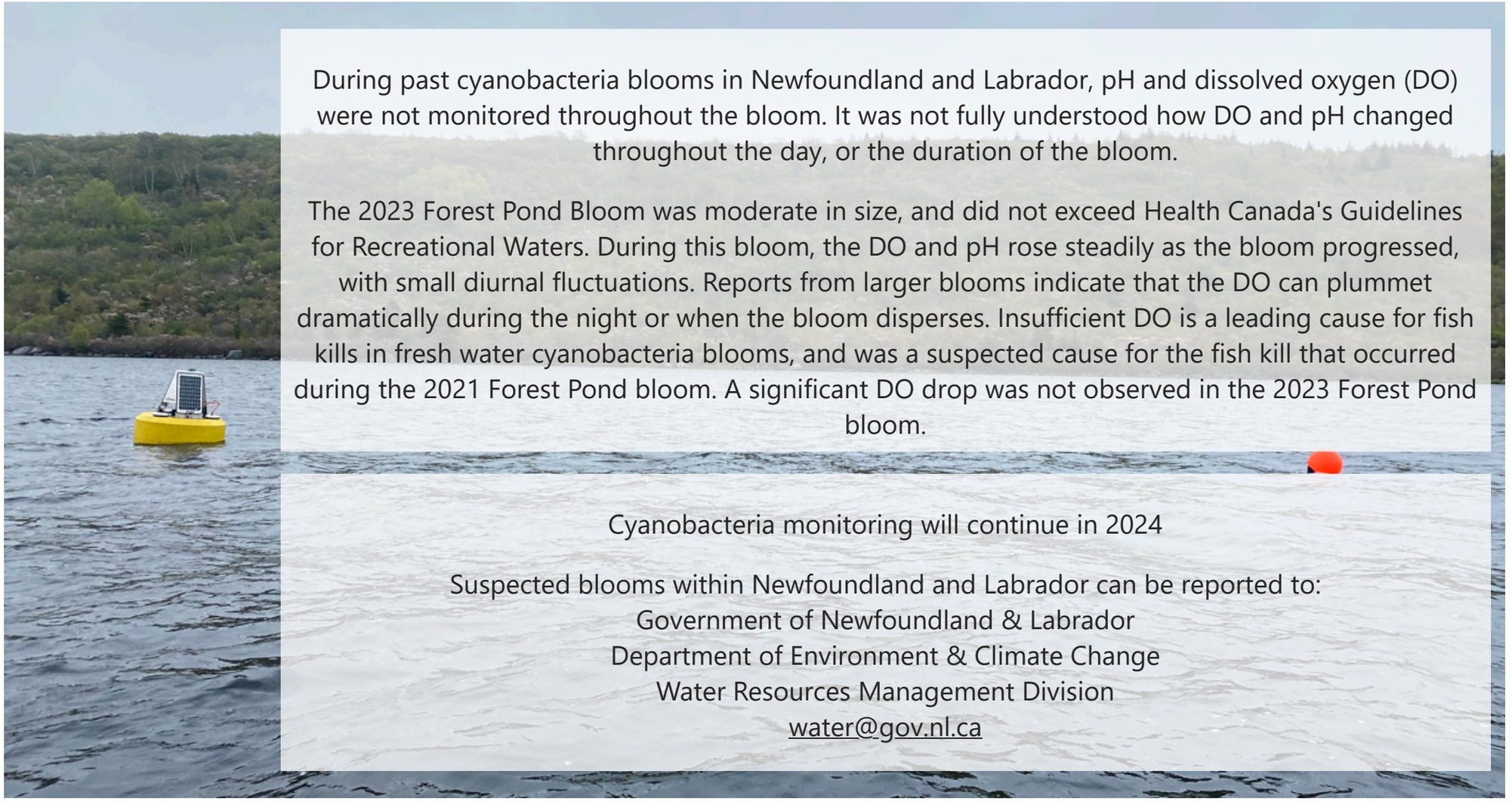


When organisms, like cyanobacteria, photosynthesize (convert light energy into sugars), they produce oxygen from carbon dioxide. During a bloom, cyanobacteria can drastically increase dissolved oxygen (DO). As seen in the DO graph to the left, DO concentrations rise and fall as the concentration of phycocyanin increases and decreases.

As blooms die off, it can also cause the concentration of DO to drop, which can result in fish kills, or other negative impacts for the waterbody. During this deployment, DO did not fall below the Canadian Council of Ministers of the Environment (CCME) Minimum Guidelines for other life stages. However, at times DO was below the guidelines for early life stages.

pH is influenced by the concentration of carbon dioxide in water. Photosynthesis decreases carbon dioxide, thus increasing the pH of the water. During the bloom, the pH of the waterbody increased significantly, becoming more basic in nature. The pH peaked on July 14th when it reached 9.99 pH units. CCME's freshwater guidelines for pH recommends a minimum pH of 6 and maximum pH of 9 for protection of aquatic life. The pH was higher than the max pH guideline during the height of the bloom.

Key Findings & Contact



During past cyanobacteria blooms in Newfoundland and Labrador, pH and dissolved oxygen (DO) were not monitored throughout the bloom. It was not fully understood how DO and pH changed throughout the day, or the duration of the bloom.

The 2023 Forest Pond Bloom was moderate in size, and did not exceed Health Canada's Guidelines for Recreational Waters. During this bloom, the DO and pH rose steadily as the bloom progressed, with small diurnal fluctuations. Reports from larger blooms indicate that the DO can plummet dramatically during the night or when the bloom disperses. Insufficient DO is a leading cause for fish kills in fresh water cyanobacteria blooms, and was a suspected cause for the fish kill that occurred during the 2021 Forest Pond bloom. A significant DO drop was not observed in the 2023 Forest Pond bloom.

Cyanobacteria monitoring will continue in 2024

Suspected blooms within Newfoundland and Labrador can be reported to:
Government of Newfoundland & Labrador
Department of Environment & Climate Change
Water Resources Management Division
water@gov.nl.ca