2024 Cyanobacteria Monitoring Report

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

Newfoundland Labrador

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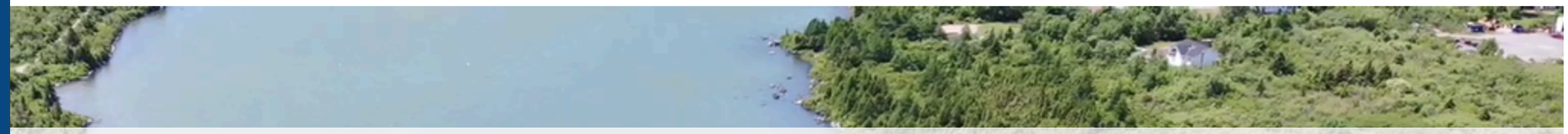
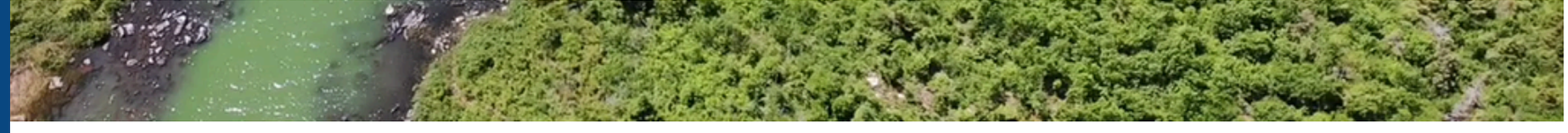


Cyanobacteria, or blue-green algae, are algae-like bacteria that naturally occur in many aquatic and terrestrial environments around the world. Cyanobacteria are considered one of the most ancient life forms on earth. Individual organisms are not visible to the human eye. Certain conditions can cause 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. Some species of cyanobacteria can produce toxins, or 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* states that total cyanobacteria cells should 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* states that the seasonal maximum acceptable concentration of total microcystin is 1.5 µg/L.



In 2023 the only confirmed algal bloom occurred in Forest Pond, a 1.5 km long lake which borders the towns of Victoria and Salmon Cove. Due to Forest Pond's proximity and history of blooms, a real-time water monitoring buoy was deployed for the 2024 season to further cyanobacteria research initiatives.

In 2024 there were four waterbodies tested for algal blooms in Newfoundland and Labrador. In late July, WRMD's buoy detected early signs of a bloom in Forest Pond; however, the bloom did not progress. The max concentration reached was 19,000 cyanobacteria cells/mL. *Dolichospermum* was the dominant genus of cyanobacteria found; however, the cell concentration did not exceed *Health Canada's Guidelines for Recreational Water Quality*, and no toxins were detected. Section II of this report goes into further details regarding the results from the data collection at Forest Pond.

Two algal blooms occurred in Labrador City; one in Little Wabush Lake, Labrador City, and the second in a small unnamed lake approximately 15 km southwest of Labrador City (52.873190°N, 67.101169°W). The Little Wabush Lake bloom was sampled on October 1st, 2024. At this time, the total cell count was 67,000 cells/mL; however, only 2100 cells/mL were cyanobacteria. The dominant genus at the time, *Dinobryon sp*., are a short lived algae that are not harmful to humans, pets, or livestock; however, they can produce toxins which can harm fish and other gill-breathing species. The second bloom was also sampled on October 1st, at an unnamed lake. It had a total cell count of 16,000 cells/mL. The dominant genus was the same cyanobacteria species as Forest Pond, *dolichospermum*, which had a concentration of 13,000 cells/mL. Neither of these sites exceeded *Health Canada's Guidelines for Recreational Water Quality*, and no toxins were detected.

The final algal bloom of 2024 occurred in Gander Lake, and was reported at the start of October. On October 4th, Gander Lake was sampled and found to be dominated by green algae genera *Desmodesmus* (13000 cells/mL) and *Volvulina* (5800 cells/mL). The cyanobacteria genus *Pseudanabaena* was detected at a concentration of 2100 cells/mL which did not exceed *Health Canada's Guidelines for Recreational Water Quality*, and no toxins were detected.

2024 Bloom Locations

Cyanobacteria, Algae, and Microcystin Grab Samples

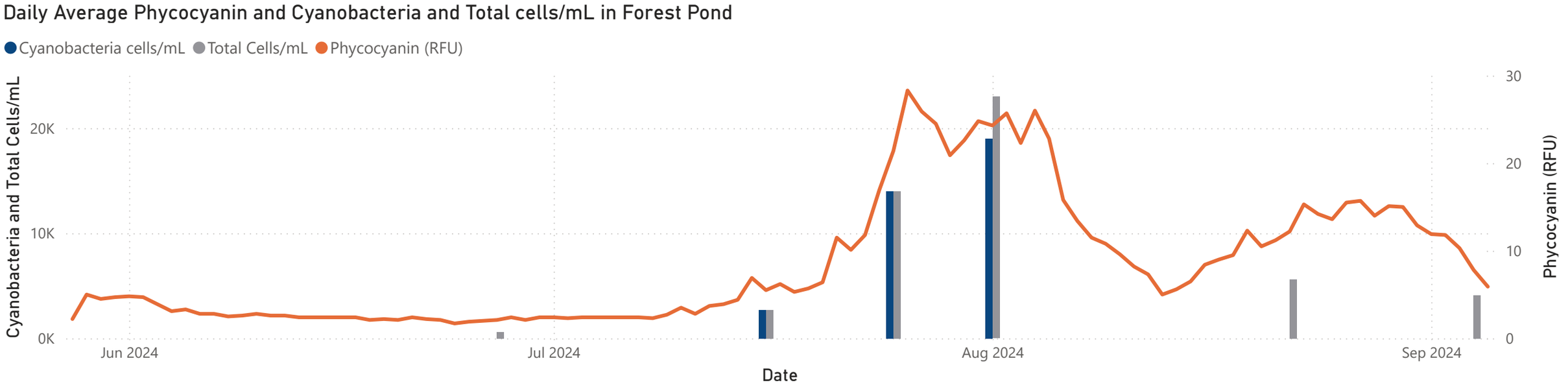
Grab sample results are listed to the right alongside regularly collected water samples from Forest Pond used to validate data collected by the research buoy deployed at this site. No blooms during 2024 exceeded *Health Canada's Guidelines for Recreational Water Quality* (50,000 cells/mL of cyanobacteria).

Waters were also tested for microcystins, the most common toxin produced by cyanobacteria. Results can be found in the table to the left. NA (not applicable) indicates that this test was not conducted at this time. No samples returned values above the analyses method detection limit of 0.15 µg/L. Health Canada's *Guidelines for Canadian Recreational Water Quality* for microcystins is 10 µg/L.

Below, the grab results from Forest Pond are plotted alongside the buoy results, which is located in the municipalities of Victoria and Salmon Cove. Buoy and grab sample results indicate early signs of a bloom at Forest Pond in July and August.

Date	Location	Cyanobacteria cells/mL	Total Cells/mL	Microcystin (µg/L)
24/05/06	Forest Pond	0	2200	NA
24/06/27	Forest Pond	0	600	NA
24/07/16	Forest Pond	2700	2700	NA
24/07/25	Forest Pond	14000	14000	<0.15
24/08/01	Forest Pond	19000	23000	<0.15
24/08/22	Forest Pond	0	5600	<0.15
24/09/04	Forest Pond	0	4100	NA
24/10/01	Little Wabush Lake	2100	67000	<0.15
24/10/01	Unnamed Lake	13000	16000	<0.15
24/10/04	Gander Lake	2100	27000	<0.15

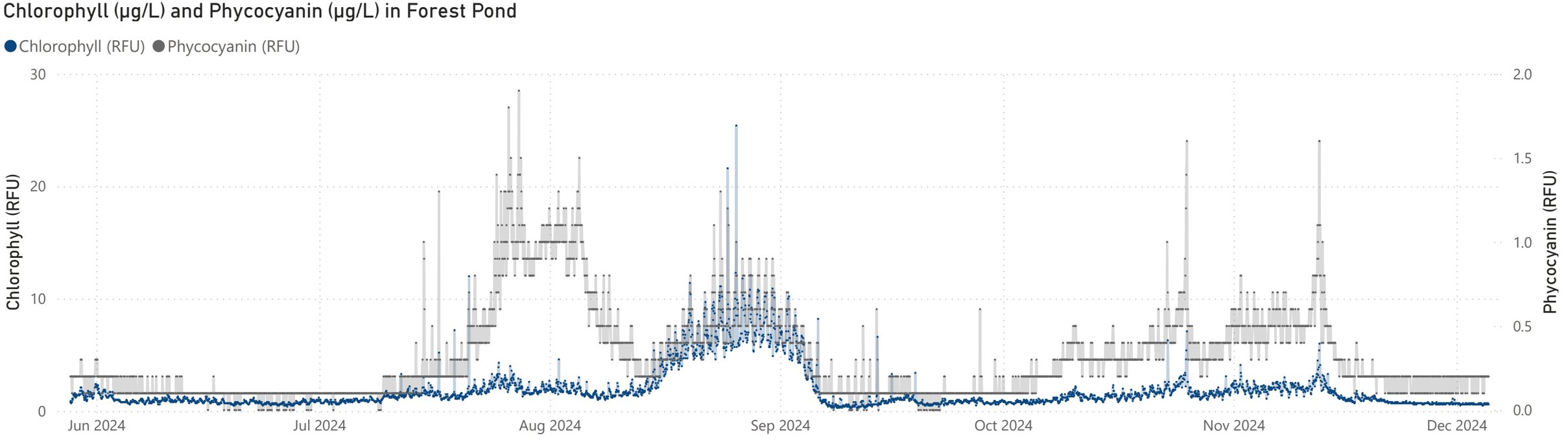
*The Method Detection Limit (minimum detectable concentration) for microcystin analysis is 0.15(µg/L).



Chlorophyll & Phycocyanin

In 2023 the only confirmed algal bloom occurred in Forest Pond, a 1.5 km lake bordering the towns of Victoria and Salmon Cove. Due to Forest Pond's proximity and history of blooms, a real-time water monitoring buoy was deployed for the 2024 season to further cyanobacteria research initiatives. In June, an EXO^2 with temperature, turbidity, dissolved oxygen, specific conductivity, and sensors measuring the concentration of Chlorophyll and Phycocyanin pigments was installed on a data collection buoy with near real-time capacity. The EXO^2 was removed in December. These sensors use RFUs or relative fluorescence units, which quantifies energy emitted by the pigments.

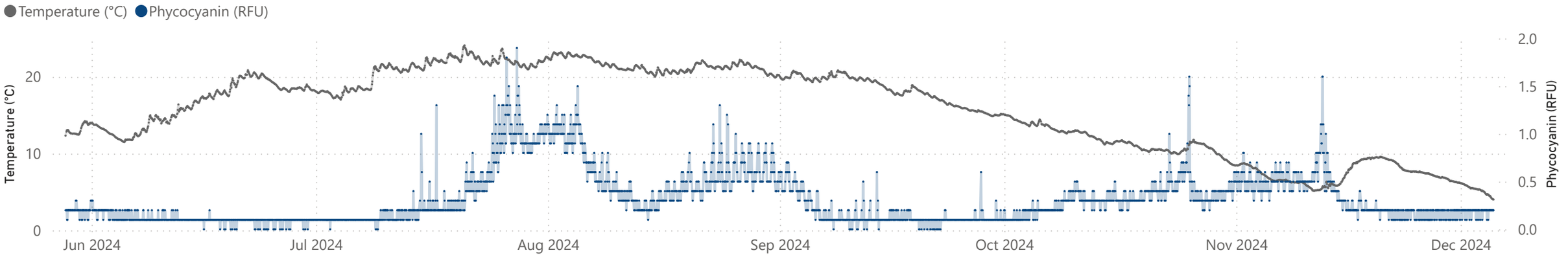
EXO^2 uses the EXO Total Algae PC Smart Sensor optical sensor to detect pigments in photosynthesizing cells (algae and cyanobacteria cells). Chlorophyll A is found in all photosynthesizing cells including green algae and cyanobacteria. Phycocyanin is predominately found in cyanobacteria cells. In 2024, there were two larger peaks; the first began around July 20th. At this time, phycocyanin rapidly rose from 0.1µg/L to 1.9 µg/L. The second peak followed around August 15th; however, this time chlorophyll rapidly rose from 5µg/L to 49µg/L. This indicates that cyanobacteria were responsible for early signs of a bloom in July and green algae (not cyanobacteria) were responsible for early signs of a bloom in August. Grab samples confirm that the first event was dominated by *dolichospermum*, a species of cyanobacteria, and the second event was dominated by a green algae.



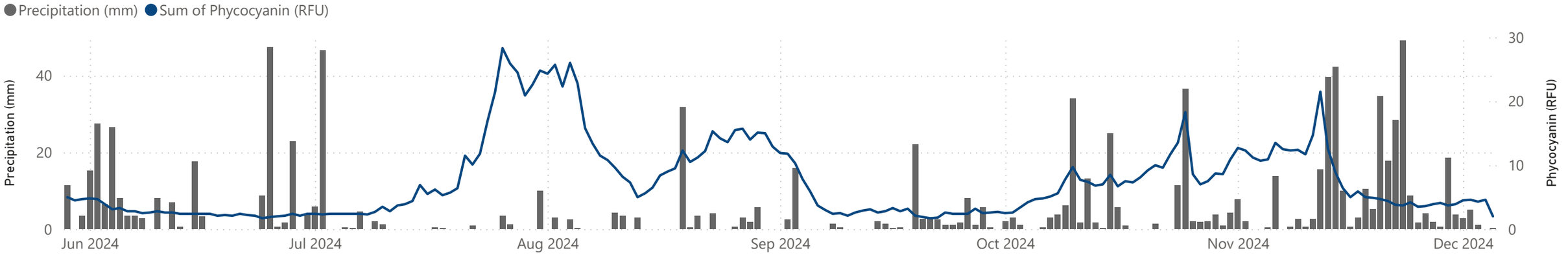
Temperature & Precipitation

Many species of cyanobacteria thrive in warm waters, which is why cyanobacteria blooms are often associated with warm summers. 2024 results from Forest Pond indicate maximum phycocyanin levels occurred during the warmest period. The temperature sensor was located approximately one meter below the lake surface, where waters reached a maximum temperature of 24.1°C. Precipitation data is from St. John's International Airport, the nearest weather station available. The maximum phycocyanin detected in 2024 occurred during a dry period in July and August. However, during October and November, phycocyanin spikes occur during large precipitation events. Such events include October 10th, 15th, and 25th, as well as November 1st, 6th, and 12th.

Temperature and Phycocyanin in Forest Pond



Precipitation from St. John's Int. Airport and Phycocyanin in Forest Pond

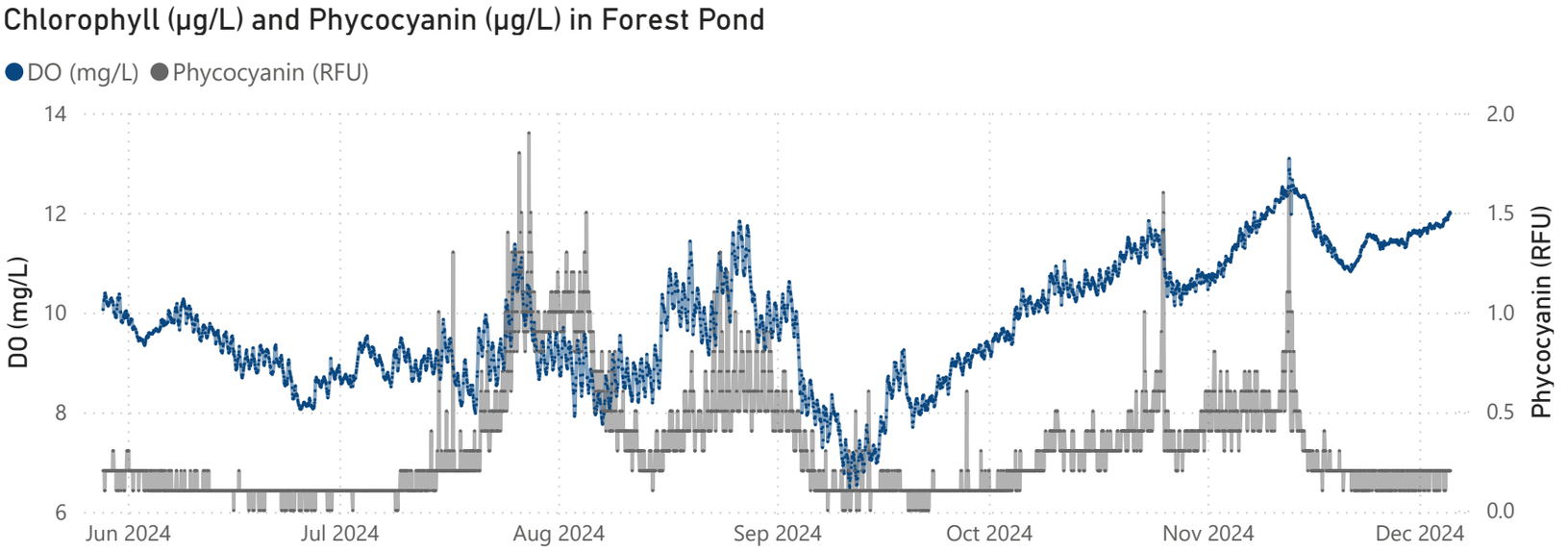


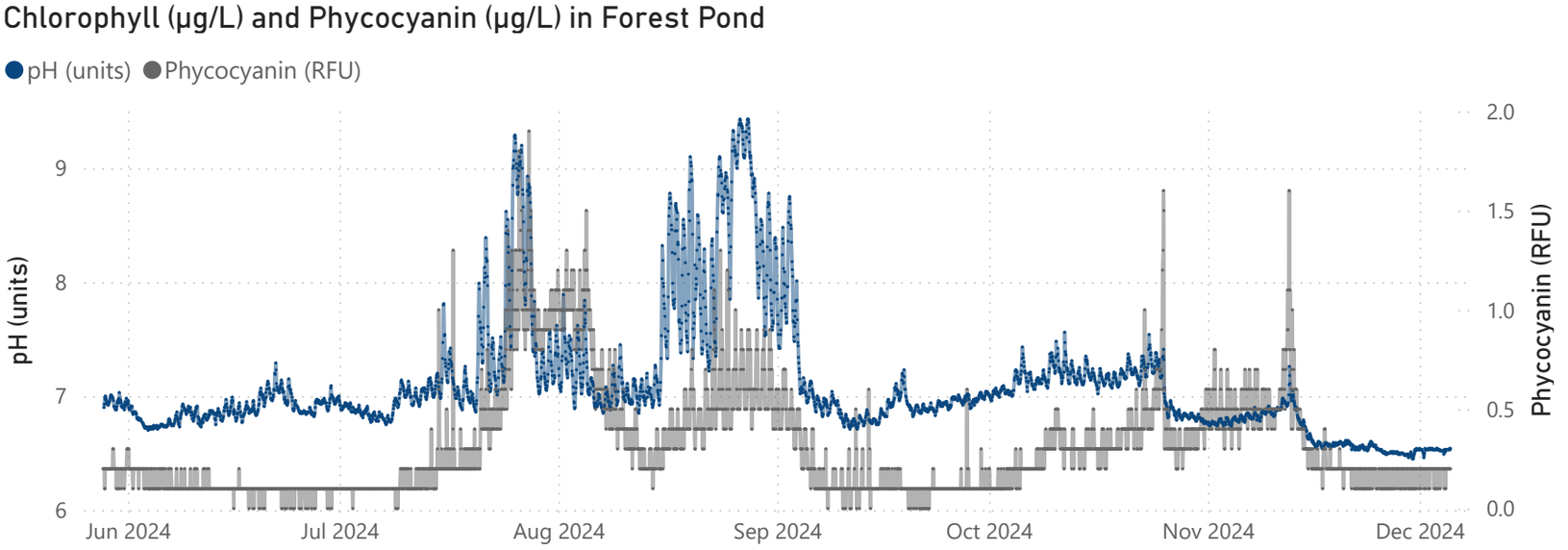
Dissolved Oxygen & pH

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, matching the concentration of phycocyanin. DO begins to trend upwards mid-September, likely influenced by cooler water temperatures.

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 (6.5 mg/L). However, at times DO was below the minimum guidelines for early life stages (9.5 mg/L), which is common during warmer summer months.

pH is influenced by the concentration of carbon dioxide in water. Photosynthesis decreases carbon dioxide, thus increasing the pH of the water. During 2024, the pH of the waterbody increased significantly, becoming more basic in nature. The pH surpassed a pH of 9 during the two largest increases to phycocyanin. CCME's freshwater guidelines for pH recommend a minimum pH of 6.5 and maximum pH of 9 for protection of aquatic life. At the peak of the bloom, the pH briefly exceeded CCME's guidelines for the maximum long term concentration of pH.





Key Findings & Contact

In 2023 a strong correlation between phycocyanin and pH was observed, and another between phycocyanin and DO; this trend was observed again in 2024. There were three additional blooms reported in 2024, resulting in the first confirmed blooms off of the Avalon Peninsula. All of the blooms reported were in or near urban areas; however, reports from remote areas are less common. Climate change is a suspected factor in the increased number of blooms reported as summer temperatures warm, and precipitation events intensify (extreme drought and rainfall). Two of the blooms occurred around Labrador City, which suffered from extreme drought and forest fires this year. The blooms occurred after the drought period; however, water levels were still low. Cyanobacteria activity in Forest Pond occurred during periods of low precipitation.

In 2025 more research will be conducted on lake stratification's association with algal blooms in Newfoundland and Labrador.

Cyanobacteria monitoring will continue in 2025
Suspected blooms within Newfoundland and Labrador can be reported to:

Government of Newfoundland & Labrador
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Water Resources Management Division
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