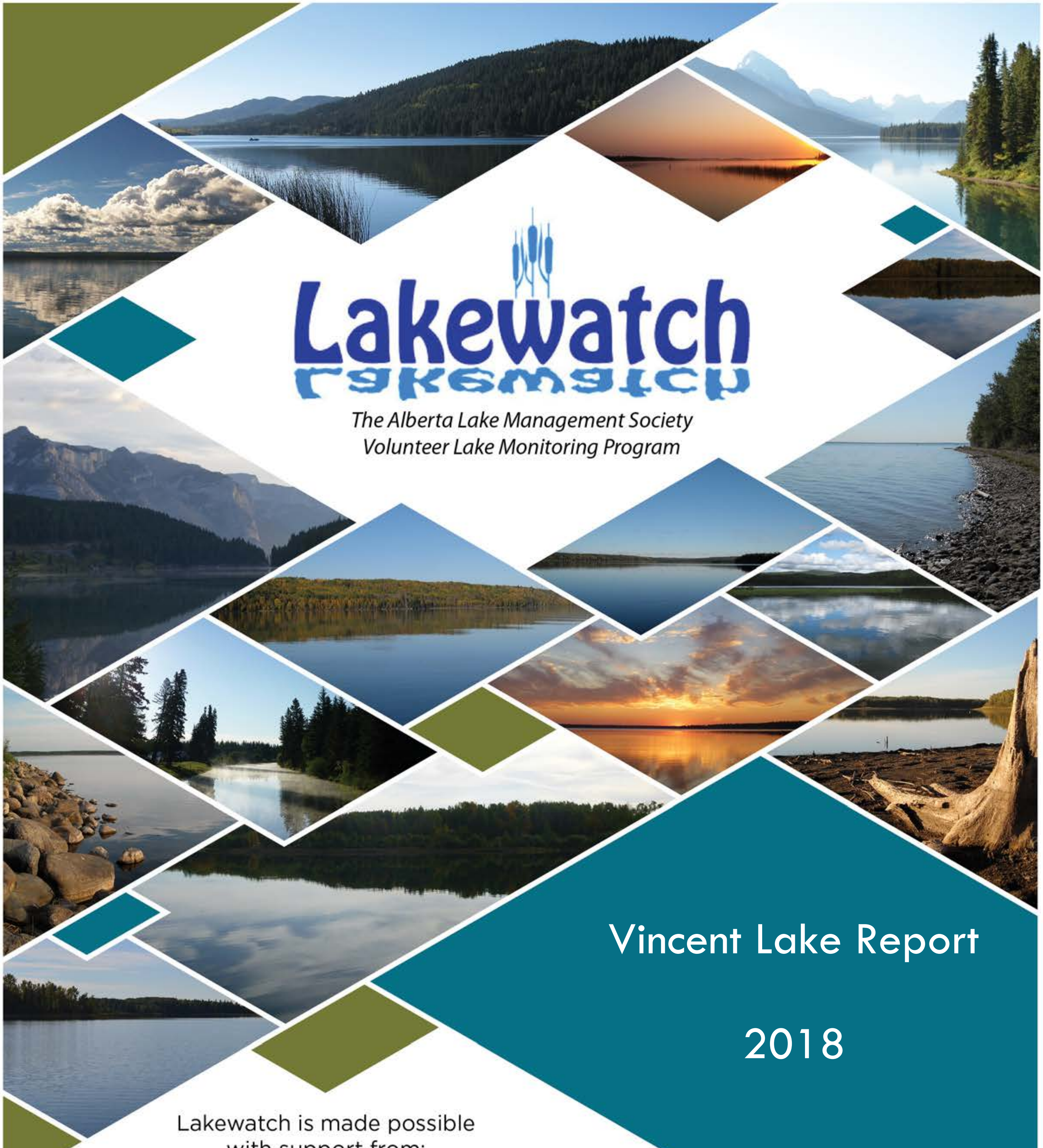


Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Vincent Lake Report

2018

Lakewatch is made possible with support from:

ALBERTA LAKE MANAGEMENT SOCIETY'S LAKEWATCH PROGRAM

LakeWatch has several important objectives, one of which is to collect and interpret water quality data on Alberta Lakes. Equally important is educating lake users about their aquatic environment, encouraging public involvement in lake management, and facilitating cooperation and partnerships between government, industry, the scientific community and lake users. LakeWatch Reports are designed to summarize basic lake data in understandable terms for a lay audience and are not meant to be a complete synopsis of information about specific lakes. Additional information is available for many lakes that have been included in LakeWatch and readers requiring more information are encouraged to seek those sources.

ALMS would like to thank all who express interest in Alberta's aquatic environments and particularly those who have participated in the LakeWatch program. These leaders in stewardship give us hope that our water resources will not be the limiting factor in the health of our environment.

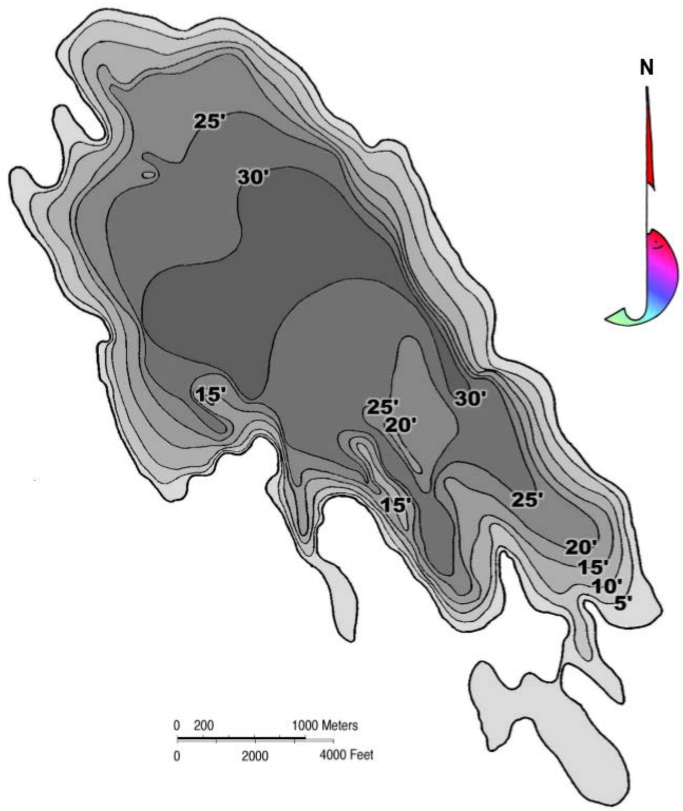
If you require data from this report, please contact ALMS for the raw data files.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. Special thanks to Patrick Traudt, who helped immensely with Vincent Lake sampling in 2019. We would also like to thank Alanna Robertson, Lindsay Boucher and Shona Derlukewich, who were summer technicians in 2018. Executive Director Bradley Peter and Program Coordinator Laura Redmond were instrumental in planning and organizing the field program. This report was prepared by Caitlin Mader and Bradley Peter.

VINCENT LAKE

Vincent Lake is a small (7.9 km^2), and relatively shallow (mean and maximum depth 5.7 and 7.5 m, respectively) lake located approximately 17 km north of the town of St. Paul. The lake has a very abundant supply of nutrients and algae and is thus considered hypereutrophic. Algae regularly bloom, turning the water green and turbid, and surface clumps and mats of algae are common along the shoreline. Also, the lake is polymictic, meaning that its water column completely mixes periodically throughout the summer. Vincent Lake has a sandy bottom with some excellent sandy beaches. Submergent aquatic plants are abundant near the shore and in shallow areas and consist mostly of northern watermilfoil. Sport fish include northern pike, yellow perch, and walleye. The lake supports approximately 580 cottagers and about 130 farmers operate in its watershed (ACA, 2000). Farmers carry out a number of agricultural operations in the watershed including the production of forage, crops, and livestock. Agriculture occupies over half of Vincent Lake's drainage basin and contributes much of the nutrient inputs to the lake[1].



Bathymetric map[2] (in feet) of Vincent Lake, survey data from 1965[1].

Emergent vegetation along the shore of Vincent Lake. Photo by Shona Derlukewich, 2018.

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[1] Mitchell, Patricia, and Ellie E. Prepas, eds. *Atlas of Alberta lakes*. University of Alberta, 1990.
[2] Anglers Atlas, retrieved 2019/02/04 from www.anglersatlas.com/place/102083/vincent-lake

METHODS

Profiles: Profile data is measured at the deepest spot in the main basin of the lake. At the profile site, temperature, dissolved oxygen, pH, conductivity and redox potential are measured at 0.5- 1.0 m intervals. Additionally, Secchi depth is measured at the profile site and used to calculate the euphotic zone. On one visit per season, metals are collected at the profile site by hand grab from the surface and at some lakes, 1 m off bottom using a Kemmerer.

Composite samples: At 10-sites across the lake, water is collected from the euphotic zone and combined across sites into one composite sample. This water is collected for analysis of water chemistry, chlorophyll-a, nutrients and microcystin. Quality control (QC) data for total phosphorus was taken as a duplicate true split on one sampling date. ALMS uses the following accredited labs for analysis: Routine water chemistry and nutrients are analyzed by Maxxam Analytics, chlorophyll-*a* and metals are analyzed by Innotech Alberta, and microcystin is analyzed by the Alberta Centre for Toxicology (ACTF). In lakes where mercury samples are taken, they are analyzed by the Biogeochemical Analytical Service Laboratory (BASL).

Invasive Species: Monitoring for invasive quagga and zebra mussels involved two components: monitoring for juvenile mussel veligers using a 63 µm plankton net at three sample sites and monitoring for attached adult mussels using substrates installed at each lake.

Data Storage and Analysis: Data is stored in the Water Data System (WDS), a module of the Environmental Management System (EMS) run by Alberta Environment and Parks (AEP). Data goes through a complete validation process by ALMS and AEP. Users should use caution when comparing historical data, as sampling and laboratory techniques have changed over time (e.g. detection limits). For more information on data storage, see AEP Surface Water Quality Data Reports at aep.alberta.ca/water.

Data analysis is done using the program R.[1] Data is reconfigured using packages tidyr [2] and dplyr [3] and figures are produced using the package ggplot2 [4]. Trophic status for each lake is classified based on lake water characteristics using values from Nurnberg (1996)[5]. The Canadian Council for Ministers of the Environment (CCME) guidelines for the Protection of Aquatic Life are used to compare heavy metals and dissolved oxygen measurements. Pearson's Correlation tests are used to examine relationships between TP, chlorophyll-*a,* TKN and Secchi depth, providing a correlation coefficient (r) to show the strength (0-1) and a p-value to assess significance of the relationship.

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[1] R Core Team (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

[2] Wickman, H. and Henry, L. (2017). tidyr: Easily Tidy Data with 'spread ( )' and 'gather ( )' Functions. R package version 0.7.2. https://CRAN.R-project.org/package=tidyr.

[3] Wickman, H., Francois, R., Henry, L. and Muller, K. (2017). dplyr: A Grammar of Data Manipulation. R package version 0.7.4. http://CRAN.R-project.org/package=dplyr.

[4] Wickham, H. (2009). ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York.

[5] Nurnberg, G.K. (1996). Trophic state of clear and colored, soft- and hardwater lakes with special consideration of nutrients, anoxia, phytoplankton and fish. Lake and Reservoir Management 12: 432-447.

BEFORE READING THIS REPORT, CHECK OUT A BRIEF INTRODUCTION TO LIMNOLOGY AT ALMS.CA/REPORTS

WATER CHEMISTRY

ALMS measures a suite of water chemistry parameters. Phosphorus, nitrogen, and chlorophyll-a are important because they are indicators of eutrophication, or excess nutrients, which can lead to harmful algal/cyanobacteria blooms. One direct measure of harmful cyanobacteria blooms are Microcystins, a common group of toxins produced by cyanobacteria. See Table 2 for a complete list of parameters.

The average total phosphorus (TP) concentration for Vincent Lake was 106 µg/L (Table 2), falling just above the threshold for hypereutrophic, or very highly productive trophic classification. This value falls within the range of historical averages. Detected TP was lowest when first sampled in June at 51 µg/L , and rose throughout the season until the final sampling at 150 µg/L in September (Figure 1).

Average chlorophyll-*a* concentrations in 2018 was 83.1 µg/L (Table 2), falling into the hypereutrophic, or very high productivity trophic classification. Like TP, Chlorophyll-*a* rose throughout the season, from a minimum of 14.7 µg/L in June to a maximum of 134 µg/L in late August.

Finally, the average TKN concentration was 3.14 mg/L (Table 2) with concentrations increasing over the course of the sampling season.

Average pH was measured as 8.83 in 2018, buffered by moderate alkalinity (240 mg/L $CaCO_3$) and bicarbonate (246 mg/L HCO_3). Magnesium was the dominant ion contributing to a medium conductivity of 672 µS/cm (Table 2).

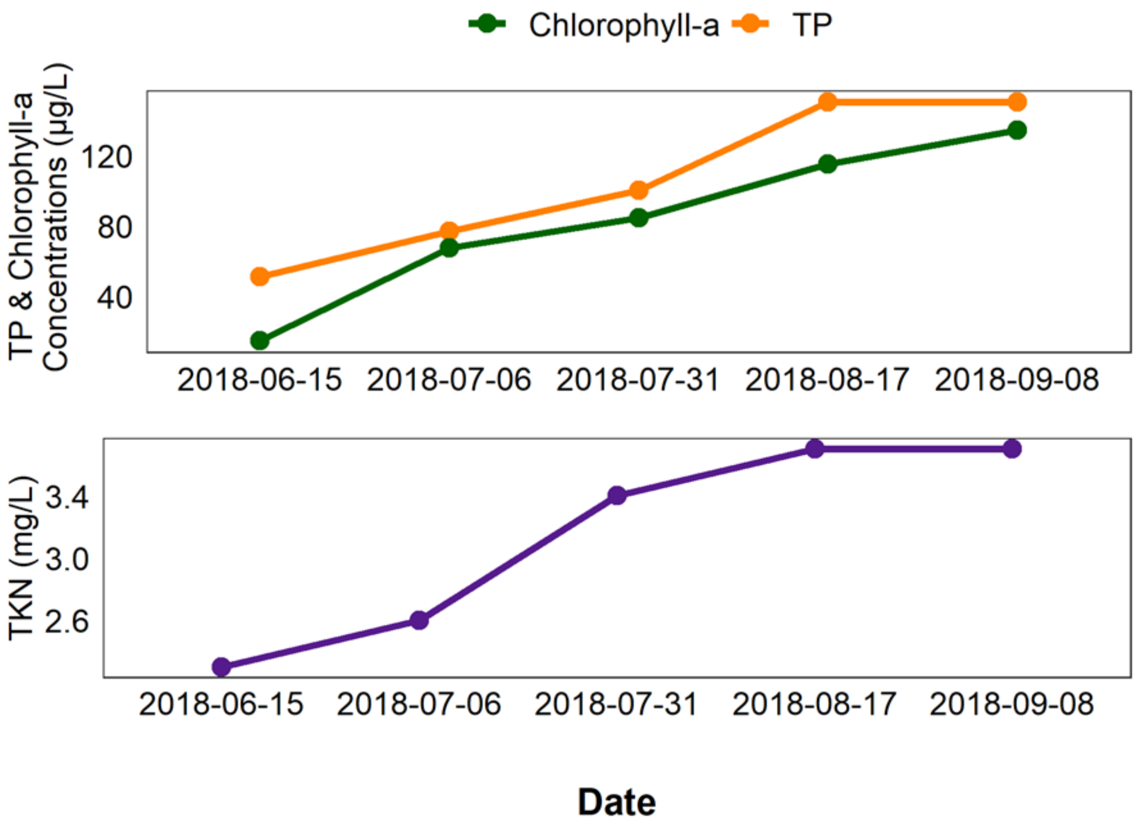

Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured five times over the course of the summer at Vincent Lake.

WATER CLARITY AND SECCHI DEPTH

Water clarity is influenced by suspended materials, both living and dead, as well as dissolved colored compounds in the water column. During the melting of snow and ice in spring, lake water can become turbid (cloudy) from silt transported into the lake. Lake water usually clears in late spring but then becomes more turbid with increased algal growth as the summer progresses. The easiest and most widely used measure of lake water clarity is the Secchi depth. Two times the Secchi depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

The average Secchi depth of Vincent Lake in 2018 was 1.14 m (Table 2). Secchi depth decreased by nearly 50% over the sampling season. This steady decrease in water clarity may have been due steadily increasing algae concentrations over the season, as indicated by increasing chlorophyll-a levels (Figure 2).

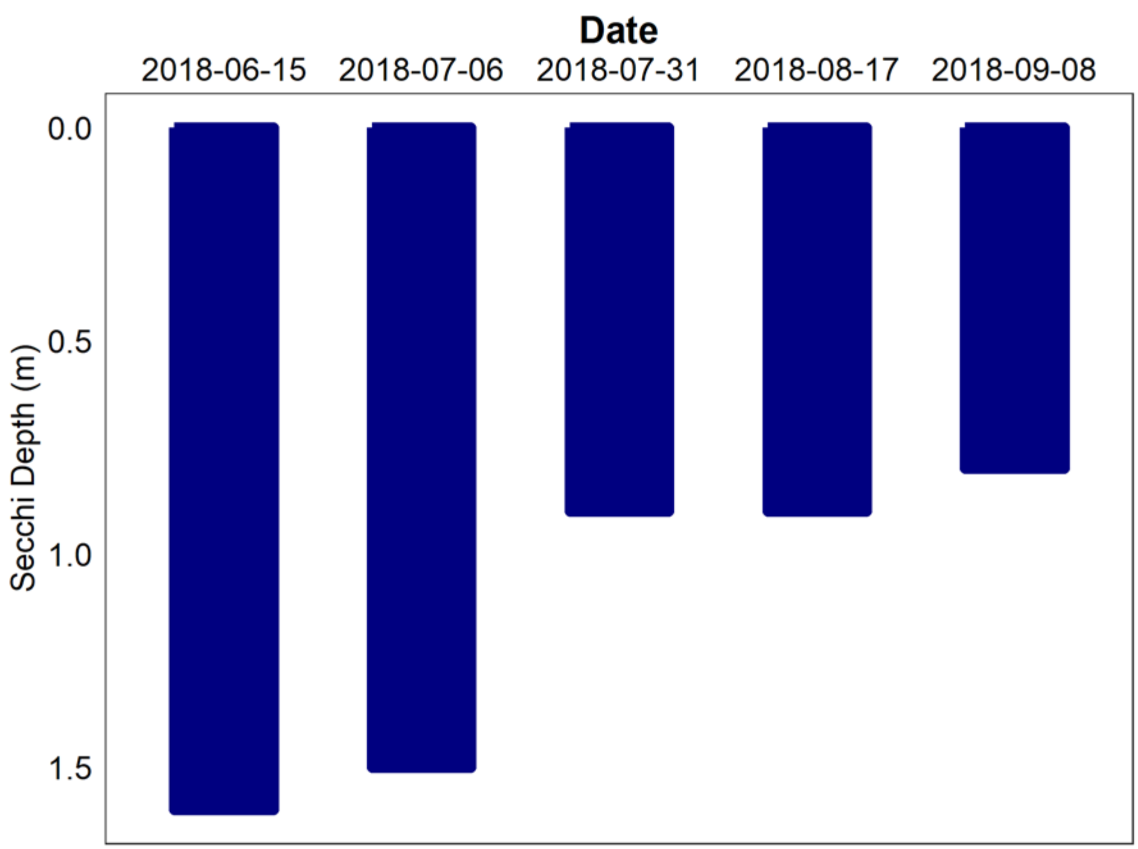

Figure 2 – Secchi depth values measured five times over the course of the summer at Vincent Lake in 2018.

WATER TEMPERATURE AND DISSOLVED OXYGEN

Water temperature and dissolved oxygen profiles in the water column can provide information on water quality and fish habitat. The depth of the thermocline is important in determining the depth to which dissolved oxygen from the surface can be mixed. Please refer to the end of this report for descriptions of technical terms.

Temperatures of Vincent Lake varied throughout the summer with a maximum temperature of 23.8°C measured at the surface on July 31 (Figure 4a). The lake was not stratified during any of the sampling trips, with temperatures fairly constant from top to bottom, which indicates partial or complete mixing throughout the season.

Vincent Lake was well oxygenated through most of the water column on all sampling trips other than on July 31, measuring above the CCME guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 4b). On July 31, the surface of the lake was supersaturated while below 2 m the lake fell below the guideline of 6.5 mg/L. This may be due to several contributing factors, including extended periods of lacking the wind required for water column mixing, decomposing matter on the lake bottom, and algae blooms.

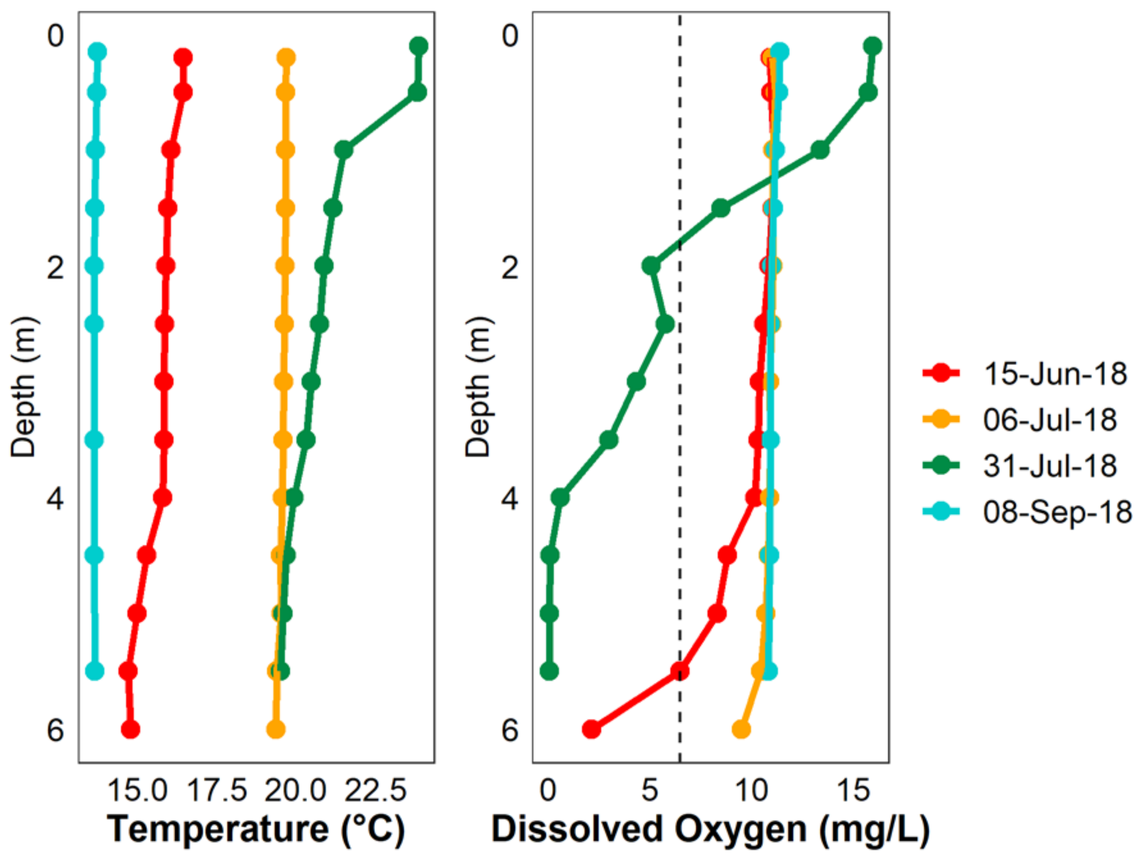

Figure 4 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Vincent Lake measured five times over the course of the summer of 2018.

MICROCYSTIN

Microcystins are toxins produced by cyanobacteria (blue-green algae) which, when ingested, can cause severe liver damage. Microcystins are produced by many species of cyanobacteria which are common to Alberta's Lakes, and are thought to be the one of the most common cyanobacteria toxins. In Alberta, recreational guidelines for microcystin are set at 20 μg/L. Blue-green algae advisories are managed by Alberta Health Services. Recreating in algal blooms, even if microcystin concentrations are not above guidelines, is not recommended.

Composited microcystin levels in Vincent Lake fell below the recreational guideline of 20 μg/L in 2018. Individual locations on the lake may experience higher concentrations of toxins, therefore recreation should be avoided in cyanobacteria blooms.

Table 1 – Microcystin concentrations measured five times at Vincent Lake in 2018.

Date	Microcystin Concentration (μg/L)
15-Jun-18	0.4
06-Jul-18	1.2
31-Jul-18	1.5
17-Aug-18	3.6
08-Sep-18	4.0
Average	2.13

INVASIVE SPECIES MONITORING

Dreissenid mussels pose a significant concern for Alberta because they impair the function of water conveyance infrastructure and adversely impact the aquatic environment. These invasive mussels have been linked to creating toxic algae blooms, decreasing the amount of nutrients needed for fish and other native species, and causing millions of dollars in annual costs for repair and maintenance of water-operated infrastructure and facilities.

Monitoring involved two components: monitoring for juvenile mussels (veligers) using a plankton net and monitoring for attached adult mussels using substrates installed in each lake. No mussels have been detected in Vincent Lake.

WATER LEVELS

There are many factors influencing water quantity. Some of these factors include the size of the lake's drainage basin, precipitation, evaporation, water consumption, ground water influences, and the efficiency of the outlet channel structure at removing water from the lake. Requests for water quantity monitoring should go through Alberta Environment and Parks Monitoring and Science division.

Records of water levels in Vincent Lake date back to 1966 (Figure 5). Water levels in the lake remained very stable from the late 1960s though the 1980s. In the early 1990s, Vincent Lake water levels began a slow decline of approximately 4 meters, until record lows in 2016.

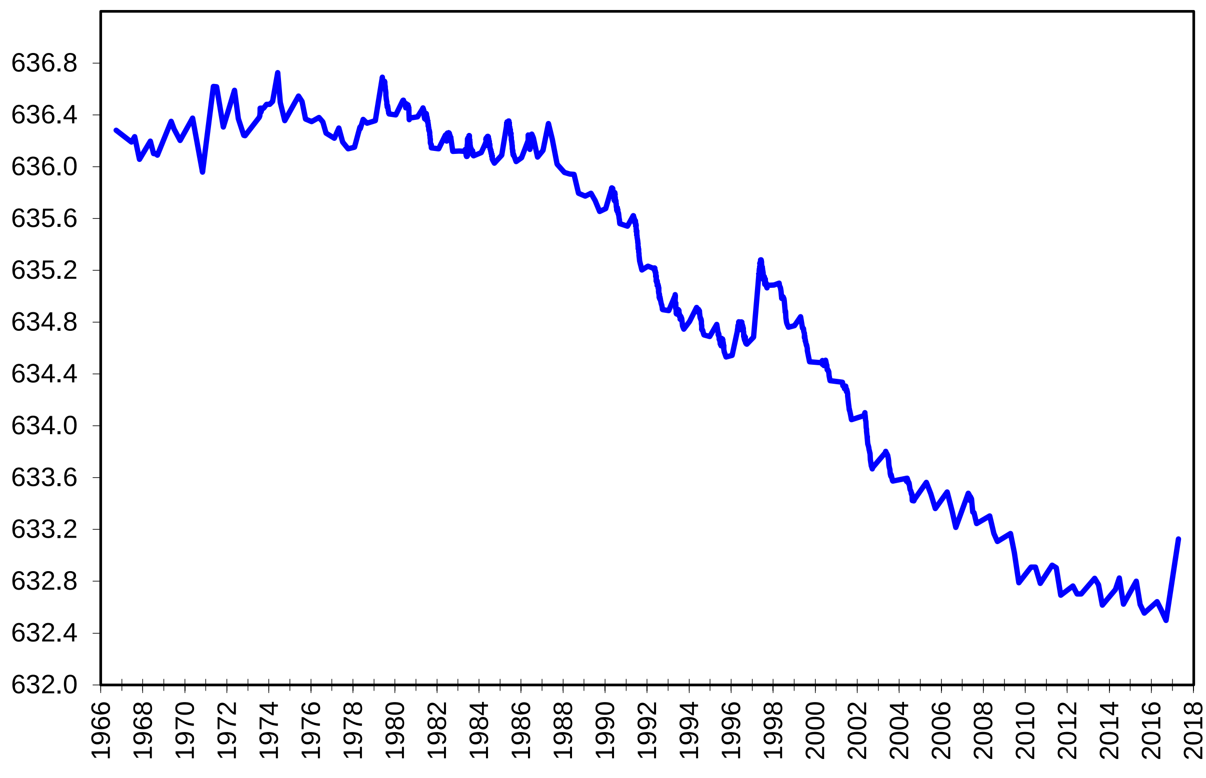

Figure 5. Surface elevation of Vincent Lake in meters above sea level (m asl) from 1966 to 2017. Data retrieved from Alberta Environment and Parks.

Table 2: Average historical Secchi depth and water chemistry values for Vincent Lake.

Parameter	**1983**	**2000**	**2001**	**2018**
TP (µg/L)	235	50	58	106
TDP (µg/L)	-	-	26	16.2
Chlorophyll-*a* (µg/L)	16.6	13	24	83
Secchi (m)	3.3	-	2.5	1.14
TKN (mg/L)	-	-	1.6	3.14
NO2.NO3 (µg/L)	-	-	8	5.26
NH3 (µg/L)	-	-	8	88.2
DOC (mg/L)	-	-	-	23.8
Ca (mg/L)	-	-	28	29.4
Mg (mg/L)	-	-	37	49.2
Na (mg/L)	-	-	16	23.8
K (mg/L)	-	-	30	43.4
Sulphate (mg/L)	-	-	55	108
Cl^- (mg/L)	-	-	6	13.2
Carbonate (mg/L)	-	-	21	23
Bicarbonate (mg/L)	-	-	114	246
pH	-	-	9	8.83
Conductivity (µS/cm)	-	-	500	672
Hardness (mg/L)	-	-	-	278
TDS (mg/L)	-	-	-	422
Microcystin (µg/L)	-	-	-	2.12
Alkalinity (mg/L)	-	-	218	240