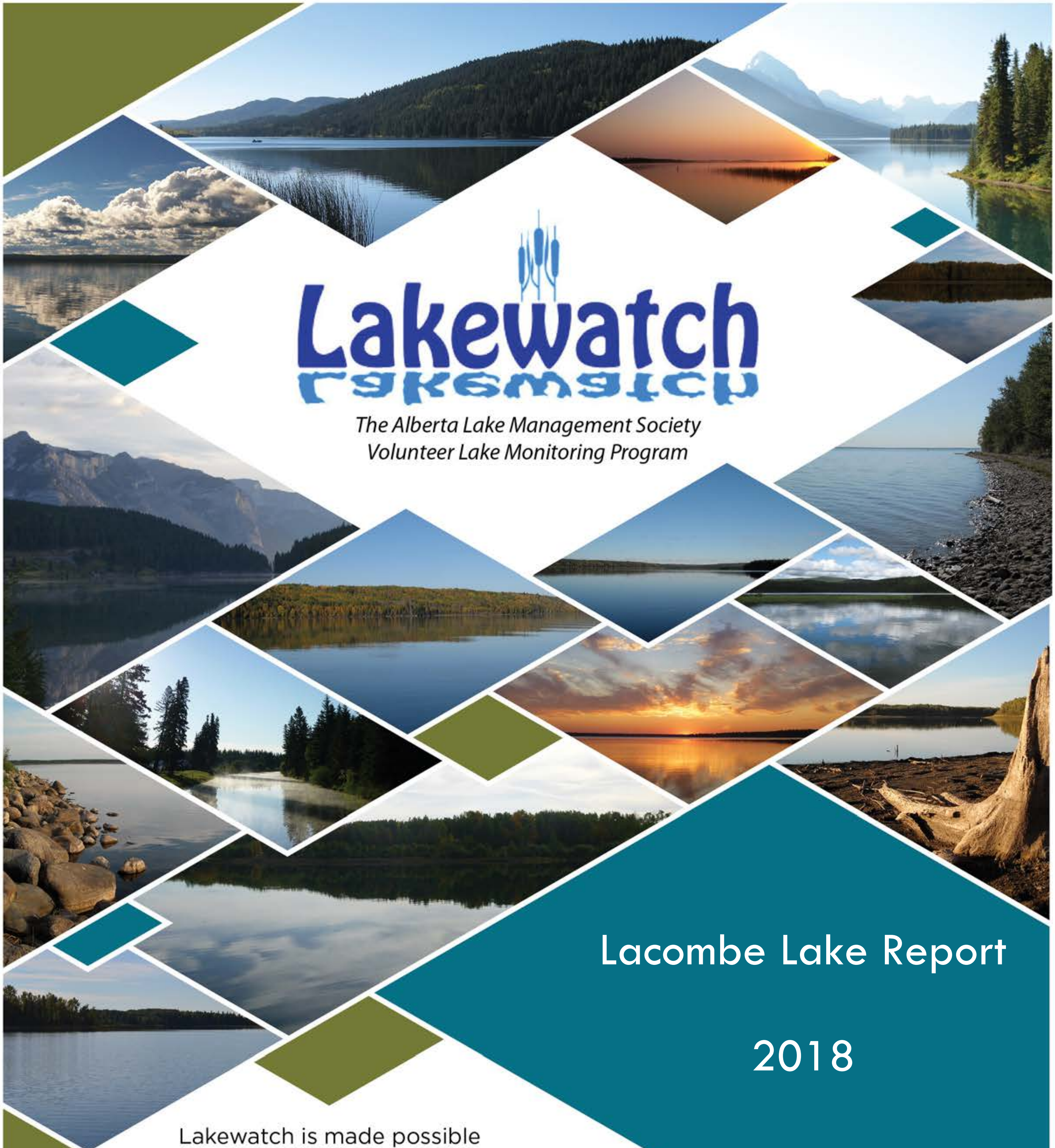

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Lacombe Lake Report

2018

Lakewatch is made possible
with support from:

Alberta
Pigeon Lake Watershed Association
Jackfish Lake
MD 61 Wainwright
LICA Environmental Stewards
Red Deer River Watershed Alliance

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.

This report has been prepared with un-validated data.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. 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.

LACOMBE LAKE

Lacombe Lake is a pothole lake found in Lacombe County in central Alberta. It is located 5 km north of the town of Blackfalds and 15 km north of Red Deer. There are no public campgrounds around the lake as most of the land is private farms and homesteads as well as public land and reserves. It is thought that the lake was once called Jackfish Lake due to the northern pike found in the lake, though in 1975 the name was changed to Lacombe Lake. The Lacombe Lake area is part of the Treaty 6 Nations and was an area where the Samson and Erminskin Cree Nations hunted and travelled. Permanent camps were traditionally located in wooded areas as well as along rivers, and a known trade existed just south of Gull Lake.

The lake is long and narrow, with a length of about 3 km, a maximum depth of ~3.0 m, and a maximum width of about 500 m. Lacombe Lake has numerous bays and points which give it a distinct shape. It is not known to be a popular fishing destination but the lake is used for non-motorized recreational water sports such as rowing as well as swimming. Lacombe Lake is found in the Aspen Parkland ecoregion of Alberta, much of which is now farmland with other foliage such as trembling aspen, oak, mixed tall shrubs, and intermittent fescue grasslands[1].

Anto Davis sampling Lacombe Lake in 2016.

Known sportfish species at Lacombe Lake are the northern pike, though angling websites state that other species may include walleye, burbot, whitefish, rainbow trout, brown trout, and brook trout[2]. Lacombe Lake has a large population of macrophytes, including yellow pond lily, various pondweeds, chara, cattail, bulrushes, and bladderwort. Due to its small size, dense macrophytes, and limited recreational activity, waterfowl are known to frequent the lake. Known species include the mallard, common grebe, goldeneye, scaup, and ruddy duck[2]. Larger vertebrates that are found around the lake are deer, muskrat, lynx, and beavers. In the 1960s, the Prairie Farm Rehabilitation Association constructed a weir on Whelp Creek to control and direct the flow into the north end of Lacombe Lake during periods of high flow.

In the years previous to 2008, residents observed deteriorations in water quality as well as dense macrophyte growth. The diversion of Whelp Creek was stopped and Golder Associates Ltd. assessed the water quality of Lacombe Lake over a period of 4 years.

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[1] Ecoregions of Canada. (1995). Available at: http://ecozones.ca/English/region/156.html

[2] http://www.hookandbullet.com/fishing-lacombe-lake-blackfalds-ab/ 2015

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 Alberta Innovates Technology Futures (AITF), 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 Lacombe Lake was 22.5 µg/L (Table 2), falling into the mesotrophic, or moderately productive trophic classification. This value falls within the range of historical averages. Detected TP was fairly consistent throughout the season, ranging from a minimum of 20.0 µg/L on September 18 to a maximum of 25 µg/L on August 29 (Figure 1).

Average chlorophyll-*a* concentration in 2018 was 12 µg/L (Table 2), falling into the mesotrophic, or moderately productive trophic classification. Chlorophyll-*a* was lowest earliest in the season, at 4.8 µg/L on June 8 and peaked at 19.6 µg/L on August 29.

Finally, the average TKN concentration was 1.33 mg/L (Table 2) with highest on August 29 at 1.1 mg/L, and lowest during the final, September 18 sampling at 1.1 mg/L.

Average pH was measured as 8.59 in 2018, buffered by moderate alkalinity (218 mg/L $CaCO_3$) and bicarbonate (248 mg/L HCO_3). Magnesium and sodium were the dominant ions contributing to a low conductivity of 429.5 µS/cm (Table 2).

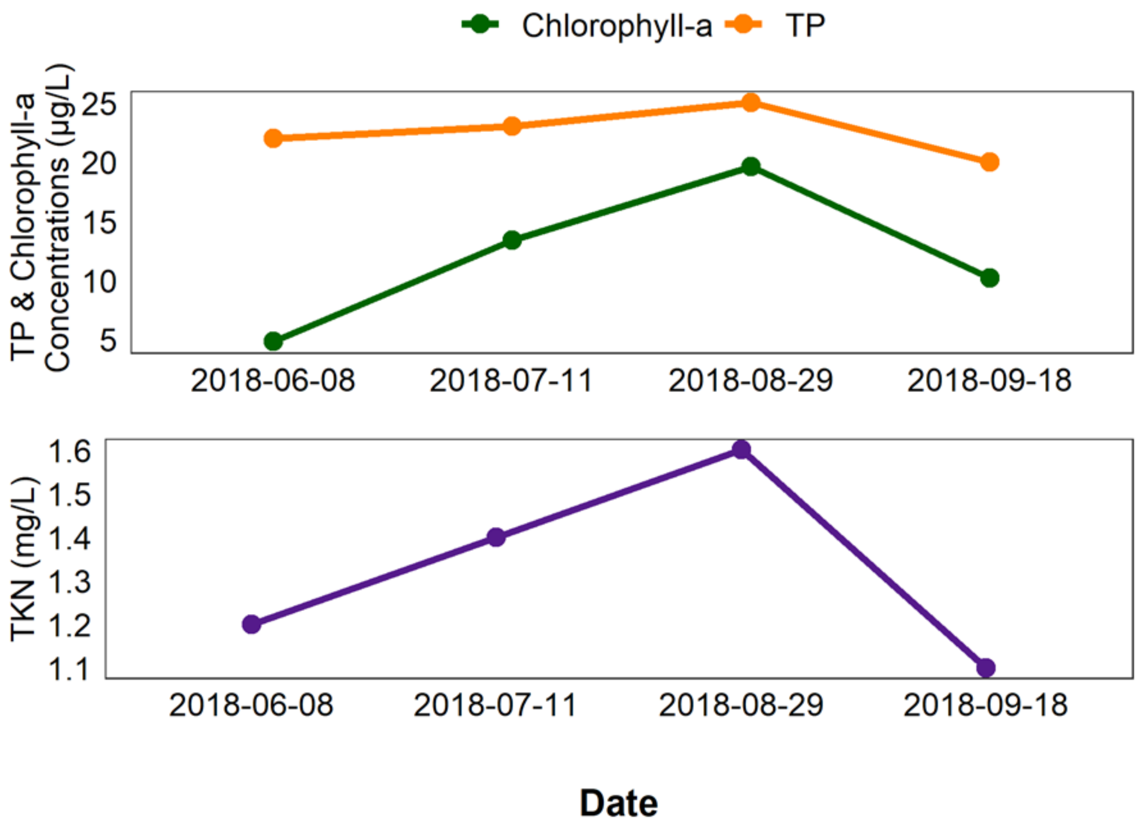

Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Lacombe Lake.

METALS

Samples were analyzed for metals once throughout the summer (Table 3). In total, 27 metals were sampled for. It should be noted that many metals are naturally present in aquatic environments due to the weathering of rocks and may only become toxic at higher levels.

Metals were not measured at Lacombe Lake in 2018, but Table 3 displays historical metal concentrations.

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 Lacombe Lake in 2018 was 1.38 m (Table 2). Secchi depth varied little over the season, from a maximum of 1.7m when first sampled on June 8, to a minimum of 1.2 m on the final two sampling dates of August 29 and September 18 (Figure 1).

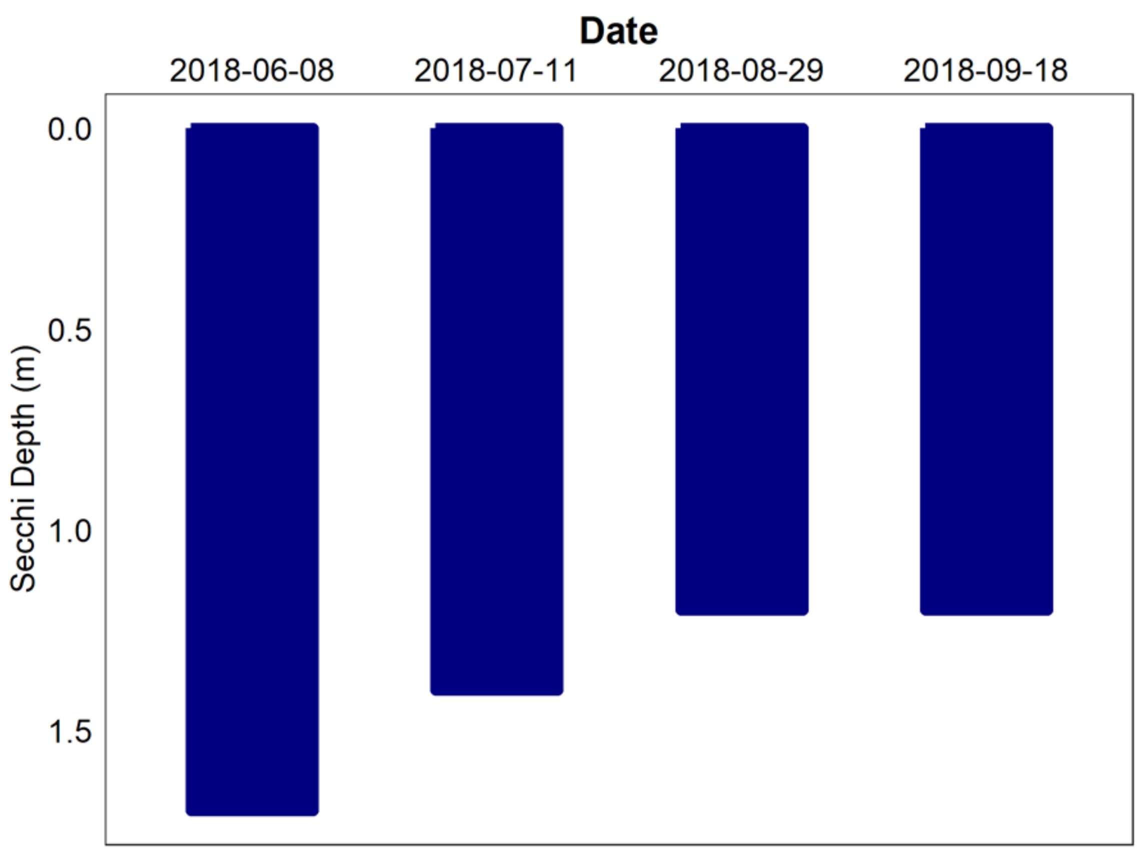

Figure 2 – Secchi depth values measured four times over the course of the summer at Lacombe Lake in 2018.

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 Lacombe Lake varied throughout the summer, with a minimum temperature of 7.8°C at 2 m on September 18, and a maximum temperature of 21.6°C measured at the surface on August July 11 (Figure 3a). The lake was not stratified during any of the sampling trips, with temperatures fairly constant from top to bottom, which indicates complete mixing throughout the season. This is typical of shallow lakes.

Lacombe Lake was well oxygenated through the water column on all sampling dates, measuring above the CCME guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 3b).

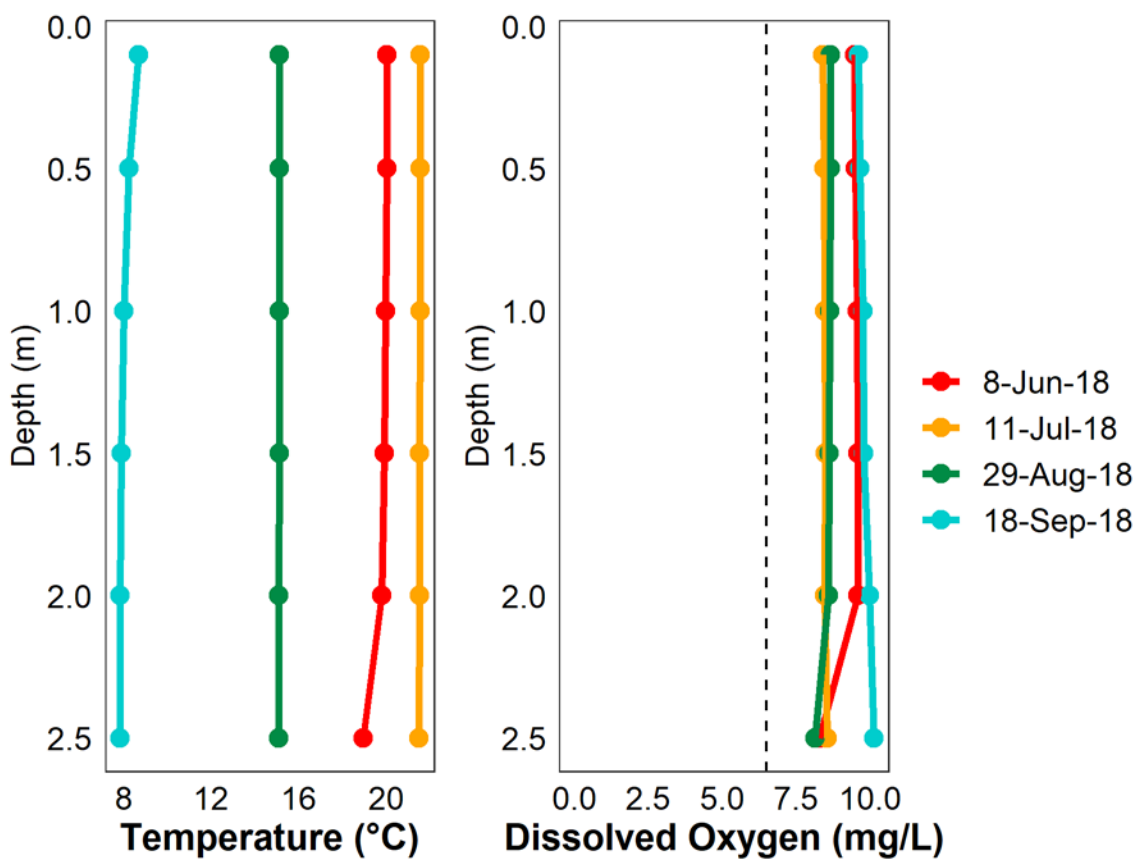

Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Lacombe Lake measured four times over the course of the summer of 2018.

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.

Microcystin levels in Lacombe Lake fell below the recreational guideline of 20µg/L for at the locations and times sampled in Lacombe Lake in 2018.

Table 1 – Microcystin concentrations measured four times at Lacombe Lake in 2018.

Date	Microcystin Concentration (µg/L)
08-Jun-18	0.11
11-Jul-18	0.24
29-Aug-18	1.55
18-Sep-18	0.25
Average	0.54

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 Lacombe Lake.

Table 2: Average Secchi depth and water chemistry values for Lacombe Lake. This table has been updated to remove Total Phosphorus data collected by Golder and Associates from 2008, 2009, and 2010 due to high detection limits (2/11/2020).

Parameter	2008	2009	2010	2011	2012	2014	2015	2016	2017	2018
TP (μg/L)	\	\	\	46	16	23	19	16	27	22.5
TDP (μg/L)	\	\	\	\	\	5.1	6.0	2.7	4.4	4.8
Chlorophyll-*a* (μg/L)	\	\	\	\	\	7.7	7.5	8.6	15.0	12
Secchi depth (m)	\	\	\	\	\	1.54	1.74	1.77	1.45	1.38
TKN (mg/L)	1.1	1.9	1.9	1.6	1.3	1.3	1.4	1.3	1.3	1.33
NO_2-N and NO_3-N (μg/L)	20	35	13.2	4.5	3	5.28	2.5	2.5	/	4.2
NH_3-N (μg/L)	\	\	\	143	75	18.02	25	54	/	23.3
DOC (mg/L)	\	\	\	\	\	\	17	14.6	15.25	15
Ca (mg/L)	\	\	\	\	\	27.18	20	21	24.25	24
Mg (mg/L)	\	\	\	\	\	31.62	32	34	30.75	31
Na (mg/L)	\	\	\	\	\	34.08	33	36	32.5	34
K (mg/L)	\	\	\	\	\	12.63	12	12	10.75	12
SO_4^{2-} (mg/L)	\	\	\	\	\	14.18	16	14	13.25	13.8
Cl^- (mg/L)	\	\	\	\	\	21.45	25	25	26.75	25
CO_3 (mg/L)	\	\	\	\	\	8.12	14	8	6.78	10.8
HCO_3 (mg/L)	\	\	\	\	\	261	230	254	255	248
pH	\	\	\	\	\	8.54	8.78	8.62	8.53	8.59
Conductivity (μS/cm)	\	\	\	\	\	505.67	478	490	515	493
Hardness (mg/L)	\	\	\	\	\	198	182	192	185	188
TDS (mg/L)	\	\	\	\	\	278	266	280	278	278
Microcystin (μg/L)	\	\	\	\	\	0.15	0.38	0.28	1.41	0.5
Total Alkalinity (mg/L $CaCO_3$)	\	\	\	\	\	228	212	224	220	218

*2008-2012 Data collected by Golder Associates. Some values have been removed due to high detection limits.

Table 3: Concentrations of metals were last measured in Lacombe Lake on August 9, 2018. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference.

Metals (Total Recoverable)	**2014**	**2015**	**2016**	**2017 Top**	**2017 Bottom**	**Guidelines**
Aluminum µg/L	14	11.5667	7.2	8.7	3.4	100[a]
Antimony µg/L	0.0595	0.0643	0.057	0.06	0.065	/
Arsenic µg/L	0.9115	0.9550	0.803	0.97	1.02	5
Barium µg/L	62.25	45.67	44.5	57	57.3	/
Beryllium µg/L	0.004	0.0073	0.004	<0.003	<0.003	100[c,d]
Bismuth µg/L	0.0005	0.0302	5.00E-04	<0.003	<0.003	/
Boron µg/L	45.75	46.63	47.7	46.5	47.1	1500
Cadmium µg/L	0.0015	0.0030	0.001	<0.01	<0.01	0.26[b]
Chromium µg/L	0.175	0.180	0.04	<0.1	L0.1	/
Cobalt µg/L	0.033	0.041	0.01	0.054	0.056	1000[d]
Copper µg/L	0.3975	0.6967	0.37	0.27	0.29	4[b]
Iron µg/L	17.7	12.4	10.4	6.6	5.3	300
Lead µg/L	0.01475	0.1047	0.021	0.049	0.013	7[b]
Lithium µg/L	19.8	22.13	24.7	24.2	24.4	2500[e]
Manganese µg/L	48.1	53.2	51	56.4	58.4	200[e]
Mercury (dissolved) ng/L	/	/	/	0.28	0.29	/
Mercury (total) ng/L	/	/	/	0.72	0.67	26
Molybdenum µg/L	0.137	0.104	0.102	0.083	0.084	73[c]
Nickel µg/L	0.042	0.109	0.035	1.2	1.2	150[b]
Selenium µg/L	0.175	0.057	0.22	0.3	0.3	1
Silver µg/L	0.001	0.005	0.001	<0.001	<0.001	0.25
Strontium µg/L	199.5	139.3	131	185	184	/
Thallium µg/L	0.001575	0.0121	0.00045	<0.002	<0.002	0.8
Thorium µg/L	0.001975	0.0938	0.0035	<0.002	0.01	/
Tin µg/L	0.00775	0.0320	0.02	<0.06	<0.06	/
Titanium µg/L	0.865	0.9833	0.76	1.09	1.04	/
Uranium µg/L	0.6785	0.5223	0.524	0.477	0.476	15
Vanadium µg/L	0.185	0.1667	0.2	0.169	0.122	100[d,e]
Zinc µg/L	0.95	1.37	0.6	0.4	0.4	30

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on water hardness > 180mg/L (as $CaCO_3$)
[c] CCME interim value.
[d] Based on CCME Guidelines for Agricultural use (Livestock Watering).
[e] Based on CCME Guidelines for Agricultural Use (Irrigation).
A forward slash (/) indicates an absence of data or guidelines.