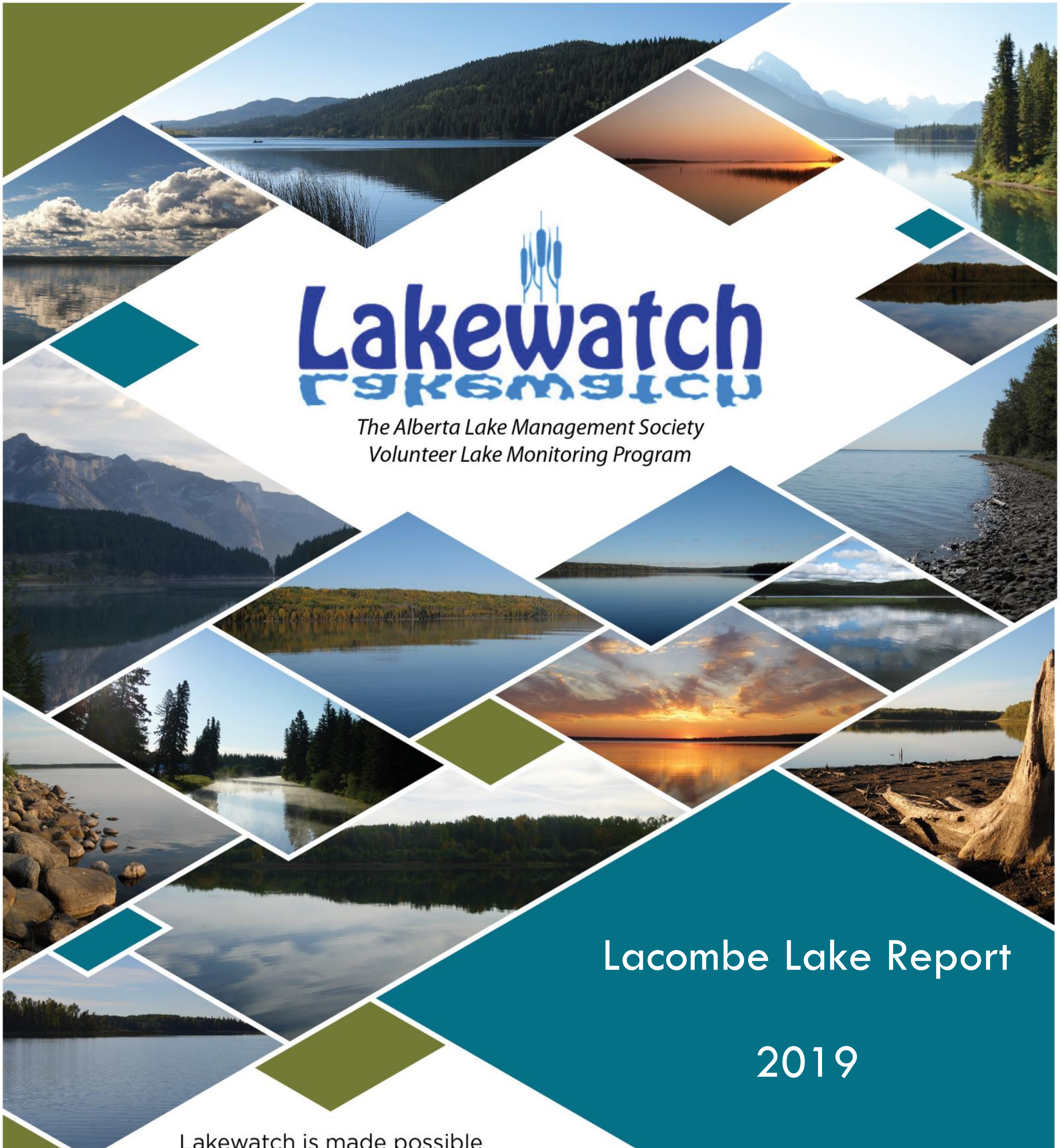

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Lacombe Lake Report

2019

Lakewatch is made possible with support from:

Alberta Environment and Parks

Pigeon Lake Watershed Association

Lacombe County

LICA Environmental Stewards

ALBERTA LAKE MANAGEMENT SOCIETY'S LAKEWATCH PROGRAM

LakeWatch has several important objectives, one of which is to collect and interpret water quality data from Alberta's Lakes. Equally important is educating lake users about aquatic environments, 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 the widest 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. A special thank you to the Lacombe Lake Stewardship Society including Anto & Ted Davis, and Cliff Soper for their time sampling Lacombe Lake. We would also like to thank Sarah Davis Cornet, Caleb Sinn, and Pat Heney, who were summer technicians in 2019. Executive Director Bradley Peter and Program Coordinator Caitlin Mader were instrumental in planning and organizing the field program. This report was prepared by Pat Heney, Bradley Peter, and Caleb Sinn.

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 Ermineskin Cree Nations hunted and travelled.

The lake is long and narrow, with a length of about 3 km, a maximum depth of about 3.0 m, and a maximum width of around 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 and 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].

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.

Anto Davis sampling Lacombe Lake in 2016.

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. Then in 2008, 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. For select lakes, metals are collected at the profile site by hand grab from the surface on one visit over the season.

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).

Invasive Species: : Invasive mussel monitoring involved sampling with a 63 µm plankton net at three sample sites twice through the summer season to determine the presence of juvenile dreissenid mussel veligers. Technicians also harvested potential Eurasian watermilfoil (*Myriophyllum spicatum)* samples and submitted them for further analysis at the Alberta Plant Health Lab to genetically differentiate whether the sample was the invasive Eurasian watermilfoil or a native watermilfoil. In addition, select lakes were subject to a bioblitz, where a concerted effort to sample the lake's aquatic plant diversity took place.

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 www.alberta.ca/surface-water-quality-data.aspx.

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 total phosphorus (TP), chlorophyll-*a,* total kjeldahl nitrogen (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 21 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 16 µg/L on June 25 to a maximum of 24 µg/L on August 27 (Figure 1).

Average chlorophyll-*a* concentration in 2019 was 10.4 µg/L (Table 2), falling into the mesotrophic, or moderately productive trophic classification. Chlorophyll-*a* was lowest earliest in the season, at 6.8 µg/L on June 25 and peaked at 13.5 µg/L on August 27.

The average TKN concentration was 1.2 mg/L (Table 2) with the highest concentration observed on August 27 at 1.5 mg/L, and lowest on the first and final sampling periods, June 25 and September 18 at 1.1 mg/L.

Average pH was measured as 8.84 in 2019, buffered by moderate alkalinity (195 mg/L $CaCO_3$) and bicarbonate (213 mg/L HCO_3). Magnesium and sodium were the dominant ions contributing to a low conductivity of 450 µS/cm (Table 2).

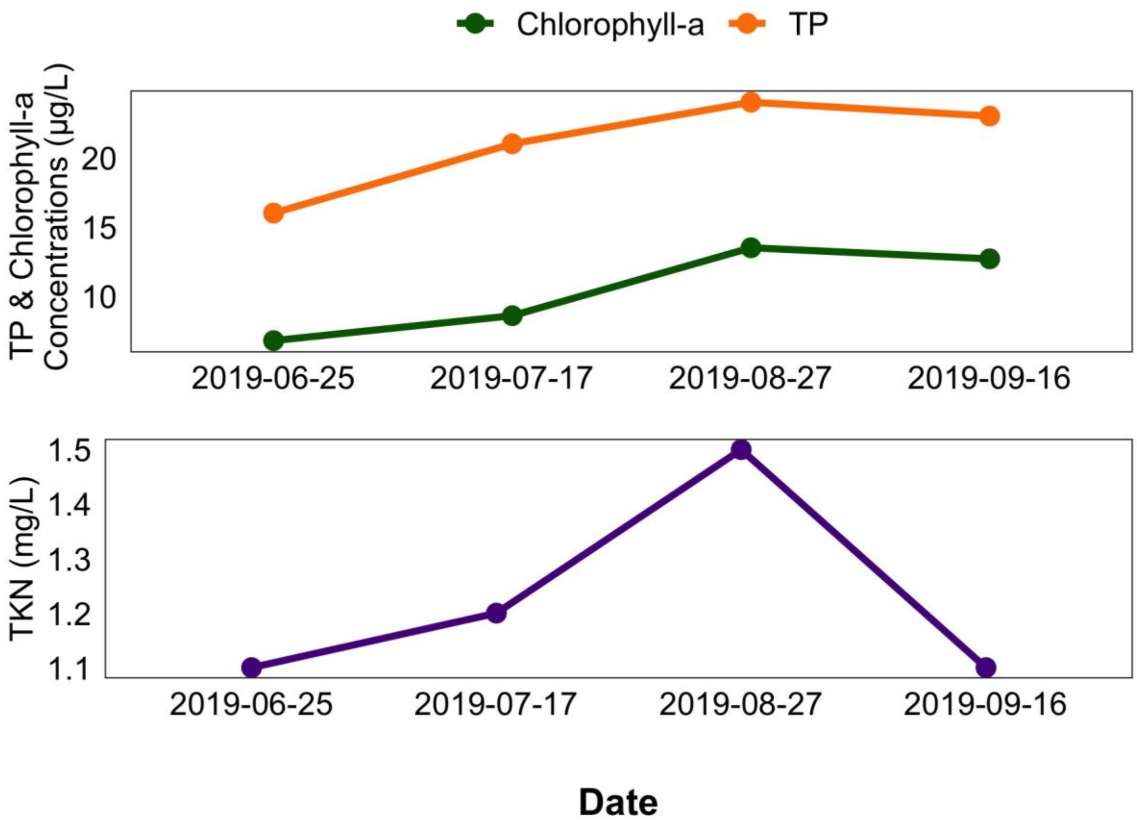

Figure 1. Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Lacombe Lake.

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 2019, 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 2019 was 1.76 m (Table 2). Secchi depth varied little over the season, from a maximum of 2.40 m when first sampled on June 25, to a minimum of 1.20 m on August 27 (Figure 2).

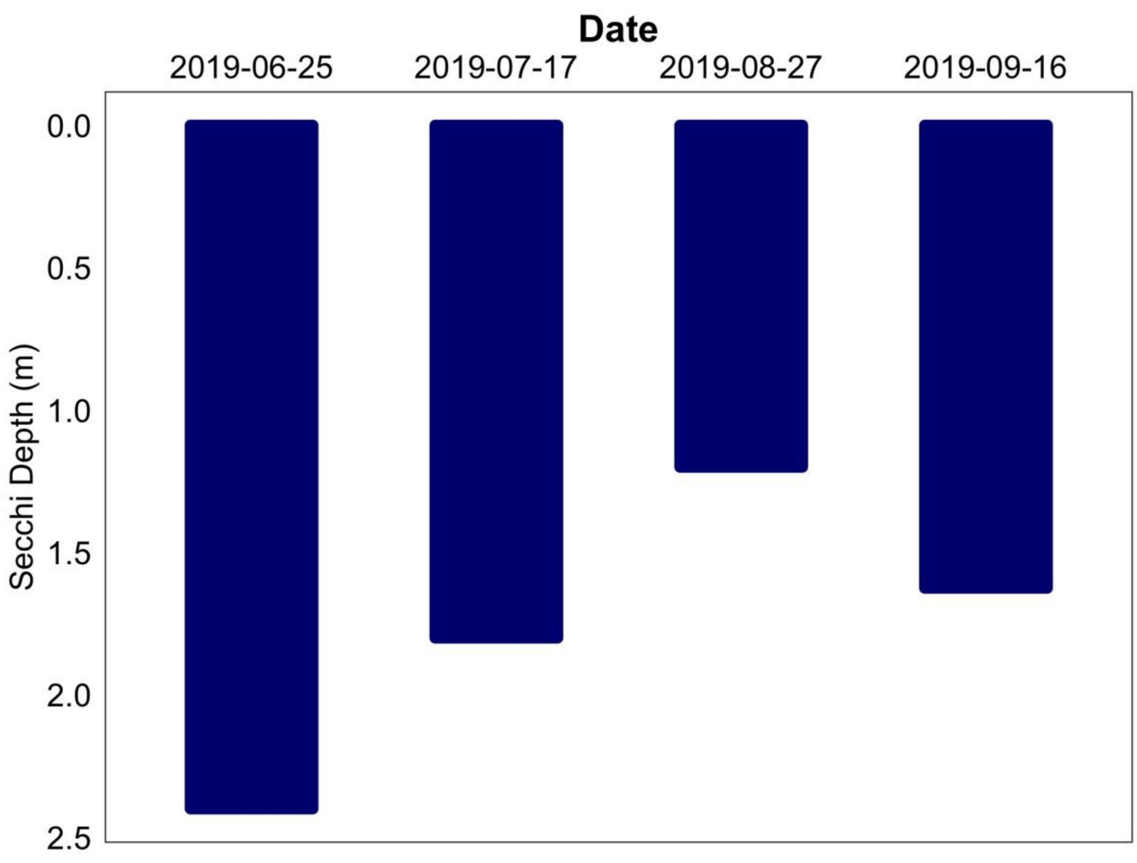

Figure 2. Secchi depth values measured four times over the course of the summer at Lacombe Lake in 2019.

WATER TEMPERATURE AND DISSOLVED OXYGEN

Water temperature and dissolved oxygen (DO) 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 15.56°C at 3 m on September 16, and a maximum temperature of 21.1°C measured at the surface on July 17 (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 dissolved oxygen (Figure 3b). The only exception was the lake bottom on July 17 and August 27, likely due to decomposition of settled organic matter.

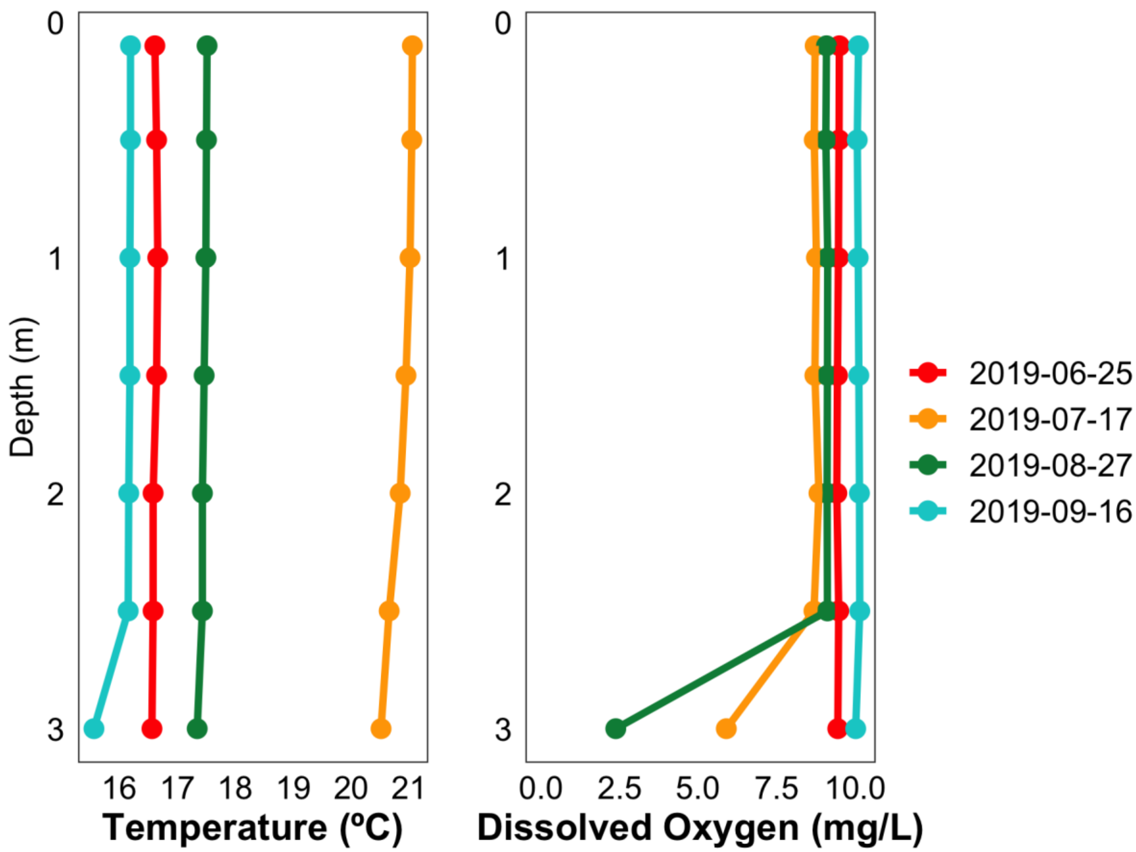

Figure 3. a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Lacombe Lake measured four times over the course of the summer of 2019.

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 20 μg/L in 2019.

Table 1. Microcystin concentrations measured four times at Lacombe Lake in 2019.

Date	**Microcystin Concentration (μg/L)**
25-Jun-19	0.14
17-Jul-19	0.34
27-Aug-19	0.51
16-Sep-19	0.35
Average	0.34

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 cyanobacteria 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 using a 63 μm plankton net at three sample sites to look for juvenile mussel veligers in each lake sampled. No mussels were detected at Lacombe Lake in the summer of 2019.

Eurasian watermilfoil is non-native aquatic plant that poses a threat to aquatic habitats in Alberta because it grows in dense mats preventing light penetration through the water column, reduces oxygen levels when the dense mats decompose, and outcompetes native aquatic plants.

Suspect samples collected from Lacombe Lake on July 13 were confirmed to be the native Northern watermilfoil (*Myriophyllum sibiricum)*.

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.

Water level data for Lacombe Lake was recorded for the first time in 2019, and for this reason, will not be presented in this report.

Table 2. Average Secchi depth and water chemistry values for Lacombe Lake. The table does not include Golder TP and NO_2+NO_3 data collected in 2008, 2009, and 2010 due to high detection limits.

Parameter	2008	2009	2010	2011	2012	2014	2015	2016	2017	2018	2019
TP (µg/L)	\	\	\	46	16	23	19	16	26	23	21
TDP (µg/L)	\	\	\	\	\	5	6	3	4	5	5
Chlorophyll-*a* (µg/L)	\	\	\	\	\	7.7	7.5	8.6	15.0	12.0	10.4
Secchi depth (m)	\	\	\	\	\	1.54	1.74	1.77	1.45	1.38	1.76
TKN (mg/L)	1.1	1.9	1.9	1.6	1.3	1.3	1.4	1.3	1.3	1.3	1.2
NO_2-N and NO_3-N (µg/L)	20	35	13	5	3	5	3	3	\	4	2
NH_3-N (µg/L)	\	\	\	143	75	18	25	54	\	23	10
DOC (mg/L)	\	\	\	\	\	\	17	15	15	15	15
Ca (mg/L)	\	\	\	\	\	27	20	21	24	24	18
Mg (mg/L)	\	\	\	\	\	32	32	34	31	31	29
Na (mg/L)	\	\	\	\	\	34	33	36	33	34	32
K (mg/L)	\	\	\	\	\	13	12	12	11	12	11
SO_4^{2-} (mg/L)	\	\	\	\	\	14	16	14	13	14	15
Cl^- (mg/L)	\	\	\	\	\	21	25	25	27	25	24
CO_3 (mg/L)	\	\	\	\	\	8	14	8	7	11	12
HCO_3 (mg/L)	\	\	\	\	\	261	230	254	255	248	213
pH	\	\	\	\	\	8.54	8.78	8.62	8.53	8.59	8.84
Conductivity (µS/cm)	\	\	\	\	\	506	478	490	515	493	450
Hardness (mg/L)	\	\	\	\	\	198	182	192	185	188	165
TDS (mg/L)	\	\	\	\	\	278	266	280	278	278	250
Microcystin (µg/L)	\	\	\	\	\	0.15	0.38	0.28	1.41	0.50	0.34
Total Alkalinity (mg/L $CaCO_3$)	\	\	\	\	\	228	212	224	220	218	195

Table 3. Concentrations of metals were last measured in Lacombe Lake on August 9, 2017. 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.

Macrophyte Monitoring

ALMS conducted a bioblitz for macrophytes (aquatic plants) and macro-algae on at Lacombe Lake on July 13, 2019, to identify the composition of the native plant community and to scan for the presence of invasive species. Forty-nine sampling locations were chosen before the bioblitz event and were selected in order to be representative of the lake's macrophyte communities. At each sample point, volunteers threw a double-sided rake over the side of a canoe, and bagged or identified plants collected. If comfortable doing so, volunteers also identified plants which could be seen from the canoe but which were not collected with a rake throw.

In total, not including emergents such as rushes and reeds, 7 unique macrophytes were identified. Three additional categories, *Stuckenia* spp., *Chara* spp., and Bladderwort (*Utricularia* spp.) were included to categorize individuals which were unidentifiable to species within the *Stuckenia*, *Chara* or Utricularia genera. There was also one unknown specimen collected. In total, 132 observations were made (Table 4). Identified plants included Arrowhead (*Sagittaria latifolia*), Northern Watermilfoil (*Myriophyllum sibiricum*), Richardson's Pondweed (*Potamogeton richardsonii*), Yellow Pond Lily (*Nuphar lutea*), Spiral Ditch Grass (*Ruppia cirrhosa*), Fries' Pondweed (*Potamogeton friesii*), and Floating Leaf Pondweed (*Potamogeton natans*). No invasive species were detected in 2019.

Table 4. The number of observations of each plant species during the 2019 bioblitz at Lacombe Lake.

Common Name	# Observations
Bladderwort	28
Stuckenia spp.	24
Chara spp.	8
Yellow Pond Lily	16
Richardson's Pondweed	14
Spiral Ditch Grass	7
Northern Watermilfoil	8
Arrowhead	5
Fries' Pondweed	4
Floating Leaf Pondweed	1
Unknown	1
TOTAL OBSERVATIONS	**132**

Figure 4a. Macrophytes collected at Lacombe Lake on July 13, 2019. Starting from top left and going clockwise: Floating Leaf Pondweed (*Potamogeton natans*), Arrowhead (*Sagittaria latifolia*), *Chara* spp., and Bladderwort (*Utricularia* spp.).

Figure 4b. Macrophytes collected at Lacombe Lake on July 13, 2019. Starting from top left and going clockwise: *Stuckenia* spp., Fries' Pondweed (*Potamogeton friesii*), Richardson's Pondweed (*Potamogeton richardsonii*), and Northern Watermilfoil (*Myriophyllum sibiricum*).

Figure 4c. Macrophytes collected at Lacombe Lake on July 13, 2019. Starting from top left and going clockwise: Yellow Pond Lily (*Nuphar lutea*), Unknown, and Spiral Ditchgrass (*Ruppia cirrhosa*).