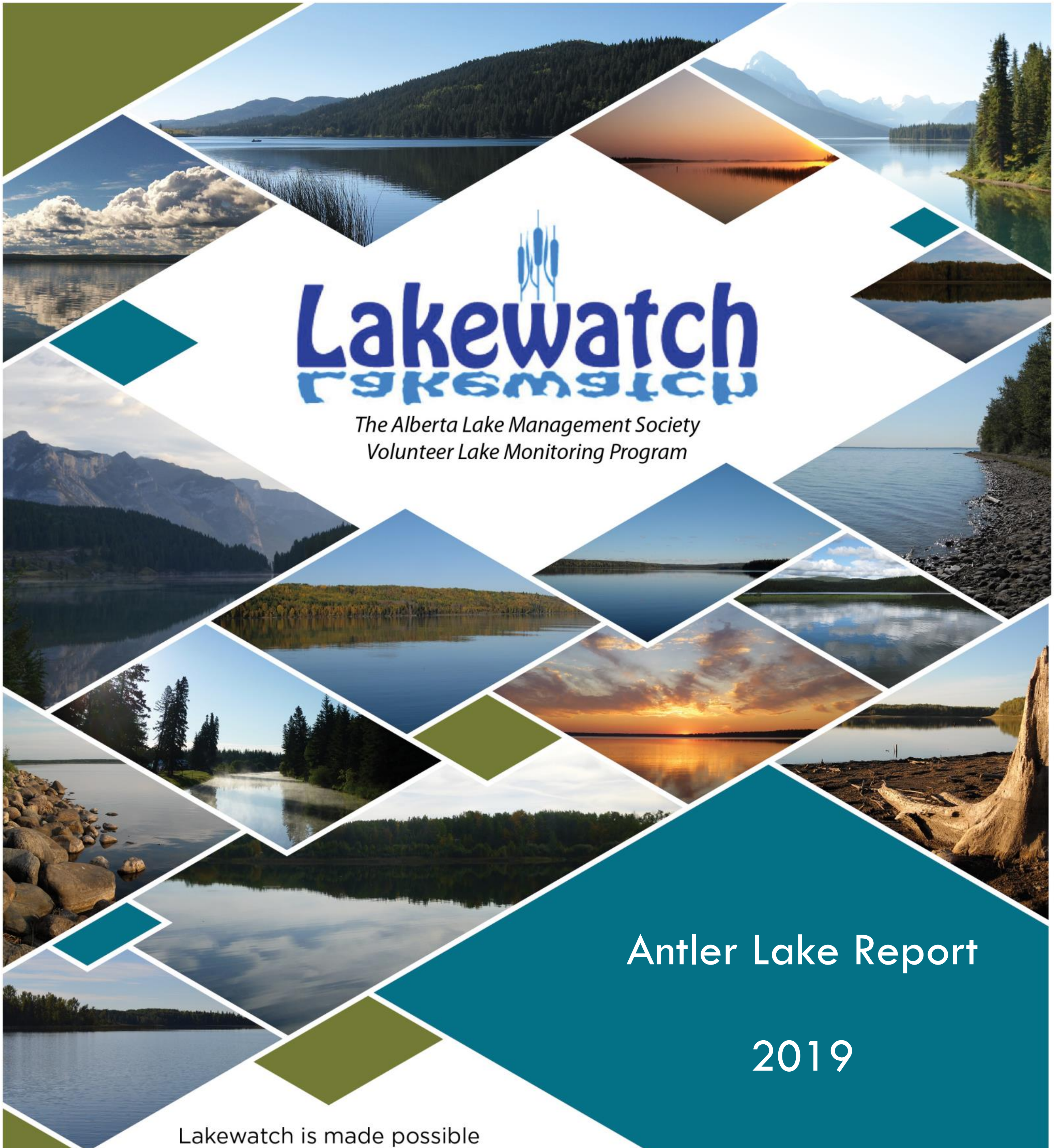


Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Antler 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

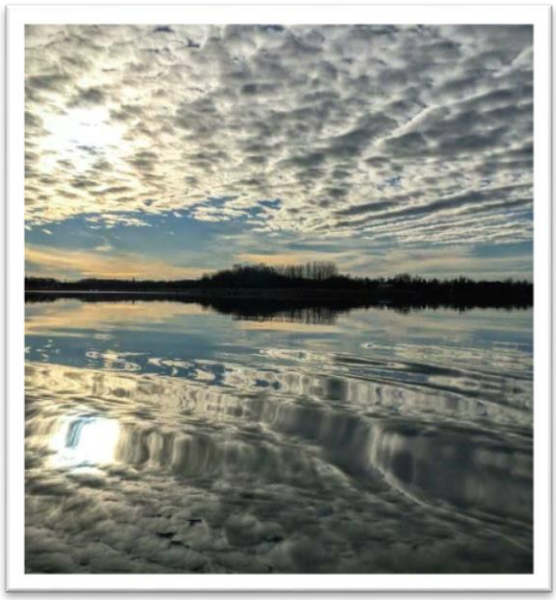
The LakeWatch program is made possible through the dedication of its volunteers. We would like to extend a special thanks to Leah Hamonic for the time and energy put into sampling Antler Lake in 2019. We would also like to thank Sarah Davis Cornet, Caleb Sinn, and Pat Heney, who were summer technicians 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.

ANTLER LAKE

Antler Lake is located 18 km east of Sherwood Park and 25 km northwest of Tofield. The lake is near Cooking Lake and Elk Island National Park, in the Boreal Forest dry-mixedwood region[1]. There once was a small island, Hazelnut Island, on the south end of lake that has now become a peninsula due to receding water levels. The peninsula, along with the rest of the lake's shoreline, has dense shrubs and sparse patches of mature birch and small poplar.

Antler Lake is also a smaller fishing spot: species caught here include Northern Pike, Perch and Rainbow Trout[2]. There are cottage residences along the eastern and southern shores, and Hazelnut Island has minor development. The maximum depth of Antler Lake is ~ 1 m, and the eastern shore has a cattail marsh.

The Antler Lake Stewardship Committee became formalized in March 2016 as a registered non-profit society. Their mission is to create a community that shares the responsibility of being the best stewards of Antler Lake and the Antler Lake watershed. In 2016, the Antler Lake Stewardship Committee partnered with the North Saskatchewan Watershed Alliance to develop a State of the Watershed Report. This report is expected to be completed in 2020.



Antler Lake. Photo by the Antler Lake Stewardship Committee.

Map of Antler Lake, AB (GPS Nautical Charts).

[1] Government of Alberta. (N.d.). http://www.albertaparks.ca/antler-lake-island/
[2] HookandBullet.com. (2017). http://www.hookandbullet.com/fishing-antler-lake-north-cooking-lake-ab/

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 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 Antler Lake was 380 µg/L (Table 2). This historically high average puts Antler Lake well into the hypereutrophic, or very productive, trophic classification. TP trends followed chlorophyll-*a* trends closely, peaking into early August (Figure 1).

Average chlorophyll-*a* concentration in 2019 was 275 µg/L (Table 2), also putting Antler Lake into the hypereutrophic classification. This is the highest average concentration of chlorophyll-*a* measured historically, however more data collection will help to establish baseline conditions.

Finally, average TKN concentration was 4.9 mg/L (Table 2). TKN concentrations varied throughout the sampling season, also peaking on August 8.

Average pH was measured as 9.30 in 2019, buffered by moderate alkalinity (180 mg/L $CaCO_3$) and bicarbonate (152 mg/L HCO_3). Chloride and carbonate were the dominant ions contributing to a low conductivity of 460 µS/cm (Table 2). Notably, Ammonia (NH_3^-) concentrations were high in Antler Lake in 2019 (81 µg/L).

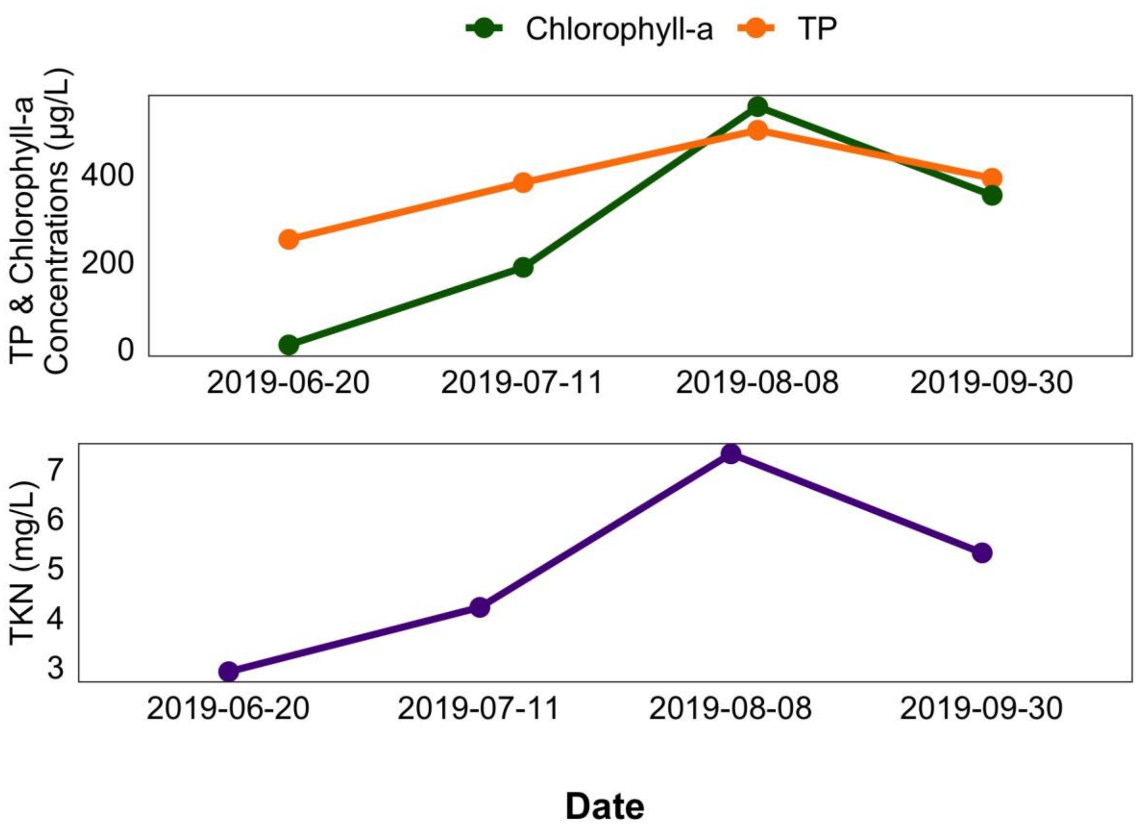

Figure 1. Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Antler Lake.

METALS

Samples were analyzed for metals (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 in Antler Lake in 2019. Table 3 presents historical metal concentrations from previously measured years.

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 Antler Lake in 2019 was 0.73 m (Table 2). Secchi depth was deepest on June 20 when chlorophyll-*a* levels were also the lowest, and decreased throughout the summer until August, rising slightly in September.

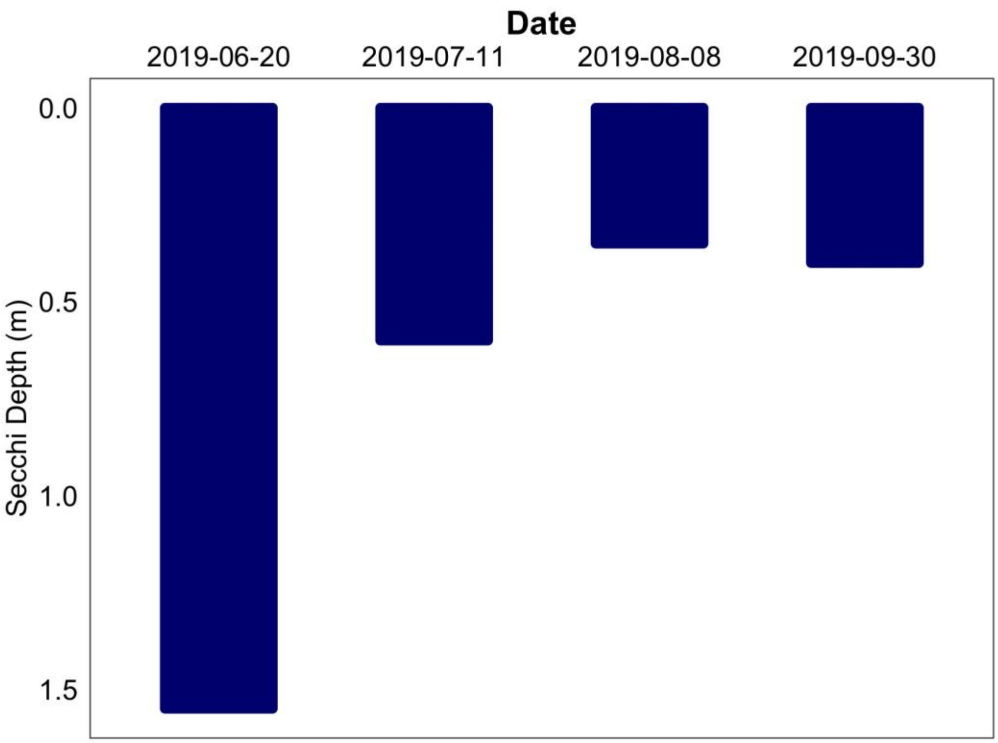

Figure 2. Secchi depth values measured four times over the course of the summer at Antler Lake in 2019.

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 ALMS' Brief Introduction to Limnology for descriptions of technical terms.

Temperatures of Antler Lake varied throughout the summer, with a maximum temperature of 21.1 °C measured at 1 m on August 8 (Figure 3a). Temperatures reached around 6.6 °C by late September. Due to its shallow depth, the lake was well mixed throughout the summer, with temperatures remaining the uniform (isothermal) throughout the water column.

Antler Lake remained well oxygenated through its water column, measuring above the CCME guidelines of 6.5 mg/L dissolved oxygen (Figure 3b).

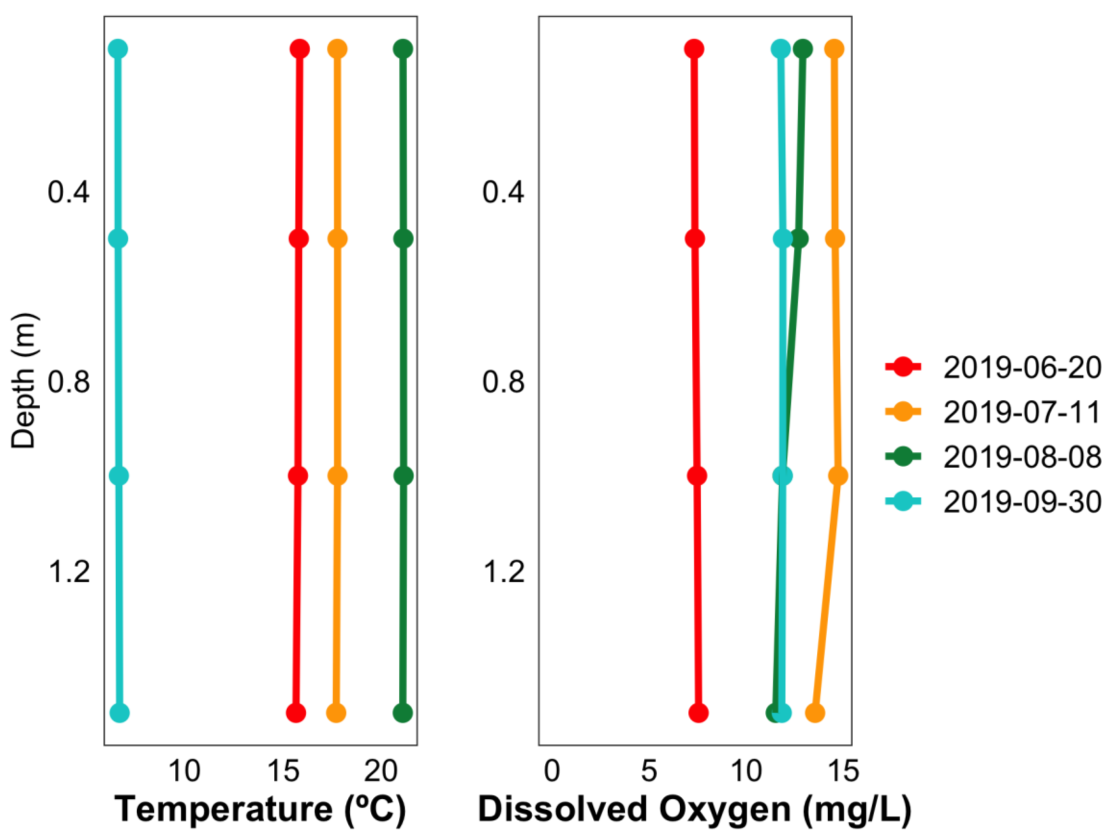

Figure 3. a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Antler Lake measured four times over the course of the summer of 2019.

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.

Composited microcystin levels in Antler Lake fell below the recreational guideline of 20 μg/L on each sampling date (Table 1). Caution should still be observed when recreating in visible cyanobacteria blooms. A concentration of 6.47 μg/L suggests that specific locations on the lake may have microcystin concentrations which exceed recreational guidelines.

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

Date	Microcystin Concentration (μg/L)
20-Jun-19	0.73
11-Jul-19	6.47
08-Aug-19	0.88
30-Sep-19	0.91
Average	2.25

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 Antler 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 Antler Lake on July 11th 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 levels in Antler Lake have fluctuated within a 2-m range since Alberta Environment began monitoring the lake in 1959, with a decline between the late 1990's until 2011 (Figure 4). Since 2011, water levels have recovered to near-historical records going back to the late 1950's.

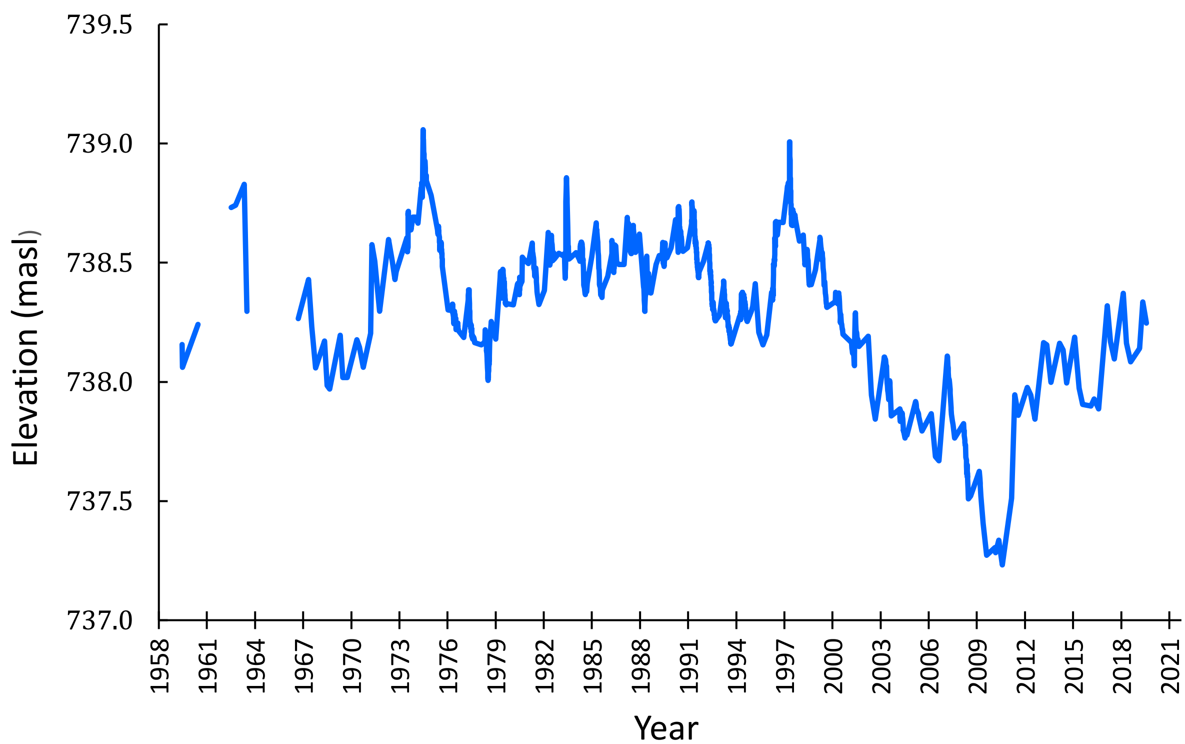

Figure 4. Water levels measured in meters above sea level (masl) from 1959-2019 at Antler Lake. No data available for 1961, and 1964-65. Data retrieved from Alberta Environment and Parks.

Table 2. Average Secchi depth and water chemistry values for Antler Lake. Historical values are given for reference.

Parameter	1987	2016	2017	2019
TP (µg/L)	190	380	412	380
TDP (µg/L)	86	188	100	203
Chlorophyll-*a* (µg/L)	46	121	238	275
Secchi depth (m)	0.88	0.40	0.31	0.73
TKN (mg/L)	2.4	4.9	6.0	4.9
NO_2-N and NO_3-N (µg/L)	6	19	5	5
NH_3-N (µg/L)	57	43	74	81
DOC (mg/L)	22	39	39	39
Ca (mg/L)	28	40	36	34
Mg (mg/L)	9	19	17	16
Na (mg/L)	14	38	36	33
K (mg/L)	13	33	30	29
SO_4^{2-} (mg/L)	23	33	25	17
Cl^- (mg/L)	7	35	32	37
CO_3 (mg/L)	<5	22	13	34
HCO_3 (mg/L)	144	196	180	152
pH	8.28	8.97	8.82	9.30
Conductivity (µS/cm)	305	534	470	460
Hardness (mg/L)	108	176	158	148
TDS (mg/L)	167	320	280	278
Microcystin (µg/L)	/	0.62	15.88	2.25
Total Alkalinity (mg/L $CaCO_3$)	122	196	170	180

Table 3. Concentrations of metals measured historically in Antler Lake. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference.

Metals (Total Recoverable)	2016	2017	Guidelines
Aluminum µg/L	165	89.2	100[a]
Antimony µg/L	0.154	0.127	/
Arsenic µg/L	1.87	1.81	5
Barium µg/L	57.9	65.9	/
Beryllium µg/L	0.015	0.013	100[c,d]
Bismuth µg/L	0.002	0.0015	/
Boron µg/L	98.7	65.2	1500
Cadmium µg/L	0.012	0.005	0.26[b]
Chromium µg/L	0.29	0.2	/
Cobalt µg/L	0.339	0.439	1000[d]
Copper µg/L	0.91	0.62	4[b]
Iron µg/L	229	172	300
Lead µg/L	0.356	0.276	7[b]
Lithium µg/L	37.6	26.4	2500[e]
Manganese µg/L	80.6	30.3	200[e]
Mercury (dissolved) ng/L	/	0.39	/
Mercury (total) ng/L	/	0.58	26
Molybdenum µg/L	0.761	0.763	73[c]
Nickel µg/L	0.979	1.39	150[b]
Selenium µg/L	0.24	0.2	1
Silver µg/L	0.003	0.002	0.25
Strontium µg/L	198	196	/
Thallium µg/L	0.0024	0.003	0.8
Thorium µg/L	0.0186	0.011	/
Tin µg/L	0.033	0.03	/
Titanium µg/L	4.96	3.2	/
Uranium µg/L	0.577	0.524	15
Vanadium µg/L	1.53	1.13	100[d,e]
Zinc µg/L	2.8	3.1	30

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5
[b] Based on water hardness > 180mg/L (as CaCO3)
[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 survey for macrophytes (aquatic plants) and macro-algae at Antler Lake on August 8, 2019, as a way to identify the composition of the native plant community and to scan for the presence of invasive species. Nine sampling locations were chosen. At each sample point, a double sided rake was thrown over the side of a canoe, and collected plants were identified or bagged. If comfortable doing so, staff 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, 5 unique macrophytes were identified. One additional category, *Stuckenia* spp., was included to categorize individuals which were unidentifiable to species within the *Stuckenia* genus. In total, 33 observations were made (Table 4). Identified plants included Small Pondweed (*Potamogeton pusillus*), Northern Watermilfoil (*Myriophyllum sibiricum*), Coontail (*Ceratophyllum demersum*), Star Duckweed (*Lemna trisulca*), and Common Duckweed (*Lemna minor*). No invasive species were detected in 2019.

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

Common Name	# Observations
Coontail	9
Star Duckweed	9
Common Duckweed	9
Northern Watermilfoil	3
Stuckenia spp.	2
Small Pondweed	1
TOTAL OBSERVATIONS	**33**

Figure 5. Macrophytes collected at Antler Lake on August 8, 2019. Starting top left going clockwise: Star Duckweed (*Lemna trisulca*), Small Pondweed (*Potamogeton pusillus*), *Stuckenia* spp., Coontail (*Ceratophyllum demersum*), and Northern Watermilfoil (*Myriophyllum sibiricum*).