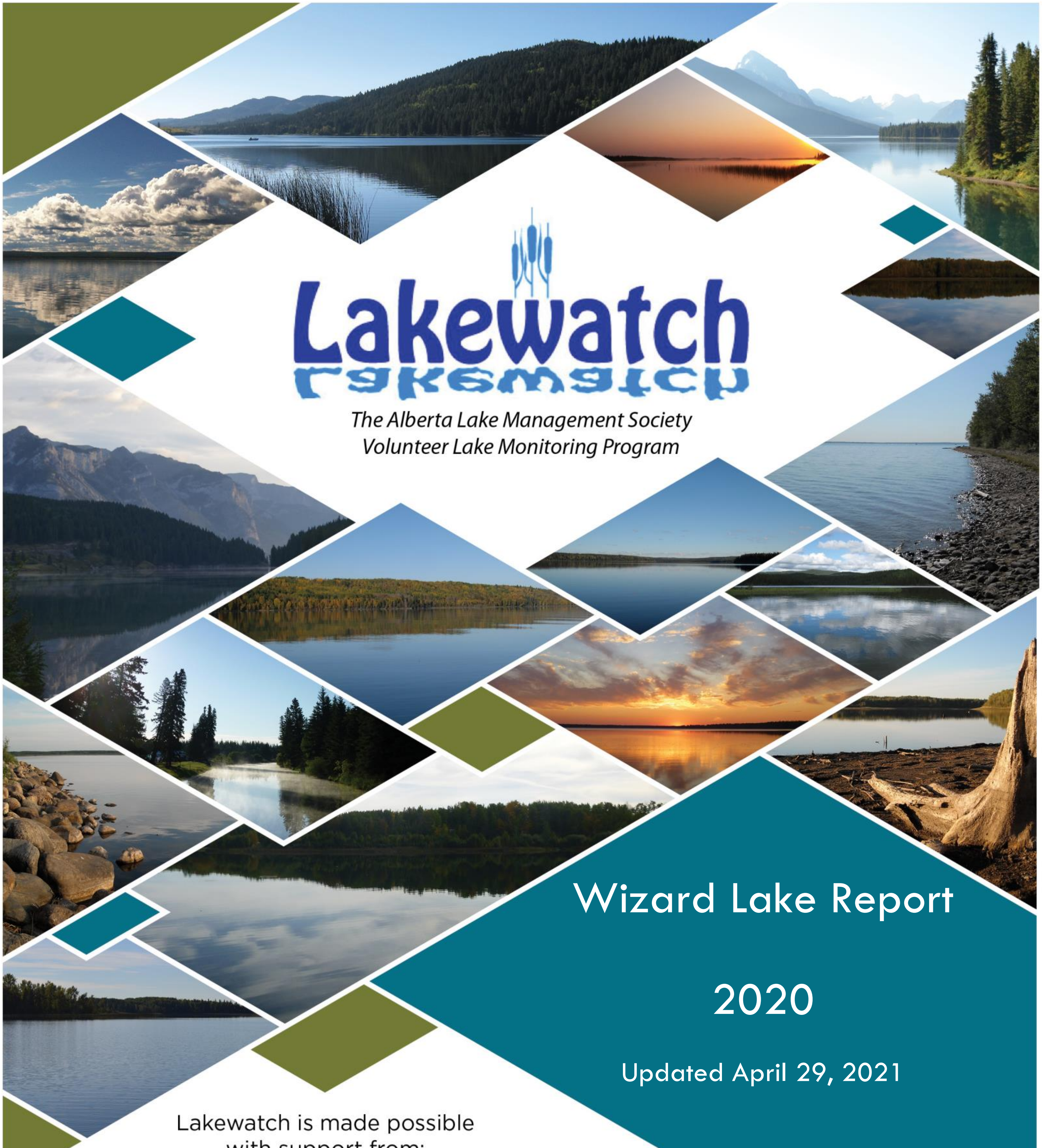


Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Wizard Lake Report

2020

Updated April 29, 2021

Lakewatch is made possible with support from:

Alberta Environment and Parks

Pigeon Lake Watershed Association

Moose Lake Watershed Society

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

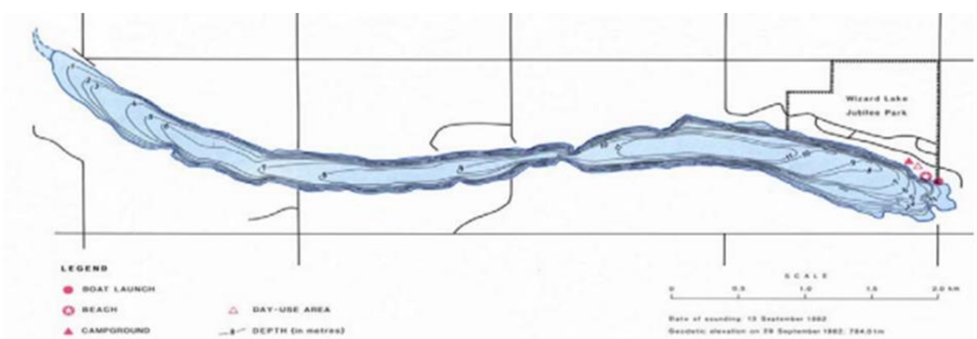
The LakeWatch program is made possible through the dedication of its volunteers. A special thanks to Larry MacPhersson for his commitment to collecting data at Wizard Lake. We would also like to thank Kyra Ford and Ryan Turner, who were summer technicians in 2020. Executive Director Bradley Peter and Program Manager Caleb Sinn were instrumental in planning and organizing the field program. This report was prepared by Caleb Sinn and Bradley Peter.

Wizard Lake

Wizard Lake 2011. Photo by Jessica Davis

Wizard Lake is a long serpentine lake lying in a heavily forested, deep glacial meltwater channel 60 km southwest of the city of Edmonton. The valley provides excellent shelter from winds, making this lake very popular for water skiing. The northern shore of the lake is in the county of Leduc and the southern shore of the lake is in the county of Wetaskiwin. The Nehiyawak name for the lake is Seksyawas Sakigan, which translates to Lizard Lake, and until the late 1960's the popular name for the lake was Conjuring Lake[1]. Cree legends said strange noises in the lake came from 'conjuring creatures'; the creek draining the lake, which enters the North Saskatchewan River ~5 km west of Devon, is still called Conjuring Creek[2].

The year 1904 saw both the first settlers and the opening of a sawmill in the lake area. The sawmill was short-lived, closing in 1905 when the railway was not built across the area as expected. The sawmill was succeeded by the building of an underground coalmine, in operation until the 1940's. Today, the area surrounding the lake includes Wizard Lake Jubilee Park and 110 cottages on the north shore, 61 cottages on the south, and a subdivision.



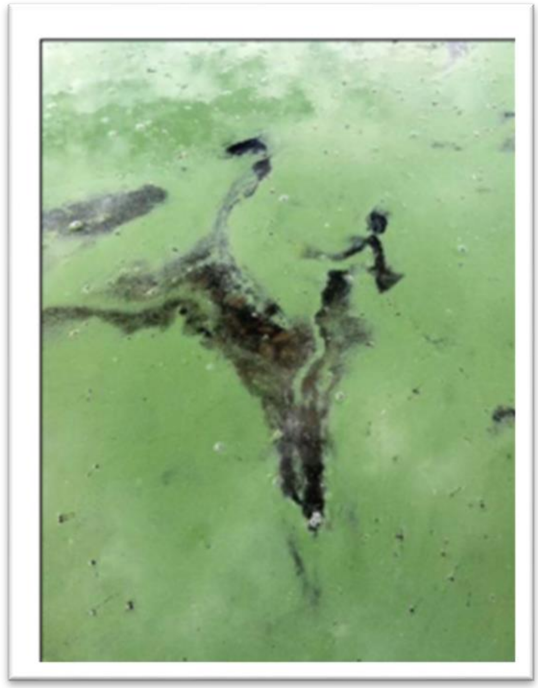
Bathymetric map of Wizard Lake (Mitchell & Prepas 1990)

---

[1] 1 Aubrey, M. K. 2006. Concise place names of Alberta. Retrieved from http://www.albertasource.ca/placenames/resources/searchcontent.php?book=1

[2] Aquality Environmental Consulting (2013). Wizard Lake State of the Watershed Report 2012. Retrieved from: http://www.Wizardlake.ca/uploads/1/8/0/3/18037581/state_of_watershed_complete.pdf January 9, 2014.

Wizard Lake is a popular recreation area for water skiing, SCUBA diving, and fishing. Intensive use of the lake, especially on summer weekends, led to conflict between water skiers, high-speed boat operators, canoers, and anglers. A lake management plan was prepared in 1979, which recommended dividing the lake into two zones: the boat speed in the west half of the lake was to be limited to 12 km/hr to facilitate access to anglers, while the boat speed in the east half was to be limited to 65 km/hr to allow water skiing. Yellow perch and northern pike are the most commonly fished species in the lake. Wizard Lake occupies an area of 2.67 km^2, with a maximum depth of 11 m and a mean depth of 6.2 m. The length of the lake stretches 11.5 km and has a maximum width of 0.55 km. Wizard Lake lies in the Strawberry Creek sub-basin of the North Saskatchewan River Watershed[2]. It is a eutrophic lake that can experience dense blue-green algae blooms during the summer months. For more detailed information on Wizard Lake and its watershed, view the State of the Watershed Report available on www.wizardlake.ca.



Cyanobacterial bloom on the surface of Wizard Lake, 2011

The watershed area for Wizard Lake is 36.99 km^2 and the lake area is 2.67 km^2. The lake to watershed ratio of Wizard Lake is 1:14. A map of the Wizard Lake watershed area can be found at: http://alms.ca/wp-content/uploads/2016/12/Wizard.pdf

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 Bureau Veritas, 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, and spiny water flea. 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.[3] Data is reconfigured using packages tidyr [4] and dplyr [5] and figures are produced using the package ggplot2 [6]. Trophic status for each lake is classified based on lake water characteristics using values from Nurnberg (1996)[7]. 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. For lakes with >10 years of long term data, trend analysis is done with non-parametric methods. The seasonal Kendall test estimates the presence of monotonic (unidirectional) trends across individual seasons (months) and is summed to give an overall trend over time. For lakes that had multiple samplings in a single month, the value closest to the middle of the month was used in analysis

[3] 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/.

[4] 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.

[5] 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.

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

[7] 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 Wizard Lake was 41 µg/L (Table 2), falling into the eutrophic, or highly productive trophic classification. This value is the lowest average TP in the historical record (Table 2). TP was lowest during the July 7th sampling at 24 µg/L, and was highest during the August 5th sampling event at 61 µg/L (Figure 1).

Average chlorophyll-*a* concentration in 2020 was 33.4 µg/L (Table 2), falling into the hypereutrophic, or very highly productive trophic classification. Chlorophyll-*a* was highest during the August 5th sampling event at 53.0 µg/L, corresponding with the peak in TP (Figure 1).

Finally, the average TKN concentration was 1.4 mg/L (Table 2) with concentrations peaking during the August sampling event, similar to TP and chlorophyll-*a*.

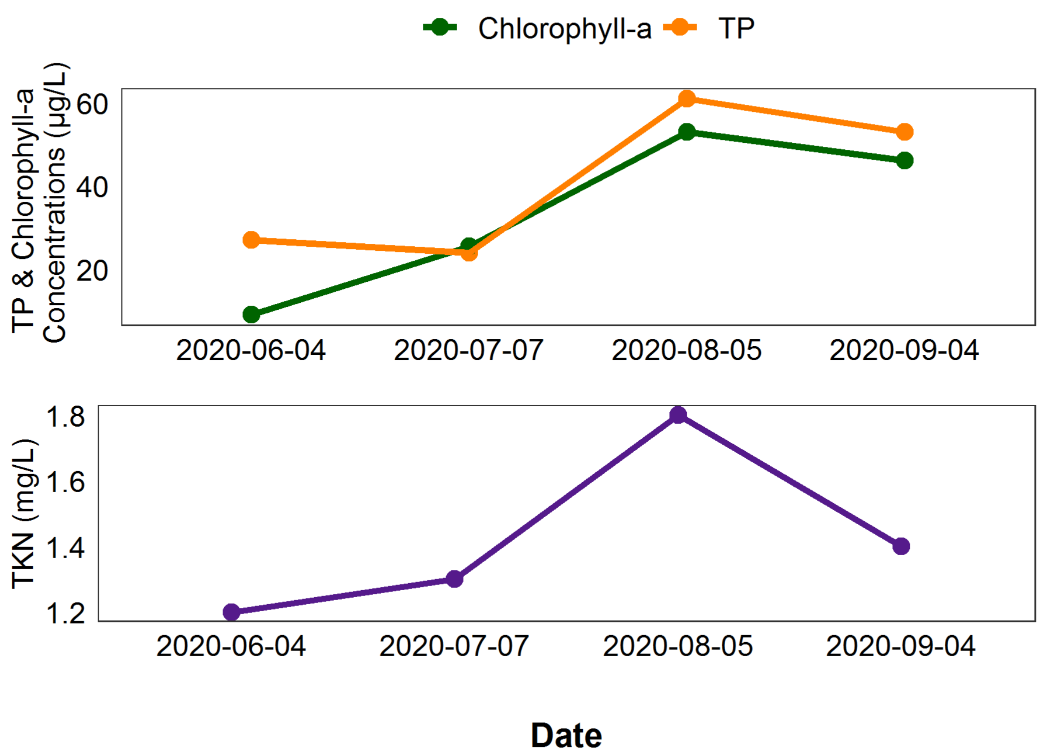


Figure 1. Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Wizard Lake.

Average pH was measured as 8.25 in 2020, buffered by moderate alkalinity (170 mg/L $CaCO_3$) and bicarbonate (200 mg/L HCO_3). Aside from bicarbonate, the dominant ions were calcium and sodium, contributing to a low conductivity of 360 µS/cm (Figure 2, top; Table 2). Sulphate notably had a large range of values, due to a large value from the June 4th sampling event. Wizard Lake is on the lower end of ion levels compared to other LakeWatch lakes sampled in 2020, with an especially low relative value for magnesium (Figure 2, bottom).

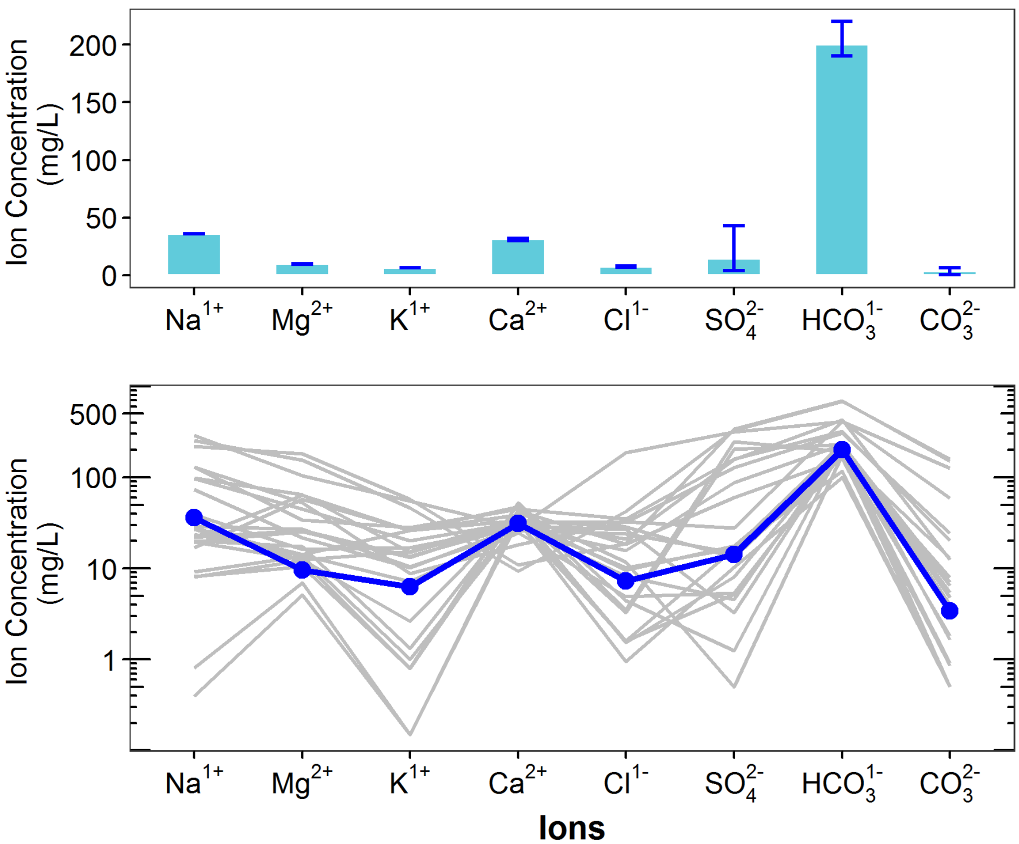


Figure 2. Average levels of cations (sodium = Na^{1+}, magnesium = Mg^{2+}, potassium = K^{1+}, calcium = Ca^{2+}) and anions (chloride = Cl^{1-}, sulphate = SO_4^{2-}, bicarbonate = HCO_3^{1-}, carbonate = CO_3^{2-}) from four measurements over the course of the summer at Wizard Lake. Top) bars indicate range of values measured, and bottom) Schoeller diagram of average ion levels at Wizard Lake (blue line) compared to 25 lake basins (gray lines) sampled through the LakeWatch program in 2020 (note log_{10} scale on y-axis of bottom figure).

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 Wizard Lake in 2020. Table 3 presents historical metal concentrations from previously sampled years.

WATER CLARITY AND EUPHOTIC 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 euphotic depth of Wizard Lake in 2020 was 3.05 m, corresponding to a Secchi depth of 1.53 m (Table 2). Euphotic depth remained fairly consistent throughout the entire sampling season (Figure 3). The euphotic depth always remained well above the lake profile depth (the deepest part of the lake). Based on the seasonal trend of euphotic depth, light penetrated to the bottom sediments only in regions of the lake which were 3 m or shallower throughout the open water season.

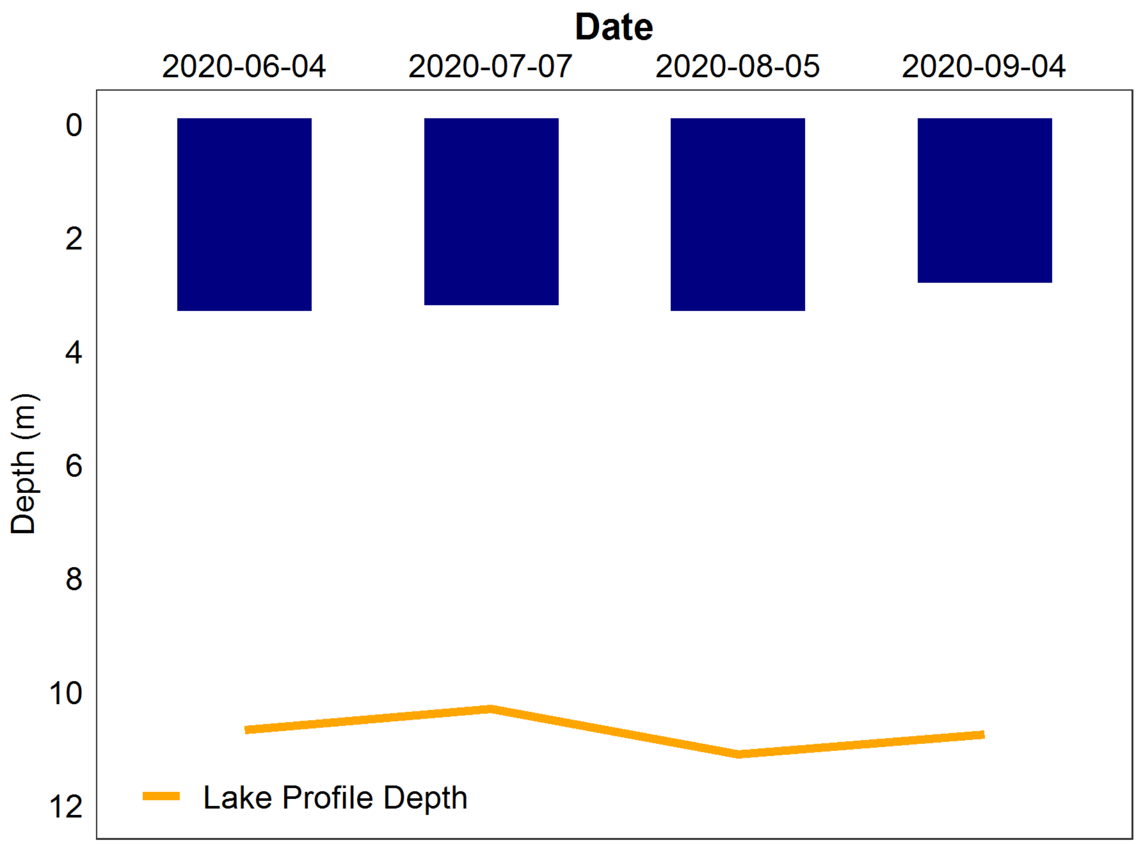


Figure 3. Secchi depth values measured four times over the course of the summer at Wizard Lake in 2020.

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 Wizard Lake varied throughout the summer, with a maximum temperature of 22.2°C measured at the surface on August 5th, and a minimum temperature of 13.6°C measured at 10 m on July 7th (Figure 4a). The lake was weakly stratified during the July and August sampling events, with thermoclines starting at around 5 meters. The lake was isothermal (consistent in temperature) when sampled in June and September, meaning it was mixing fully during those sampling events.

Wizard Lake remained well oxygenated through most of the water column throughout the summer, measuring above the CCME guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 3b). The oxygen level fell below this level in the bottom 4.5 to 5.5 meters in August and July, respectively, and reached anoxia (dissolved oxygen below 1.0 mg/L) around 7 m in both months. The lack of oxygen at greater depths is due to the decomposition of organic matter at lake bottom, combined with isolation from surface oxygen due to the weak thermoclines that prevented mixing. In June and September, dissolved oxygen levels were above 6.5 mg/L until about 10 m, or 1 m from the bottom, and did not reach anoxic levels.

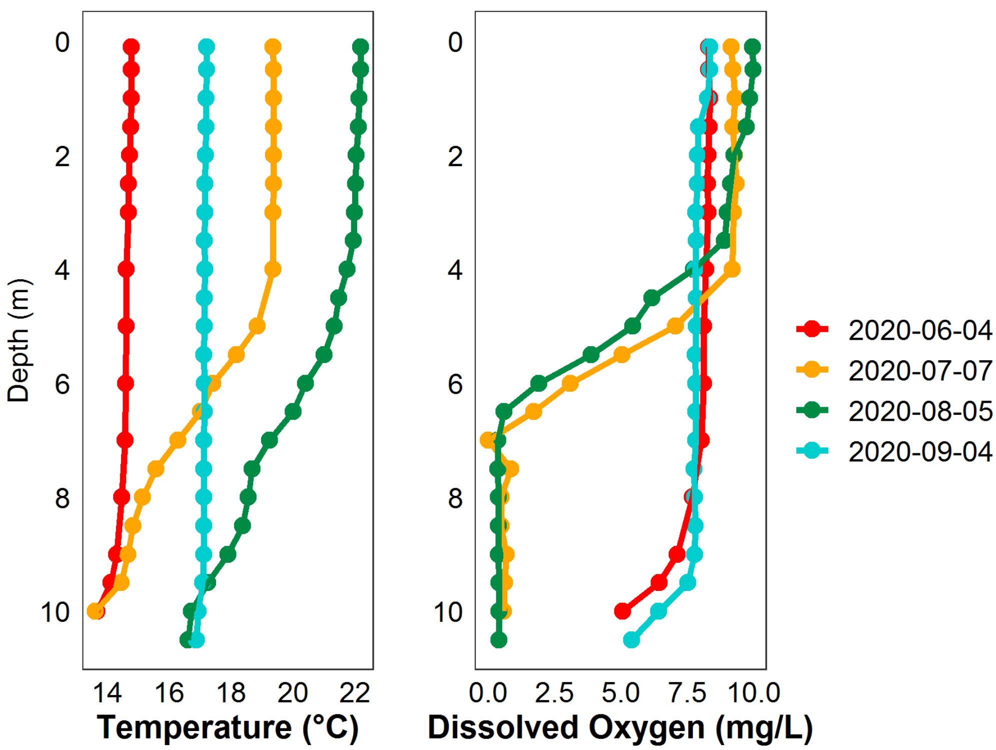


Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Wizard Lake measured four times over the course of the summer of 2020.

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 Wizard Lake fell below the recreational guideline of 20 μg/L at the locations and times sampled at Wizard Lake in 2020. Microcystin was even below detection limit during the June 4th sampling event. A value of 0.05 μg/L is used for the purpose of calculating average concentration in instances of no detection. Despite microcystin concentrations remaining low throughout the summer, caution should be observed when recreating in visible blooms.

Table 1. Microcystin concentrations measured four times at Wizard Lake in 2020.

Date	Microcystin Concentration (μg/L)
4-Jun-20	<0.1
7-Jul-20	0.53
5-Aug-20	0.21
4-Sep-20	0.28
Average	**0.27**

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 can change lake conditions which can then lead to toxic cyanobacteria blooms, decrease the amount of nutrients needed for fish and other native species, and cause millions of dollars in annual costs for repair and maintenance of water-operated infrastructure and facilities. Spiny water flea pose a concern for Alberta because they alter the abundance and diversity of native zooplankton as they are aggressive zooplankton predators. Through over-predation, they will impact higher trophic levels such as fish. They also disrupt fishing equipment by attaching in large numbers to fishing lines.

Monitoring involved sampling with a 63 μm plankton net at three sample sites to look for juvenile mussel veligers and spiny water flea in each lake sampled. In 2020, no mussels or spiny water flea were detected at Wizard Lake.

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. Eurasian watermilfoil can look similar to the native Northern watermilfoil, thus genetic analysis is ideal for suspect watermilfoil species identification.

Samples collected from Wizard Lake on July 20th 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.

Records of water levels at Wizard Lake date back to 1968 (Figure 5). Lake levels have been relatively stable, fluctuating only 1.3 m over this time period, and remain close to the overall average of 783.9 m.

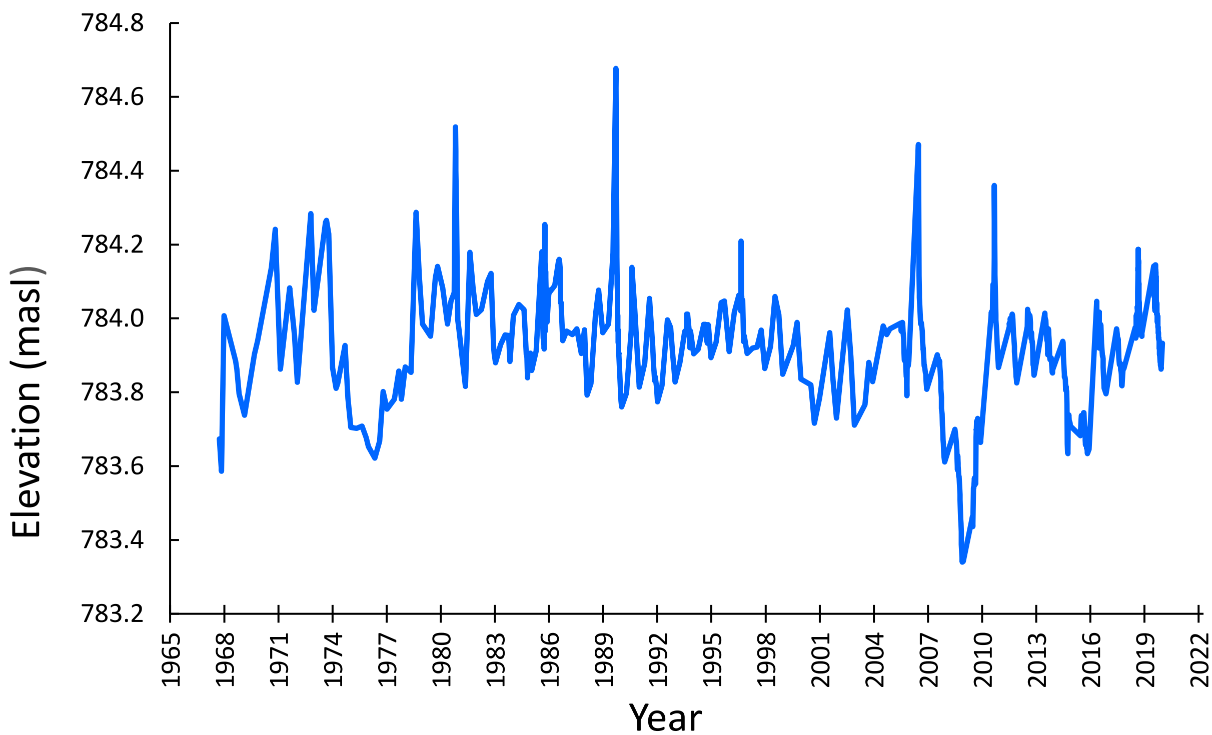


Figure 5. Water levels measured in meters above sea level (masl) from 1968- 2020. Data retrieved from Alberta Environment and Parks.

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

Parameter	2006	2008	2009	2010	2011	2013	2016	2018	2020
TP (µg/L)	48	50	52	48	76	53	43	47	41
TDP (µg/L)	14	12	18	20	14	19	6	6	7
Chlorophyll-*a* (µg/L)	32.6	23.9	26.8	17.1	39.2	23.8	44.0	35.3	33.4
Secchi depth (m)	1.33	1.43	1.81	2.71	1.15	1.36	1.52	1.16	1.53
TKN (mg/L)	1.3	1.2	1.3	1.3	1.6	1.2	1.2	1.3	1.4
NO_2 and NO_3 (µg/L)	7	3	46	20	3	6	3	4	4
NH_3 (µg/L)	31	21	29	81	19	28	25	27	38
DOC (mg/L)	/	/	/	12	15	13	12	13	14
Ca (mg/L)	25	28	28	24	28	29	26	25	31
Mg (mg/L)	9	9	10	9	9	9	11	10	10
Na (mg/L)	36	35	38	38	32	37	39	41	36
K (mg/L)	6	6	6	6	6	6	7	7	6
SO_4^{2-} (mg/L)	4	5	5	4	3	6	3	2	14
Cl^- (mg/L)	5	5	5	6	5	5	6	7	7
CO_3 (mg/L)	6	10	6	/	4	5	4	4	3
HCO_3 (mg/L)	202	206	207	216	200	202	210	208	200
pH	8.3	8.3	8.44	8.29	8.45	8.472	8.5	8.49	8.25
Conductivity (µS/cm)	335	337	341	346	337	354	350	350	360
Hardness (mg/L)	97	106	109	96	107	110	105	103	118
TDS (mg/L)	186	191	196	193	185	197	202	200	213
Microcystin (µg/L)	/	/	/	0.09	0.25	0.25	1.41	0.38	0.27
Total Alkalinity (mg/L $CaCO_3$)	172	175	176	177	170	174	176	173	170

Table 3. Concentrations of metals measured in Wizard Lake on in each sampling year since 2013. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference. Values exceeding these guidelines are presented in red.

Metals (Total Recoverable)	2013	2016	Guidelines
Aluminum μg/L	18	7.7	100[a]
Antimony μg/L	0.06565	0.074	6[d]
Arsenic μg/L	1.205	1.17	5
Barium μg/L	60.35	52.8	1000[d]
Beryllium μg/L	0.0015	0.029	100[c,e]
Bismuth μg/L	0.00255	0.004	/
Boron μg/L	43.85	39.3	1500
Cadmium μg/L	0.00225	0.029	0.26[b]
Chromium μg/L	0.3215	0.08	/
Cobalt μg/L	0.0312	0.06	1000[e]
Copper μg/L	0.7635	0.51	4[b]
Iron μg/L	52.15	56.3	300
Lead μg/L	0.0277	0.053	7[b]
Lithium μg/L	15.5	12.4	2500[f]
Manganese μg/L	74.6	88.1	200[f]
Molybdenum μg/L	0.3795	0.376	73[c]
Nickel μg/L	0.2135	0.095	150[b]
Selenium μg/L	0.095	0.23	1
Silver μg/L	0.011475	0.028	0.25
Strontium μg/L	230.5	211	/
Thallium μg/L	0.001175	0.0358	0.8
Thorium μg/L	0.00015	0.0148	/
Tin μg/L	0.015	0.033	/
Titanium μg/L	0.7815	0.9	/
Uranium μg/L	0.328	0.342	15
Vanadium μg/L	0.1915	0.23	100[e,f]
Zinc μg/L	1.914	0.5	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 Canadian Drinking Water Quality guideline values.

[e] Based on CCME Guidelines for Agricultural use (Livestock Watering).

[f] Based on CCME Guidelines for Agricultural Use (Irrigation).

A forward slash (/) indicates an absence of data or guidelines.