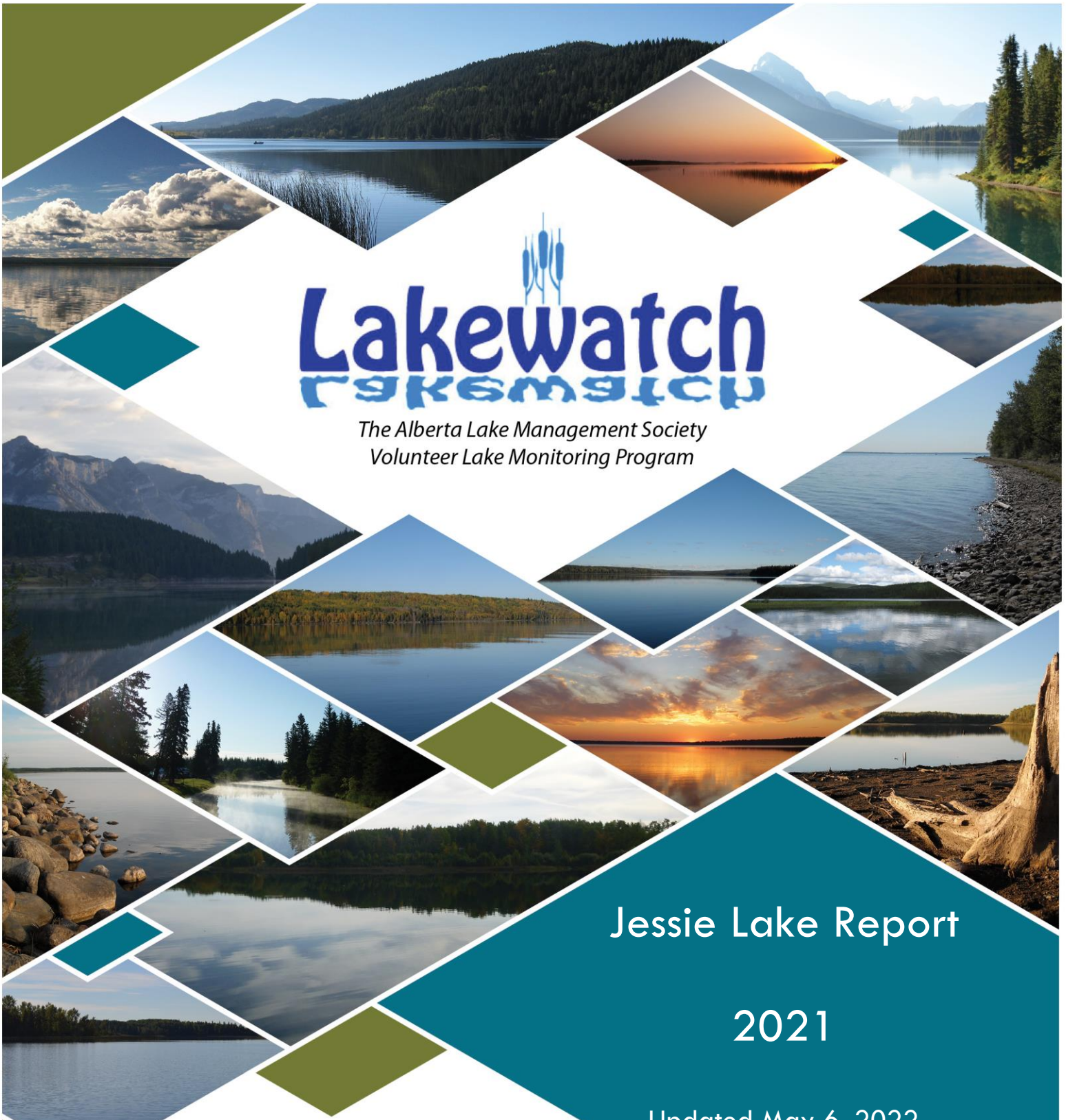

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Jessie Lake Report

2021

Updated May 6, 2022

Lakewatch is made possible with support from:

Alberta
LICA Environmental Stewards
Pigeon Lake Watershed Association
MD 61
Alberta ecotrust
Discover Hardisty More than you imagine
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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 Paul St. Amant for his commitment to collecting data at Jessie Lake. We would also like to thank Keri Malanchuk and Brittany Onysyk, who were summer technicians in 2021. 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.

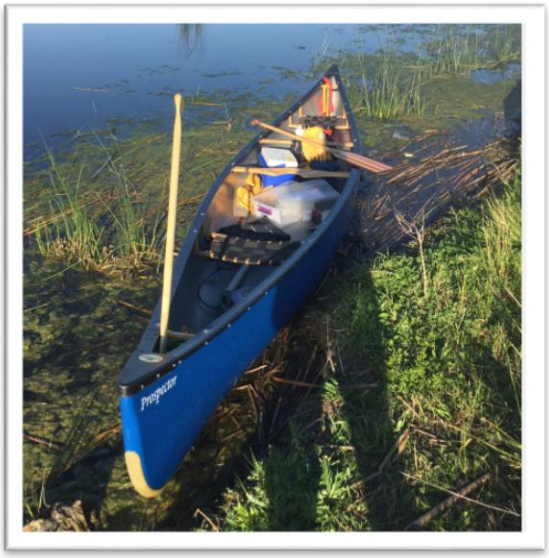
BEFORE READING THIS REPORT, CHECK OUT A BRIEF INTRODUCTION TO LIMNOLOGY AT ALMS.CA/REPORTS

JESSIE LAKE

Jessie Lake is a shallow lake with an area of 5.3 km^2. It is located in the dry mixedwood, natural subregion of the boreal forest[1]. Jessie Lake is bordered to the north by the town of Bonnyville, and to the south by agricultural land.

Jessie Lake is located 8 km north of the Muriel Lake Important Bird Area. The shallow, reedy areas attract aquatic and shorebirds such as the yellow headed blackbird, northern pintail and Franklin's Gull. Surrounding Jessie Lake are pathways and observation towers for birdwatching. Jessie Lake is also used for recreational fishing, and is stocked approximately every 3 years with rainbow trout[2].

In 2018, volunteers organized by the Lakeland Industry and Community Association (LICA) and the town of Bonnyville, planted over 5000 seedling trees on the shoreline of Jessie Lake. The planting is part of a shoreline restoration project aimed at stabilizing the shoreline and preventing nutrient runoff into Jessie Lake, with the long term goal of improving water quality and reducing algae blooms[3].



The reedy shoreline of Jessie Lake. Photo by Shona Derlukewich.

[1] Nat. Regions Committee. (2006). Nat. Regions and Subregions of AB. Compiled by D.J. Downing and WW Pettapiece. GoA Pub. No. T/852

[2] Alberta Fishing Guide (2018). Retrieved from http://www.albertafishingguide.com/location/water/jessie-lake#stock

[3] Bonnyville Nouvelle, 28 August 2018. Retrieved 2019/02/06 from https://www.bonnyvillenouvelle.ca/article/adding-some-new-plants-to-jessie-lake-2018082

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 Jessie Lake was 255 µg/L (Table 2), falling into the hypereutrophic, or very highly productive trophic classification. This value falls below the range of historical averages. TP was lowest on the July 15th sampling event at 200 µg/L, and was highest on September 14th at 350 µg/L (Figure 1).

Average chlorophyll-*a* concentration in 2021 was 77.2 µg/L (Table 2), falling into the hypereutrophic, or very highly productive trophic classification. Chlorophyll-*a* was lowest late in the season, at 4.1 µg/L on September 14th and peaked at 177.0 µg/L on July 15th (Figure 1).

The average TKN concentration was 5.7 mg/L (Table 2) and varied from 4.5 – 6.3 mg/L from June to September (Figure 1).

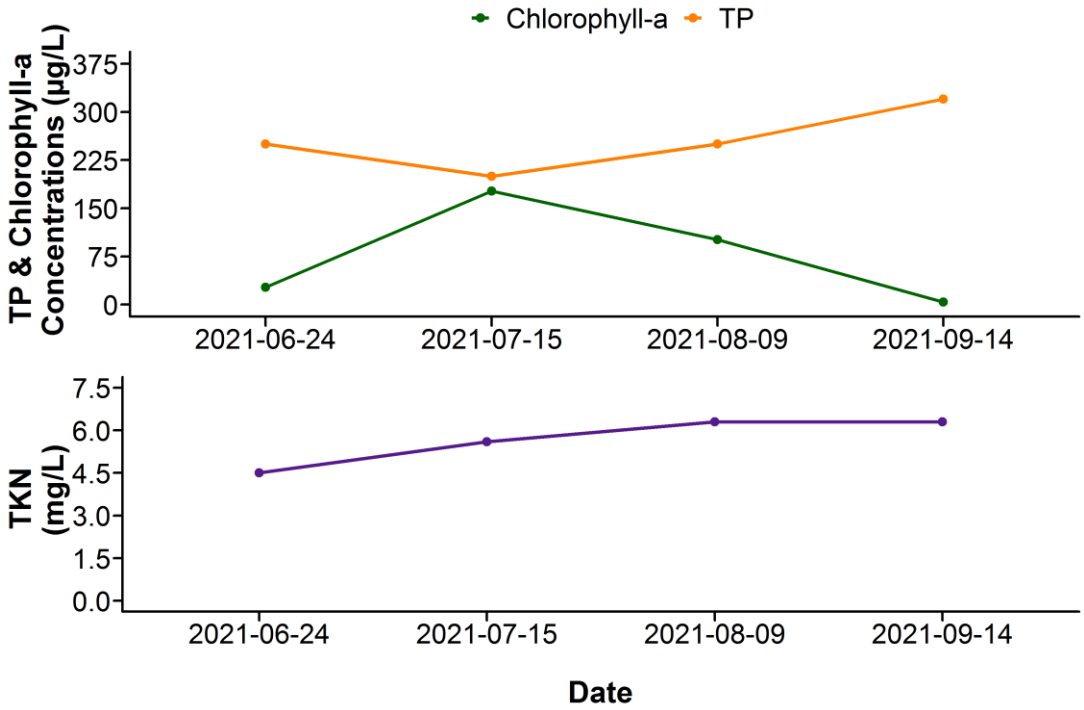


Figure 1. Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured four times over the course of the summer at Jessie Lake.

Average pH was measured as 9.18 in 2021, buffered by high alkalinity (632 mg/L $CaCO_3$) and bicarbonate (495 mg/L HCO_3). Along with bicarbonate, the most abundant ions were sulphate, chloride, and sodium. Together, the ions contributed to a high conductivity of 2325 µS/cm (Figure 2, top; Table 2). Jessie Lake is in the moderate to high range for most ion levels compared to other LakeWatch lakes sampled in 2021 (Figure 2, bottom), with the exception of calcium, for which it is among the lowest.

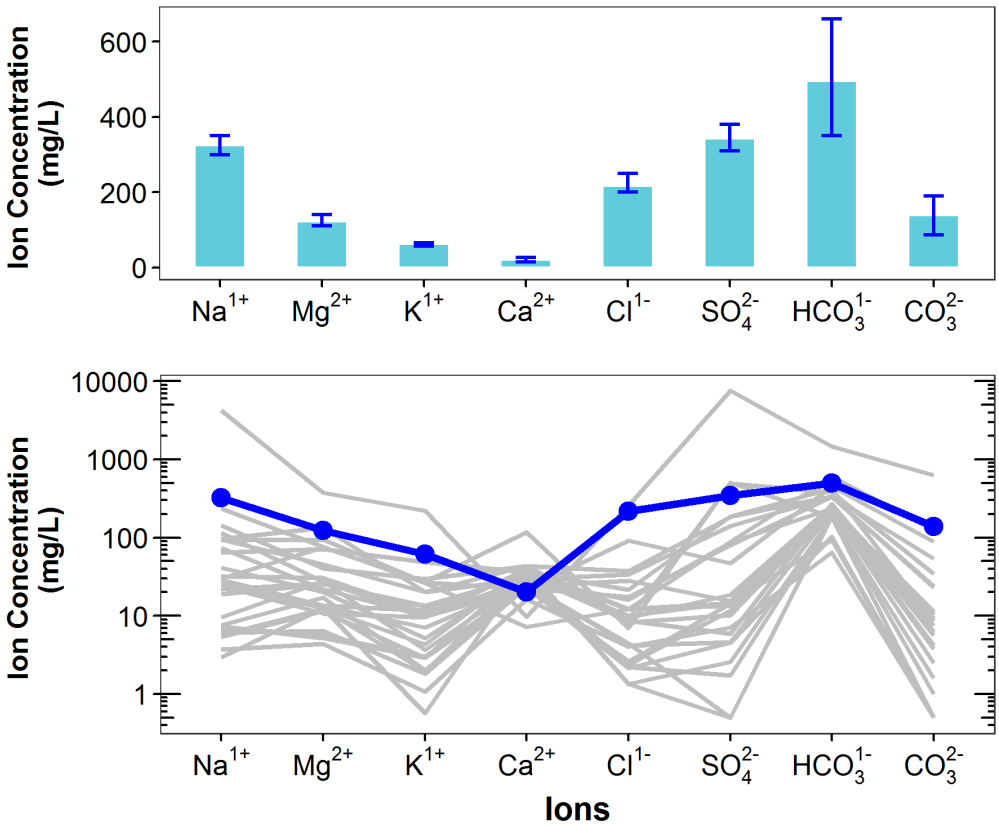


Figure 2. Average levels of cations (sodium = Na^{1+}, magnesium = Mg^{2+}, potassium = K^{1+}, calcium = Ca^{2+}) and anions (chloride = Cl^{1-}, sulphate = SO_4^{2-}, bicarbonate = HCO_3^{1-}, carbonate = CO_3^{2-}) from four measurements over the course of the summer at Jessie Lake. Top) bars indicate range of values measured, and bottom) Schoeller diagram of average ion levels at Jessie Lake (blue line) compared to 25 lake basins (gray lines) sampled through the LakeWatch program in 2021 (note $\log_{10}$ scale on y-axis of bottom figure).

METALS

Metals will naturally be present in aquatic environments due to in-lake processes or the erosion of rocks, or introduced to the environment from human activities such as urban, agricultural, or industrial developments. Many metals have a unique guideline as they may become toxic at higher concentrations. Where current metal data are not available, historical concentrations for 27 metals have been provided (Table 3).

Metals were measured at Jessie Lake in 2021, and arsenic and selenium exceeded the CCME protection of aquatic life chronic exposure guideline.

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 Jessie Lake in 2021 was 1.56 m, corresponding to an average Secchi depth of 1.16 m (Table 2). On all sample dates with the exception of July 15th, light was able to reach the bottom of the lake. In these cases, euphotic depth was adjusted to equal the bottom depth. The date with the lowest euphotic depth, July 15th, corresponds to the date with the highest chlorophyll-a abundance, indicating that algal and cyanobacteria growth was high enough during that time, to prevent light from reaching the bottom of the lake in the deepest areas.

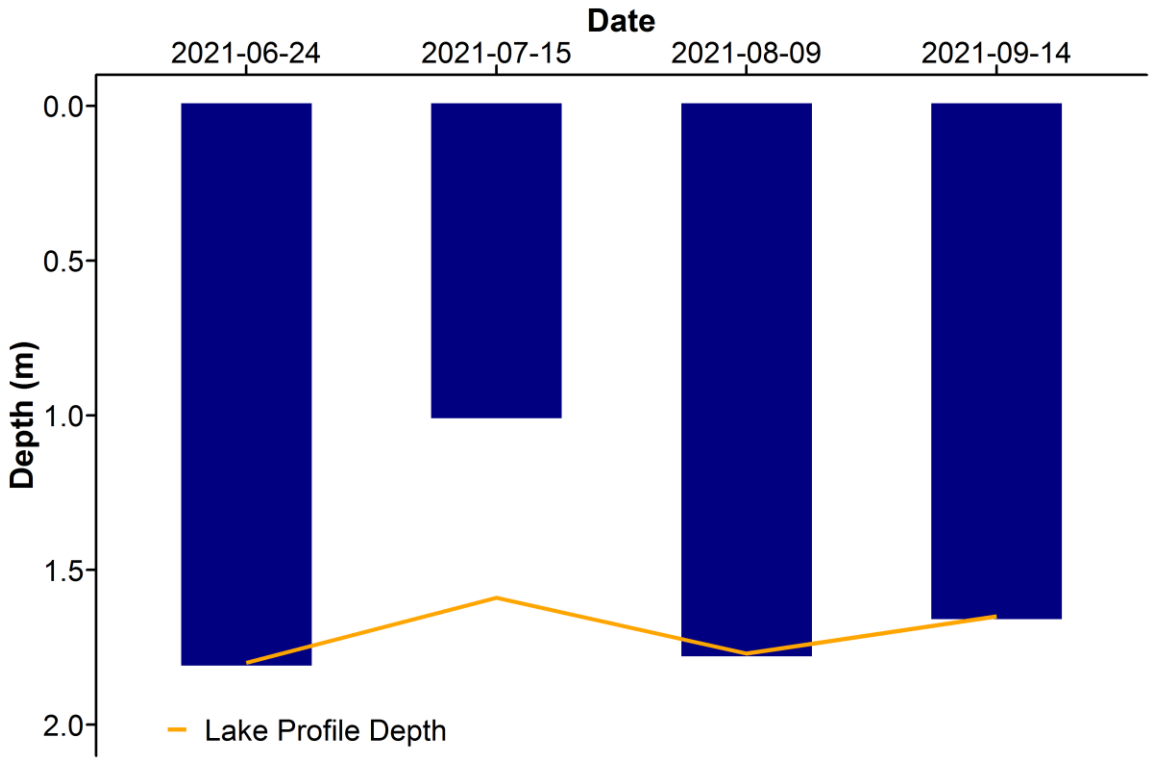


Figure 3. Euphotic depth values measured four times over the course of the summer at Jessie Lake in 2021.

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.

Surface temperatures at Jessie Lake varied throughout the summer, with the July 15th sampling date having the warmest surface temperatures at 26.1°C (Figure 4a). The lake was essentially mixed on every sample date, but displayed slight warming of surface waters during the June and July sampling events.

With the exception of August 9th, Jessie Lake's surface waters were well oxygenated and measured above the CCME guidelines of 6.5 mg/L dissolved oxygen (Figure 4b). On August 9th, the whole lake was below 6.5 mg/L dissolved oxygen. The July 15th sampling event, interestingly, displayed very high oxygen levels, and then an oxygen peak deeper in the water column, followed by a large decrease in oxygen levels, toward the bottom of the lake. This oxygen peak could be indicative of high cyanobacteria productivity and the regulation of their vertical position in the lake, which is known to happen on very hot days (see July 15 on Figure 6).

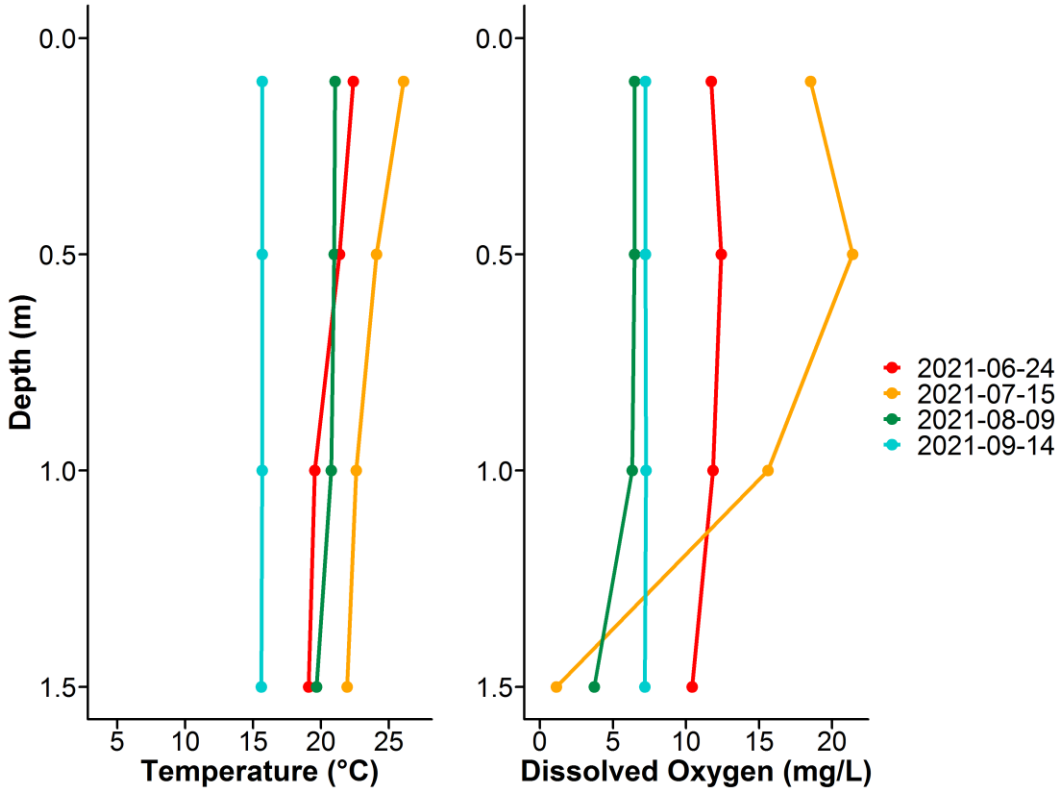


Figure 4. a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Jessie Lake measured four times over the course of the summer of 2021.

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 one of the most common cyanobacteria toxins. In Alberta, recreational guidelines for microcystin are set at 10 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 Jessie Lake fell below the recreational guideline of 10 µg/L during every sampling event in 2021. Even though low levels of microcystin were detected, caution should always be observed when recreating around cyanobacteria.

Table 1. Microcystin concentrations measured four times at Jessie Lake in 2021.

Date	Microcystin Concentration (µg/L)
24-Jun-21	2.08
15-Jul-21	0.92
9-Aug-21	0.70
14-Sep-21	0.24
Average	0.98

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 2021, no mussels or spiny water flea were detected at Jessie Lake.

Eurasian watermilfoil is a 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.

No suspect watermilfoil was observed or collected from Jessie Lake in 2021.

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 from Jessie Lake is only available from 1968-2019 (Figure 5). In that time period, the lake level has varied over a 2 m range, with most recent levels being close to the historical average, although the 2019 levels display an appreciable decrease.

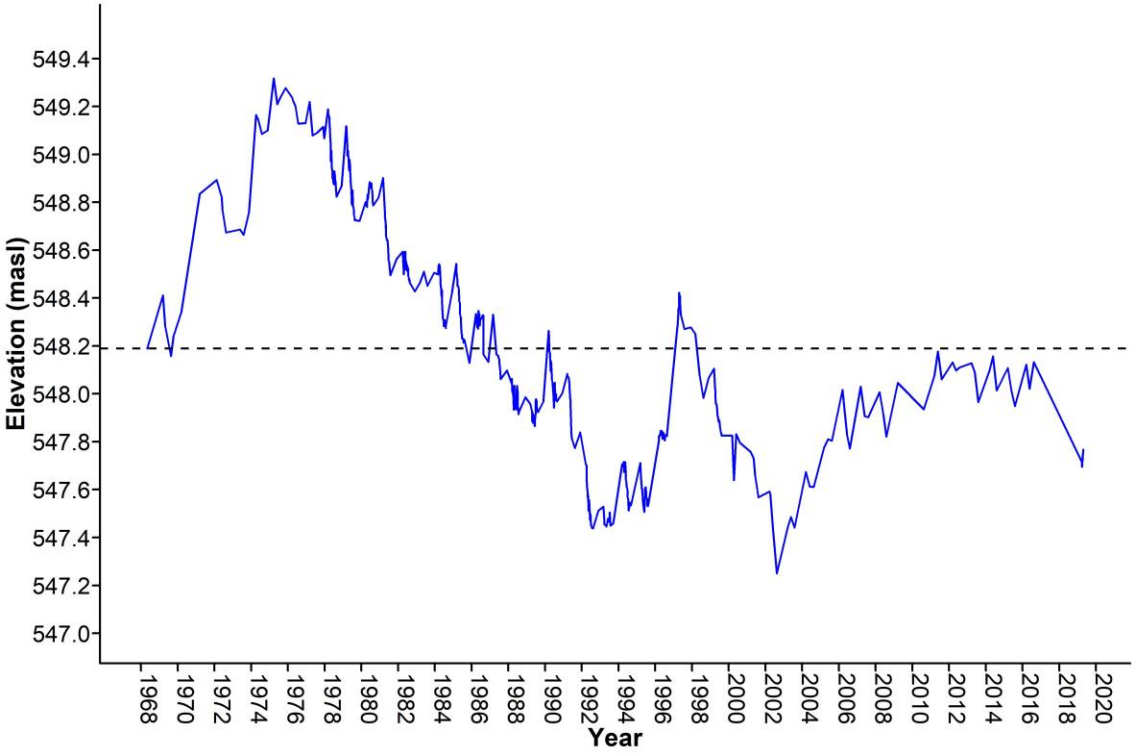


Figure 5. Water levels measured at Jessie Lake in metres above sea level (masl) from 1968-2019. Data retrieved from Alberta Environment and Parks. Black dashed line represents historical yearly average water level.

WEATHER & LAKE STRATIFICATION

Air temperature will directly impact lake temperatures, and result in different temperature layers (stratification) throughout the lake, depending on its depth. Wind will also impact the degree to which a lake mixes, and how it will stratify. The amount of precipitation that falls within a lake's watershed will have important implications, depending on the context of the watershed and the amount of precipitation that has fallen. Solar radiation represents the amount of energy that reaches the earth's surface, and has implications for lake temperature & productivity.

Jessie Lake experienced a warmer, drier, windier summer with slightly more solar radiation compared to normal (Figure 6). It is likely that very warm conditions on and leading up to the July 15th sampling event contributed to the high surface water temperatures and slight stratification.

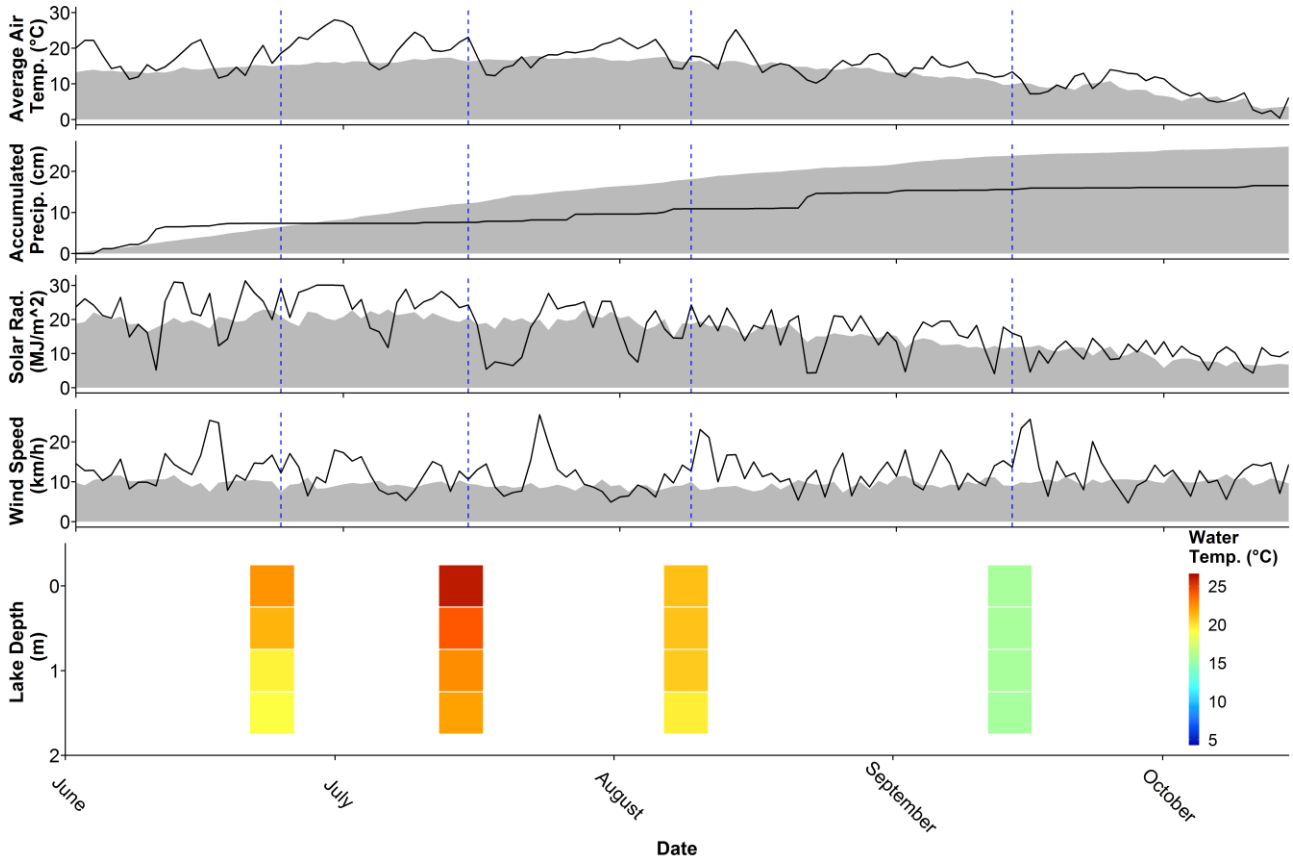


Figure 6. Average air temperature (°C), accumulated precipitation (cm), and wind speed (km/h) measured from Hoselaw AGCM, and solar radiation (MJ/m^2) measured from Dupre ACGM, with Jessie Lake temperature profiles (°C) at the bottom. Black lines indicate 2021 levels, gray indicates long-term normals, and blue lines indicate sampling dates for Jessie Lake over the summer. Further information about the weather data provided is available in the LakeWatch 2021 Methods report. Weather data provided by Agriculture, Forestry and Rural Economic Development, Alberta Climate Information Service (ACIS) https://acis.alberta.ca (retrieved April 2022).

Table 2. Average Secchi depth and water chemistry values for Jessie Lake. Historical values are given for reference. Number of sample trips are inconsistent between years.

Parameter	1989	2018	2020	2021
TP (µg/L)	725	1058	308	255
TDP (µg/L)	526	992	252	171
Chlorophyll-*a* (µg/L)	33.3	25.4	68.1	77.2
Secchi depth (m)	0.65	0.88	1.35*	1.18
TKN (mg/L)	9.1	5.7	5.2	5.7
NO_2-N and NO_3-N (µg/L)	53	141	43	119
NH_3-N (µg/L)	502	1780	472	395
DOC (mg/L)	101	46	35	63
Ca^{2+} (mg/L)	11	29	28	20
Mg^{2+} (mg/L)	195	118	105	122
Na^{+} (mg/L)	572	312	288	325
K^{+} (mg/L)	95	63	55	62
SO_4^{2-} (mg/L)	872	338	318	342
Cl^{-} (mg/L)	210	188	188	218
CO_3^{2-} (mg/L)	170	39	127	139
HCO_3^{-} (mg/L)	789	720	412	495
pH	9.10	8.62	9.17	9.18
Conductivity (µS/cm)	3590	2360	2025	2325
Hardness (mg/L)	830	564	515	560
TDS (mg/L)	2515	1460	1350	1475
Microcystin (µg/L)	/	1.20	2.39	0.98
Total Alkalinity (mg/L $CaCO_3$)	931	654	548	632

*Secchi depth on September 9, 2020 hit lake bottom

Table 3. Concentrations of metals measured in Jessie Lake. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference. Note that metal sample collection method changed in 2016 from composite to single surface grab at the profile location.

Metals (Total Recoverable)	2018	2020	2021	Guidelines
Aluminum µg/L	40.5	14.2	20.2	100[a]
Antimony µg/L	0.22	0.28	0.252	/
Arsenic µg/L	4.39	5.73	5.47	5
Barium µg/L	53.5	32.3	18.5	/
Beryllium µg/L	0	0.0015	0.0015	100[c,d]
Bismuth µg/L	0	0.003	0.005	/
Boron µg/L	420	324	339	1500
Cadmium µg/L	0.01	0.005	0.005	0.37[b]
Chromium µg/L	0.2	0.05	0.05	/
Cobalt µg/L	0.2	0.252	0.18	50,1000[c,d]
Copper µg/L	0.24	0.31	0.19	4[b]
Iron µg/L	87	31.6	35.1	300
Lead µg/L	0.07	0.045	0.045	7[b]
Lithium µg/L	111	107	125	2500[d]
Manganese µg/L	18.2	5.96	6.27	140[e]
Molybdenum µg/L	0.66	0.857	0.778	73
Nickel µg/L	0.98	0.98	0.82	150[b]
Selenium µg/L	3	2.1	2.3	1
Silver µg/L	0	0.0005	0.002	0.25
Strontium µg/L	336	256	121	/
Thallium µg/L	0	0.001	0.03	0.8
Thorium µg/L	0.01	0.017	0.012	/
Tin µg/L	0.06	0.03	0.03	/
Titanium µg/L	2.33	1.83	1.73	/
Uranium µg/L	1.01	1.33	1.29	15
Vanadium µg/L	0.66	1.87	1.05	100[c,d]
Zinc µg/L	2.3	1.3	1.7	30[f]

Values represent means of total recoverable metal concentrations.

[a] Based on pH ≥ 6.5

[b] Based on 2021 avg. water hardness (as CaCO3) with CCME equation

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

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

[e] Based on CCME Manganese variable calculation (https://ccme.ca/en/chemical/129#_aql_fresh_concentration), using 2021 avg. water hardness (as CaCO3) and avg. pH

[f] Based on 2021 avg. water hardness (as CaCO3), avg. pH, and avg. DOC with CCME equation

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