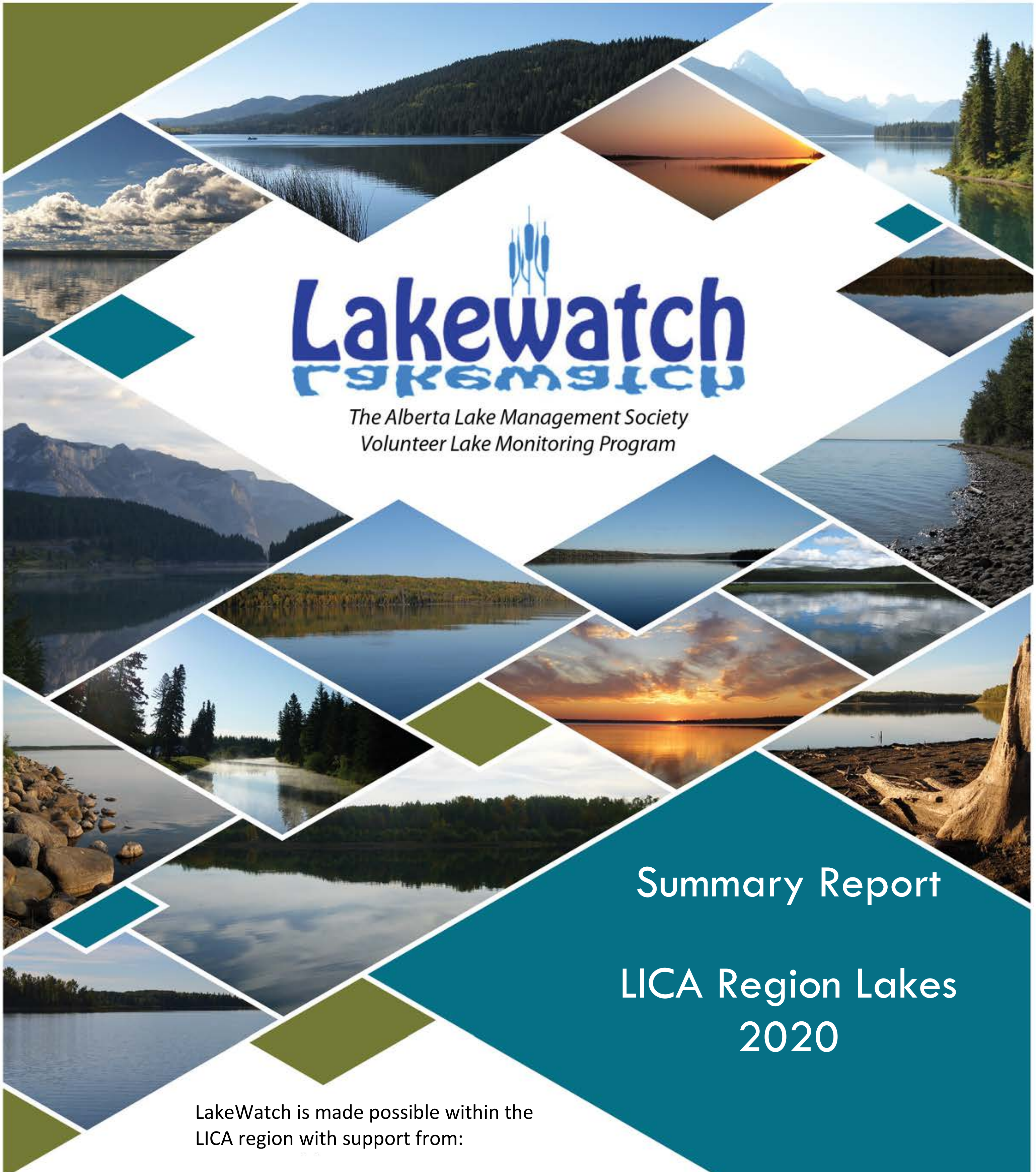

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Summary Report

LICA Region Lakes 2020

LakeWatch is made possible within the LICA region with support from:

Alberta

LICA ENVIRONMENTAL STEWARDS

Classification: Protected A

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.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would also like to thank Kyra Ford and Ryan Turner who were summer technicians in 2020. Executive Director Bradley Peter and Program Coordinator Caleb Sinn were instrumental in planning and organizing the field program. This report was prepared by Caleb Sinn and Bradley Peter.

INTRODUCTION

In 2020, ALMS received funding from the Lakeland Industry and Community Association (LICA) and Alberta Environment and Parks to conduct LakeWatch, a participatory water quality monitoring program, for select lakes in the LICA region. This report presents a concise summary of key parameters from six lakes which were sampled within the LICA region in the summer of 2020. The figures presented below are simply meant to contextualize lakes in the Alberta context and are not necessarily comparisons of lake health. More comprehensive water quality reports are available for each individual and can be accessed on the ALMS website (https://alms.ca/reports/), along with historical reports for those lakes. These individual LakeWatch reports may also present trend analysis results, where enough historical data exists, which is the best approach for evaluating lake water quality and health over time.

LakeWatch 2020 Volunteer Richard on the shores of Muriel Lake

SAMPLE RECORD

From June through September 2020, six lakes in the LICA region were sampled four times each (Table 1). This sampling record represents a 100% completion rate which was possible this season due to the lower number of lakes sampled in the LICA region relative to past years.

Table 1- The LICA region lakes LakeWatch sample completion record for 2020.

Lake	Trip 1	Trip 2	Trip 3	Trip 4
Crane	16-Jun	16-Jul	17-Aug	18-Sep
Jessie	10-Jun	20-Jul	9-Sep	22-Sep
Moose	16-Jun	21-Jul	21-Aug	10-Sep
Muriel	19-Jun	20-Jul	17-Aug	9-Sep
Skeleton North	29-Jun	23-Jul	23-Aug	14-Sep
Skeleton South	29-Jun	23-Jul	23-Aug	5-Sep

STAFF AND VOLUNTEERS

ALMS worked with nine volunteers in the LICA region for a total of 104 volunteer hours spent lake sampling. Volunteers provided boats used for sampling, operated the boats, and assisted the LakeWatch technician with sampling procedures. Volunteers also provided invaluable local knowledge about their lake that is used to contextualize lake conditions and navigate lakes safely. Each year ALMS volunteers show outstanding dedication and commitment to the LakeWatch program, and in 2020 deserve particular appreciation for their support during the COVID-19 pandemic.

Volunteer Orest on Skeleton Lake North in 2020

RESULTS

While ALMS collects a large suite of water chemistry parameters, this report will highlight the variability which exists between lakes across only a few of our major parameters: euphotic depth, total phosphorus, chlorophyll-a, microcystin, and select metals. Please note that variation within these parameters does not necessarily reflect a degree of lake management, for many factors outside of human control also impact lake water quality. The depth of the lake, the size of the drainage basin, lake order (indicative or groundwater influx and position in hydrological network), and the composition of bedrock and sediment are just some of the factors which affect lake water quality and should be taken into consideration when reading these results. Results are also presented as seasonal averages for comparability – seasonal trends (and in some cases, historical trends where enough data for a trend analysis is available) for the parameters presented below are available in each lake's individual 2020 LakeWatch reports. Results are categorized into trophic status, or degree of lake productivity. More on trophic status, along with class criteria, can be found in 'A Brief Introduction to Limnology' on the ALMS website.

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, 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 disk depth – the depth to which a checkered disk disappears. Two times the Secchi disk depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

Average euphotic depths within the LICA region in 2020 ranged from a minimum of 1.44 m at Muriel Lake to a maximum of 6.01 m at Crane Lake (Figure 1). Lake profile depth, or the depth of the location where the Secchi depth measurement was taken, is also presented for context. Euphotic depth averages were not significantly correlated with average chlorophyll-*a* concentrations across lakes (Kendalls' Tau-b, τ_b= -0.57, *p-value* = 0.24). This means that across LICA region lakes in 2020, water turbidity was not entirely associated with algal blooms, and may be indicative of other turbidity sources such as suspended sediments. Also of note is that Jessie Lake displayed an average euphotic depth that was almost as deep as the average lake profile depth (Figure 1). This means that light was reaching the bottom sediments across all depths of the lake for the majority of the summer, likely having a large influence on the lake's aquatic plant distribution, and benthic (lake bottom) algae and cyanobacteria communities. This makes Jessie Lake unique among the lakes sampled within the LICA region in 2020, where average euphotic depth compared to lake profile depth indicates that light was not reaching the majority of the bottom sediments across each of the other lakes (Figure 1).

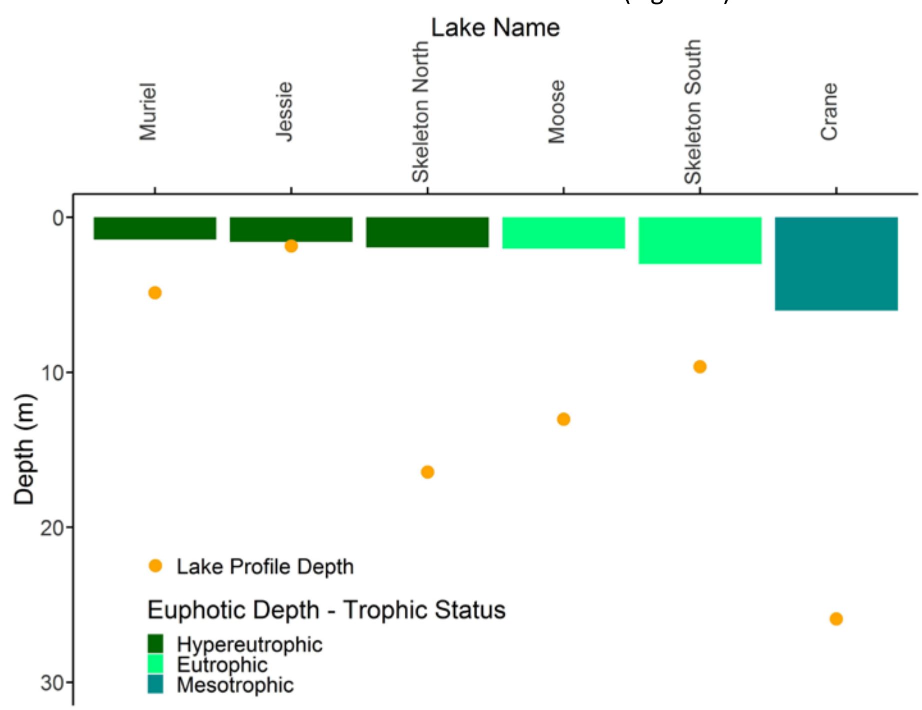

Figure 1. Average euphotic depth (m) and lake profile depth (m) values from 6 LICA region lakes sampled through the LakeWatch program during the summer of 2020.

WATER CHEMISTRY

ALMS measures a suite of water chemistry parameters. Phosphorus 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. Some lakes in Alberta have naturally high levels of phosphorus due to nutrient-rich geology, while others experience eutrophication resulting from human-related activities. High levels of phosphorus promote cyanobacteria growth, which is measured by assessing chlorophyll-a concentrations. While absolute values of phosphorus and chlorophyll-a can not indicate human-caused eutrophication or naturally elevated nutrients, the trajectory of those parameters over time, coupled with other lake information, may indicate whether the nutrient and chlorophyll-a levels are natural, or human-caused.

Average total phosphorus concentrations ranged from a minimum of 13.0 μg/L at Crane Lake to a maximum of 308 μg/L at Jessie Lake (Figure 2, Table 3).

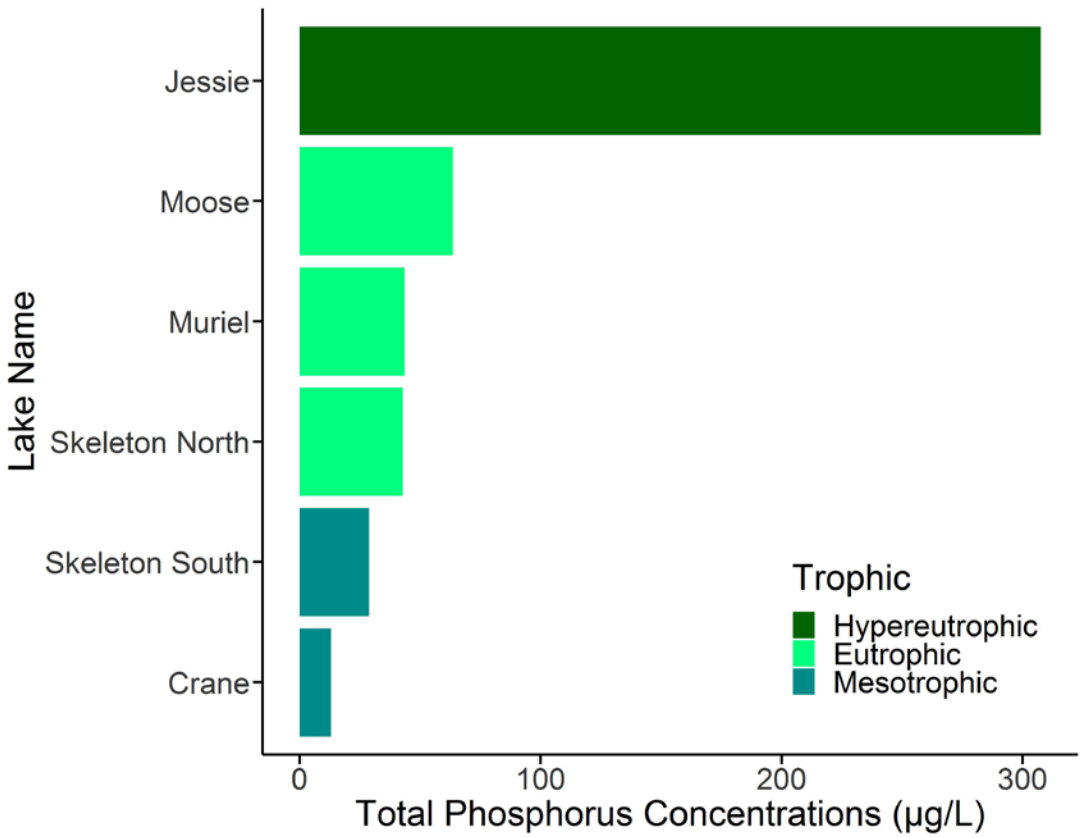

Figure 2. Average total phosphorus (TP) concentrations from 6 LICA region lakes sampled through the LakeWatch program during the summer of 2020.

CHLOROPHYLL-A

Chlorophyll-a is the green pigment found in plants, algae, and cyanobacteria that allows them to photosynthesize. Measuring the concentration of chlorophyll-a is a proxy for how much algae and cyanobacteria is present in lake water, because all algae and cyanobacteria will produce chlorophyll-a to support photosynthesis.

Average chlorophyll-*a* concentrations ranged from a minimum of 6.83 µg/L at Crane Lake to a maximum of 68.13 µg /L at Jessie Lake (Figure 3, Table 3). Chlorophyll-*a* and total phosphorus averages were significantly positively correlated across lakes (Kendalls' Tau, τ= 0.85, *p-value* = 0.03), meaning that for lakes sampled in the LICA region in 2020, high levels of phosphorus were related to high levels of cyanobacteria and algae.

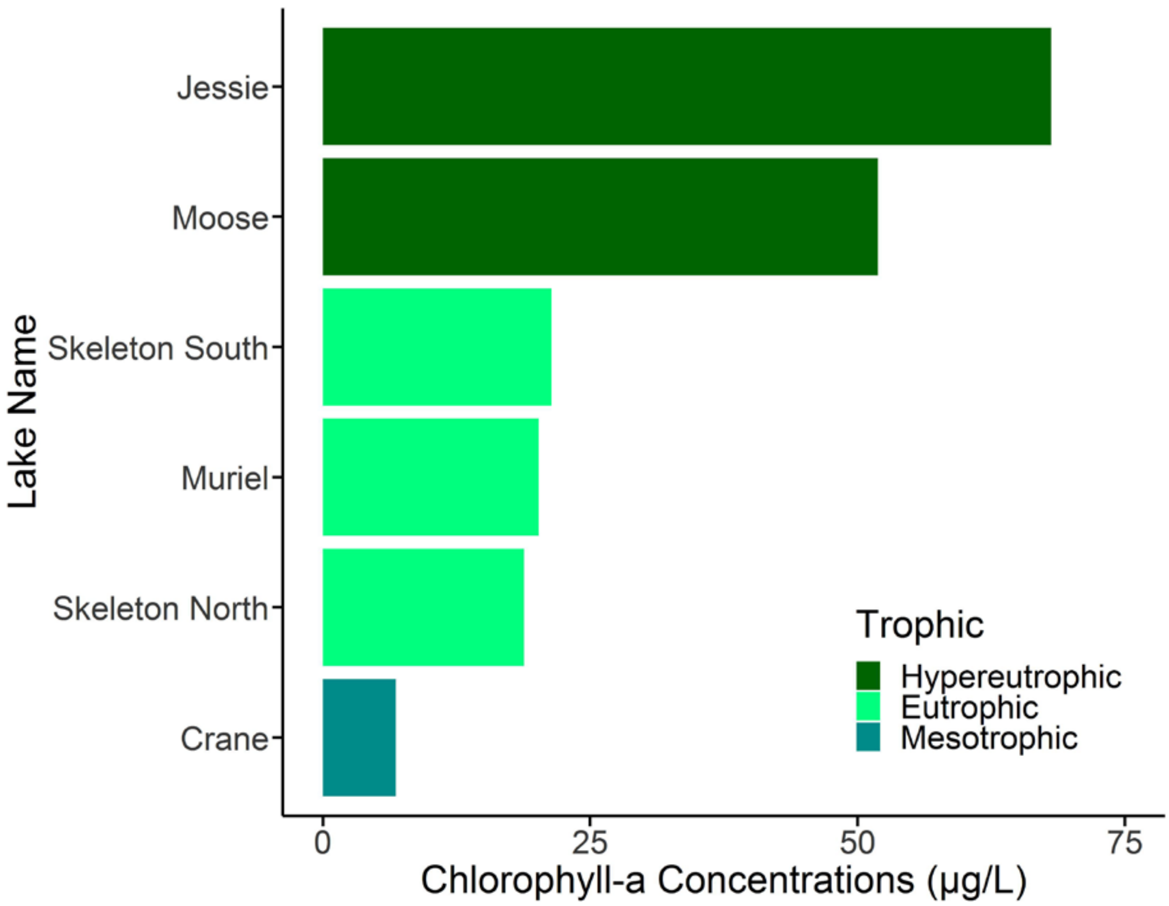

Figure 3. Average chlorophyll-*a* values from 6 LICA region lakes sampled through the LakeWatch program during the summer of 2020.

MICROCYSTIN

Microcystins are toxins produced by cyanobacteria (blue-green algae) which, when ingested by mammals, 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 20 µg/L, and as of 2020, the laboratory detection limit (the lowest level to which microcystin can be confidently detected by the analysis technique) is 0.1 µg/L.

Average microcystin concentrations ranged from <0.1 µg/L at Crane Lake to 4.40 µg/L at Skeleton Lake North (Figure 4, Table 3). None of the lakes measured higher than the recreational guideline of 20 µg/L during any single sampling event throughout the summer of 2020. However, individual locations not sampled by ALMS at each lake may display toxin concentrations higher than the recreational guidelines, and caution should be observed when recreating in or around cyanobacteria. For more information about recreating in lakes with cyanobacteria, refer to this document produced by Alberta Health Services about frequently asked questions regarding cyanobacteria.

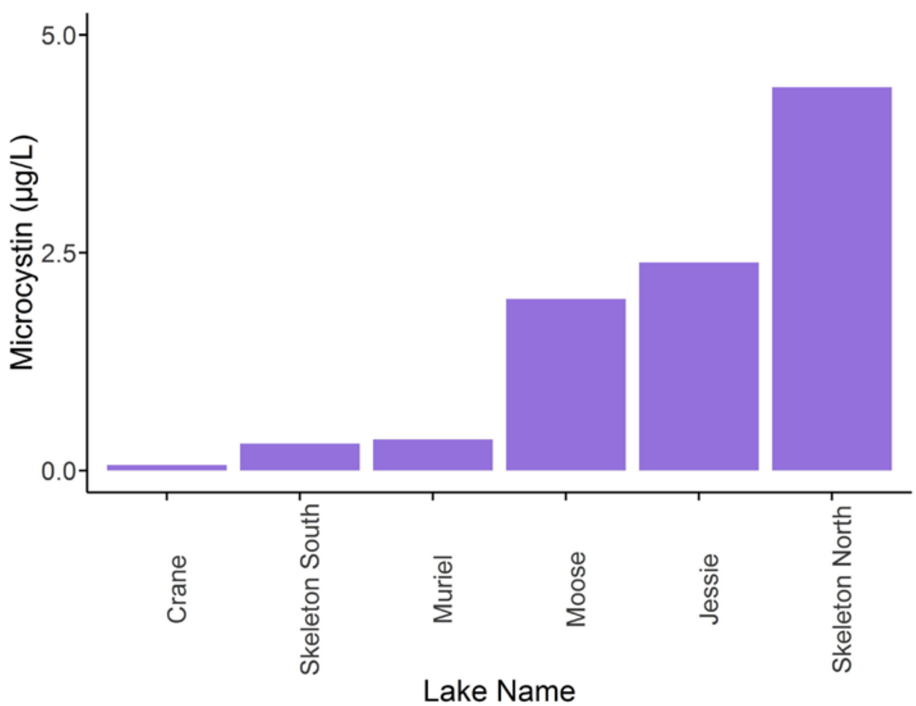

Figure 4. Average microcystin concentrations from 6 LICA region lakes sampled through the LakeWatch program during the summer of 2020.

Summarized Parameters

Table 3. Average water chemistry, euphotic depth, and lake profile depth summaries for LICA region lakes sampled through the LakeWatch program during the summer of 2020.

Lake Name	Total Phosphorus (µg/L)	Total Dissolved Phosphorus (µg/L)	Chlorophyll-a (µg/L)	Microcystin (µg/L)	Euphotic depth (m)	Lake Profile Depth (m)
Crane	13.0	4.7	6.83	<0.10	6.01	25.93
Jessie	308	252	68.13	2.39	1.59	1.86
Moose	63.5	12.6	51.90	1.97	2.03	13.03
Muriel	43.5	9.9	20.18	0.36	1.44	4.87
Skeleton North	42.8	11.3	18.80	4.40	1.95	16.44
Skeleton South	28.8	5.0	21.35	0.31	3.03	9.64

Invasive Species

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 in the 6 LICA region lakes sampled.

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.

No suspect watermilfoil was observed or collected from the 6 LICA region lakes sampled through the LakeWatch program in 2020. Through ALMS' aquatic plant monitoring initiatives, suspect watermilfoil specimens were collected at 4 other lakes in the LICA region; Floatingstone Lake, Beaver Lake, Fork Lake, and Cold Lake. These specimens were confirmed to be the native Northern watermilfoil (*Myriophyllum sibiricum)* upon genetic confirmation by the Alberta Plant Health Laboratory.

METALS

Samples were analyzed for metals once throughout the summer. In total, the abundance of 29 metals were investigated. 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. In this report we highlight the results of arsenic, boron, aluminum and selenium as they have fallen above their recommended Canadian Council for Ministers of the Environment (CCME) guidelines in the LICA region in previous years. Individual LakeWatch reports will present the complete suite of metal results. In wet years, metals in LICA region lakes may be elevated as a result due to groundwater recharge and the weathering of rocks and sediments.

Even though aluminum can be found in water naturally, examples of anthropogenic (human caused) sources of aluminum include dust produced from agriculture, mining, and coal combustion. In 2020, none of the sampled lakes were in exceedance of the aluminum CCME guidelines for the Protection of Aquatic Life (100 µg/L; Table 4).

Arsenic is naturally elevated in the Beaver River Watershed and can be introduced into the aquatic environment through industrial or municipal discharges or from the combustion of fossil fuels. In 2020, arsenic levels in Jessie Lake and Muriel Lake exceeded the CCME guidelines for the Protection of Aquatic Life (5 µg/L; Table 4).

Boron is naturally occurring in many minerals, particularly in clay-rich sediments, and natural weathering can release boron into the environment at rates comparable to or greater than anthropogenic sources, such as municipal wastewater, coal power plants, irrigation, copper smelters and other industries that use boron. In 2020, none of the sampled LICA region lakes exceeded the CCME guidelines for Boron concentrations (1500 µg/L; Table 4).

Selenium can be found in water from both natural and anthropogenic sources. Examples of anthropogenic sources of selenium are the burning of coal and oil, and from agriculture. In 2020, Jessie Lake and Muriel Lake were in exceedance of the selenium CCME guidelines for the Protection of Aquatic Life (1 µg/L; Table 4).

Table 4. Values of select metals for LICA region lakes sampled through the LakeWatch program during August or September 2020. Also provided are the Canadian Council for Ministers of the Environment (CCME) recommended guidelines for the Protection of Aquatic Life.

Lake	Aluminum (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Selenium (µg/L)
CCME PAL Guideline	100	5	1500	1
Crane	3.4	4.61	270	0.6
Jessie	14.2	5.73	324	2.1
Moose	3.7	2.03	151	0.5
Muriel	16.8	9.96	305	1.4
Skeleton North	3.4	0.94	88.9	0.3
Skeleton South	3.2	1.2	96.1	0.1