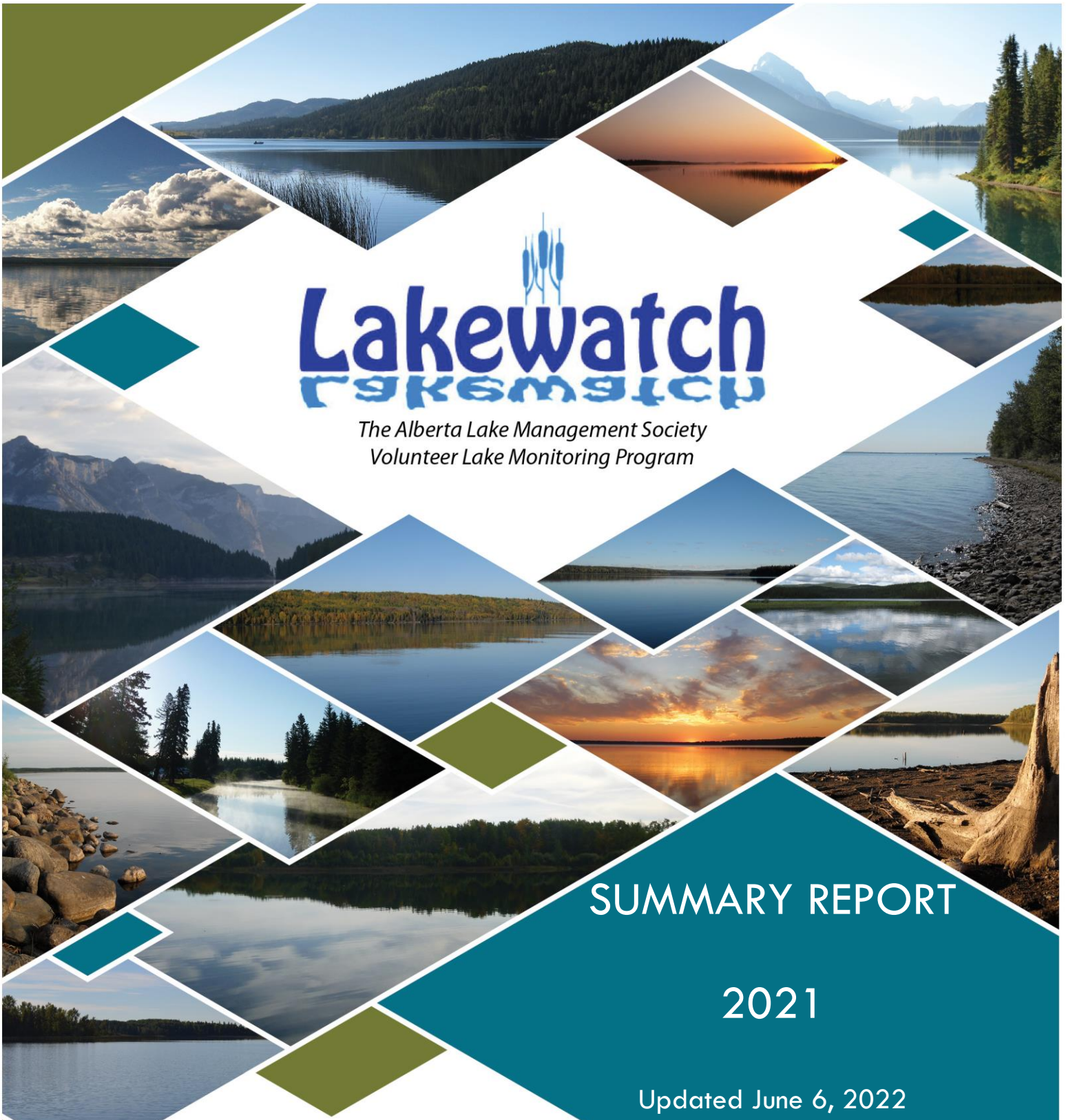

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

SUMMARY REPORT

2021

Updated June 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
Municipal District Bonnyville No. 87

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 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.

INTRODUCTION

In 2021, ALMS received funding from the Lakeland Industry and Community Association (LICA), the Pigeon Lake Watershed Association, Alberta EcoTrust, the Town of Hardisty, the Municipal District of Wainwright, the Municipal District of Bonnyville, and Alberta Environment and Parks, to conduct LakeWatch, a volunteer-based participatory water quality monitoring program.

SAMPLE RECORD

Two summer field technicians (Brittany Onysyk and Keri Malanchuk) were hired in May of 2021 to conduct water quality sampling. ALMS completed a provincial park monitoring program at 5 lakes and a standard monitoring program at 21 lakes. From June through September 2021, lakes were visited four times each, with the exception of Skeleton Lake South, which was visited five times. In 2021, all 105 scheduled trips were completed. This resulted in a completion rate of 100% (Table 1). It is rare to have a LakeWatch season with no missed trips – the weather, volunteer commitment, slightly lower number of lakes, requirement of four sampling events (down from five in past seasons), and the scheduling capability of the field technicians all cooperated to achieve a perfect sampling season.

The 2021 LakeWatch Technicians Brittany Onysyk (left), and Keri Malanchuk (right).

Table 1. The LakeWatch sample completion record for 2021. Note that Skeleton Lake South Basin had an additional sampling trip on September 22, 2021.

Program	Lakes	Trip 1	Trip 2	Trip 3	Trip 4
Base Lakes	Arm	24-Jun	14-Jul	12-Aug	01-Sep
	Battle	09-Jul	26-Jul	19-Aug	14-Sep
	Burnstick	21-Jun	19-Jul	16-Aug	24-Sep
	Calling	13-Jun	19-Jul	06-Aug	03-Sep
	Gull	29-Jun	22-Jul	26-Aug	21-Sep
	Hardisty	24-Jun	14-Jul	12-Aug	01-Sep
	Isle	13-Jun	12-Jul	14-Aug	12-Sep
	Jackfish (near Carvel)	07-Jun	05-Jul	27-Aug	23-Sep
	Lac Ste. Anne (East Basin)	07-Jun	05-Jul	31-Aug	20-Sep
	Lacombe	25-Jun	20-Jul	19-Aug	13-Sep
	Little Beaver	02-Jun	08-Jul	13-Aug	20-Sep
	Pigeon	04-Jun	13-Jul	04-Aug	22-Sep
	Pine	18-Jun	09-Jul	13-Aug	11-Sep
	Wabamun	08-Jun	08-Jul	06-Aug	09-Sep
LICA	Jessie	24-Jun	15-Jul	09-Aug	14-Sep
	Marie	15-Jun	26-Jul	24-Aug	21-Sep
	Minnie	03-Jun	15-Jul	13-Aug	14-Sep
	Moose	25-Jun	14-Jul	13-Aug	10-Sep
	Skeleton North Basin	09-Jun	07-Jul	19-Aug	22-Sep
	Skeleton South Basin	14-Jun	19-Jul	05-Aug	28-Aug
	Upper Mann	24-Jun	25-Jul	14-Aug	11-Sep
Parks	Crimson	22-Jun	28-Jul	24-Aug	29-Sep
	Gregoire	18-Jun	09-Jul	20-Aug	17-Sep
	Long (near Boyle)	17-Jun	12-Jul	19-Aug	13-Sep
	Miquelon	09-Jun	07-Jul	20-Aug	09-Sep
	Steele (Cross)	09-Jun	12-Jul	17-Aug	13-Sep

VOLUNTEERS

In 2021, ALMS worked with 41 unique volunteers, for a total of 382 volunteer hours spent sampling lakes. Volunteers also provided invaluable local knowledge about their lake that is used to contextualize lake conditions and inform safe lake sampling. Each year, ALMS volunteers show outstanding dedication and commitment to the LakeWatch program, and deserve particular appreciation for their support during the COVID-19 pandemic in 2021. Each year, ALMS recognizes one volunteer who has shown outstanding dedication and commitment to an ALMS program. This year, Daren Lorentz from Pigeon Lake was presented with the ALMS Volunteer of the Year Award.

ALMS Volunteer of the Year (2021) recipient Daren Lorentz during a sampling trip on Pigeon Lake with ALMS LakeWatch technician Brittany Onysyk, September 2021.

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, and Microcystin. 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 lake depth, the size of the drainage basin, 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 2021 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.

The 2021 LakeWatch season captured a range of lake types situated in the central and eastern portions of the province. The lakes are located in boreal, parkland, and foothills natural regions of the province. The 2021 season also included a lake system (Skeleton Lake) which has morphologically distinct basins that were sampled separately. This allows for the opportunity to investigate the differences between basins, which are unique from each other in morphology (depth, surface area). Interestingly, the basins of Skeleton Lake diverged primarily in water clarity and microcystin levels, indicating that algal and cyanobacteria communities differ.

The LakeWatch 2021 Summary report incorporates lake water quality data from Lac La Biche County's (LLBC) lake sampling program and Alberta Environment and Park's lake monitoring results from Lesser Slave Lake (LSL). Incorporating data from LLBC into this report will help to bring awareness to their program, as well as support the County with their environmental reporting efforts. Incorporating LSL data helps contextualize LSL's two basins within the broader province-wide context, in order to support stakeholder engagement efforts by the Lesser Slave Watershed Council. Similar to LakeWatch, LLBC collects Secchi depth at the profile site, and total phosphorus, chlorophyll-*a*, and total Kjeldahl nitrogen were measured from euphotic-spatial composites. LSL was sampled in a method aligning with LakeWatch sampling protocol. Seasonal sampling frequency for LLBC lakes and LSL differed from the LakeWatch season – all lakes (Beaver, Fork, Elinor, Lac La Biche East, Lac La Biche West, Lesser Slave Lake East, and Lesser Slave Lake West) were sampled three times each, and generally not in September. The comparison of monthly sampling proportion, or sample effort, can be viewed in Figure 6, and in the sample completion record in Table 2.

Data from LLBC's lake water quality monitoring program is available through DataStream (https://gordonfoundation.ca/initiatives/datastream/). The total phosphorus data selected was quantified using the PHA 4500 method, and total Kjeldahl nitrogen was quantified using the method from J. ENVIRON. MONIT., 2005,7,37-42,RSC. For more information about LLBC's lake water quality data, contact: green@laclabichecounty.com.

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 in 2021 ranged from a minimum of 0.37m at Miquelon Lake to a maximum of 10.05m at Burnstick 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 significantly correlated with average chlorophyll-*a* concentrations across lakes (Kendalls' Tau-b, τ_b= -0.53, *p-value* < 0.001). This means that water turbidity appeared to be primarily associated with the growth of cyanobacteria and algae. Jessie Lake, Lacombe Lake, and Upper Mann Lake also displayed average euphotic depths that were almost as deep as the average lake profile depth (Figure 1). This means that light was likely reaching the bottom sediments across the majority of depths of the lake through the summer, likely having a large influence on the lake's aquatic plant distribution, and benthic (lake bottom) algae and cyanobacteria communities.

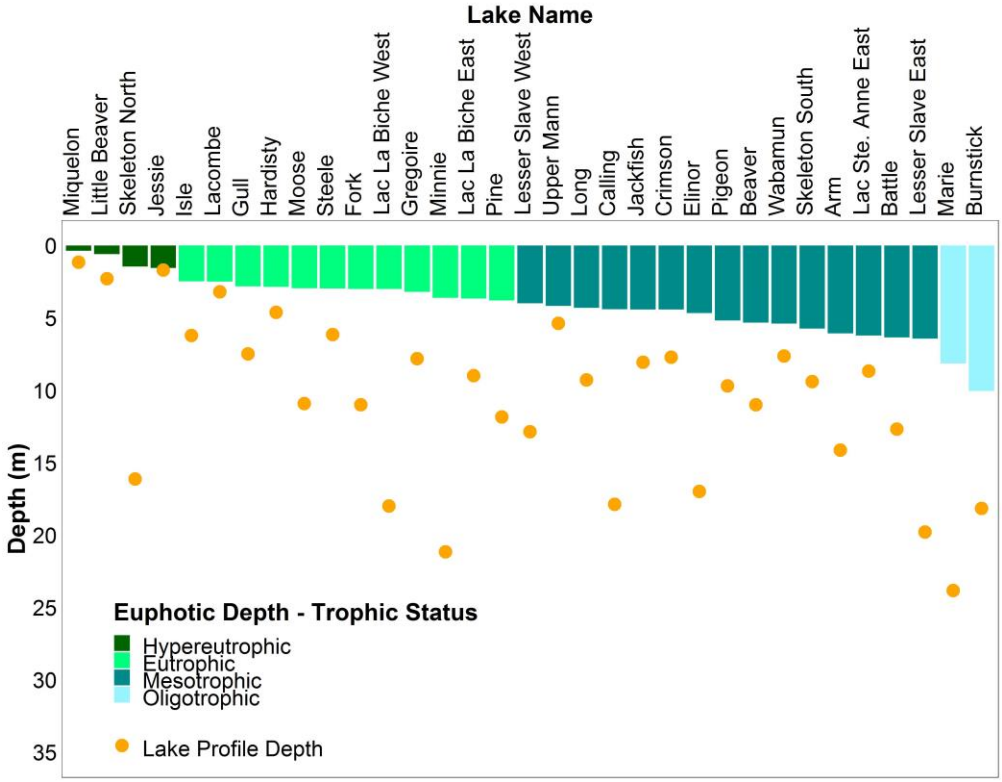

Figure 1. Average euphotic depth (m) values and lake profile depth measured at 26 lakes sampled as part of the LakeWatch program, including Lesser Slave Lake (LSL) and lakes sampled by Lac La Biche County (LLBC) during the summer of 2021. Note that LSL and LLBC lakes were sampled three times each, generally not in September, and that euphotic depth was not available for Fork Lake during the June 24th sampling event.

WATER CHEMISTRY – Total Phosphorus

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. Absolute values of phosphorus and chlorophyll-a alone do not point to human-caused eutrophication or naturally elevated nutrients, however 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 7.08 µg/L at Marie Lake to a maximum of 802.5 µg/L at Little Beaver Lake (Figure 2).

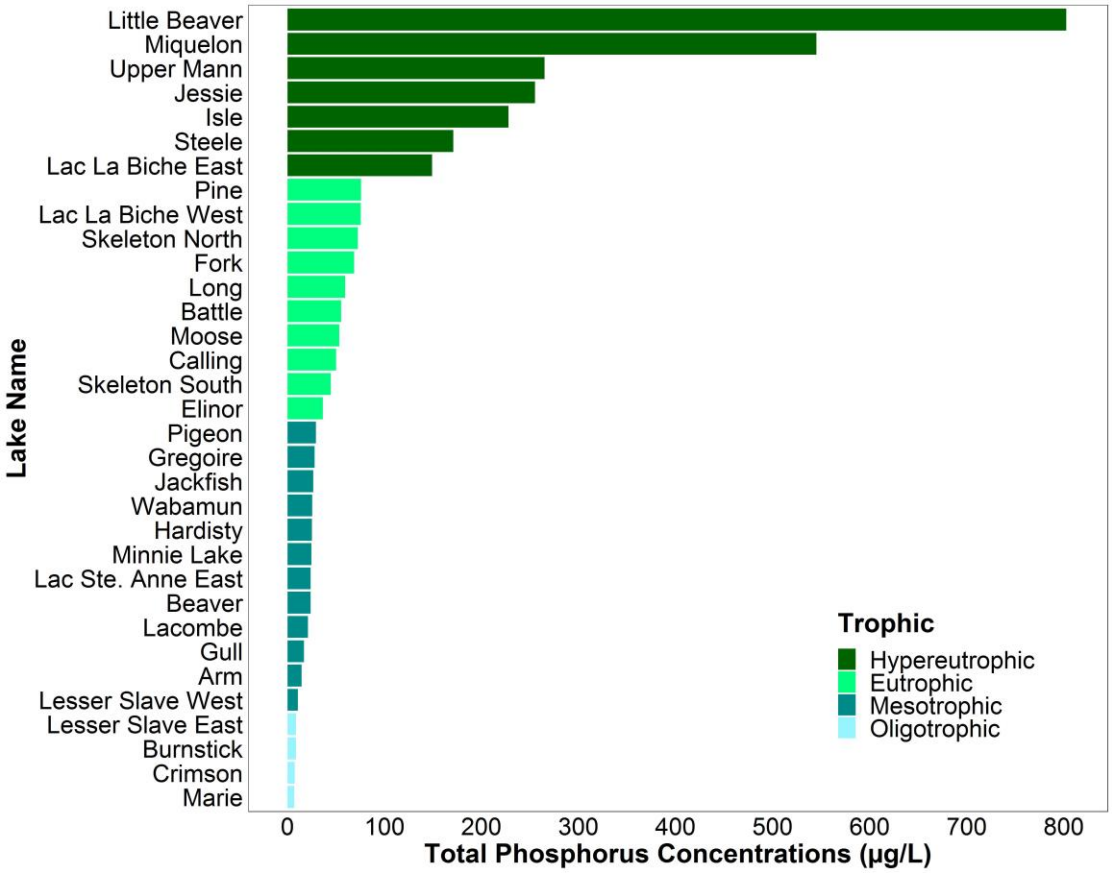

Figure 2. Average total phosphorus (TP) concentrations measured at 26 lakes sampled as part of the LakeWatch program, including Lesser Slave Lake (LSL) and lakes sampled by Lac La Biche County (LLBC) during the summer of 2021. Note that LSL and LLBC lakes were sampled three times each, and generally not in September.

WATER CHEMISTRY – 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 4.00 µg/L at Burnstick Lake to a maximum of 213 µg/L at Little Beaver Lake (Figure 3). Chlorophyll-*a* and TP averages were significantly correlated across lakes (Kendalls' Tau, τ= 0.76, *p-value* < 0.001).

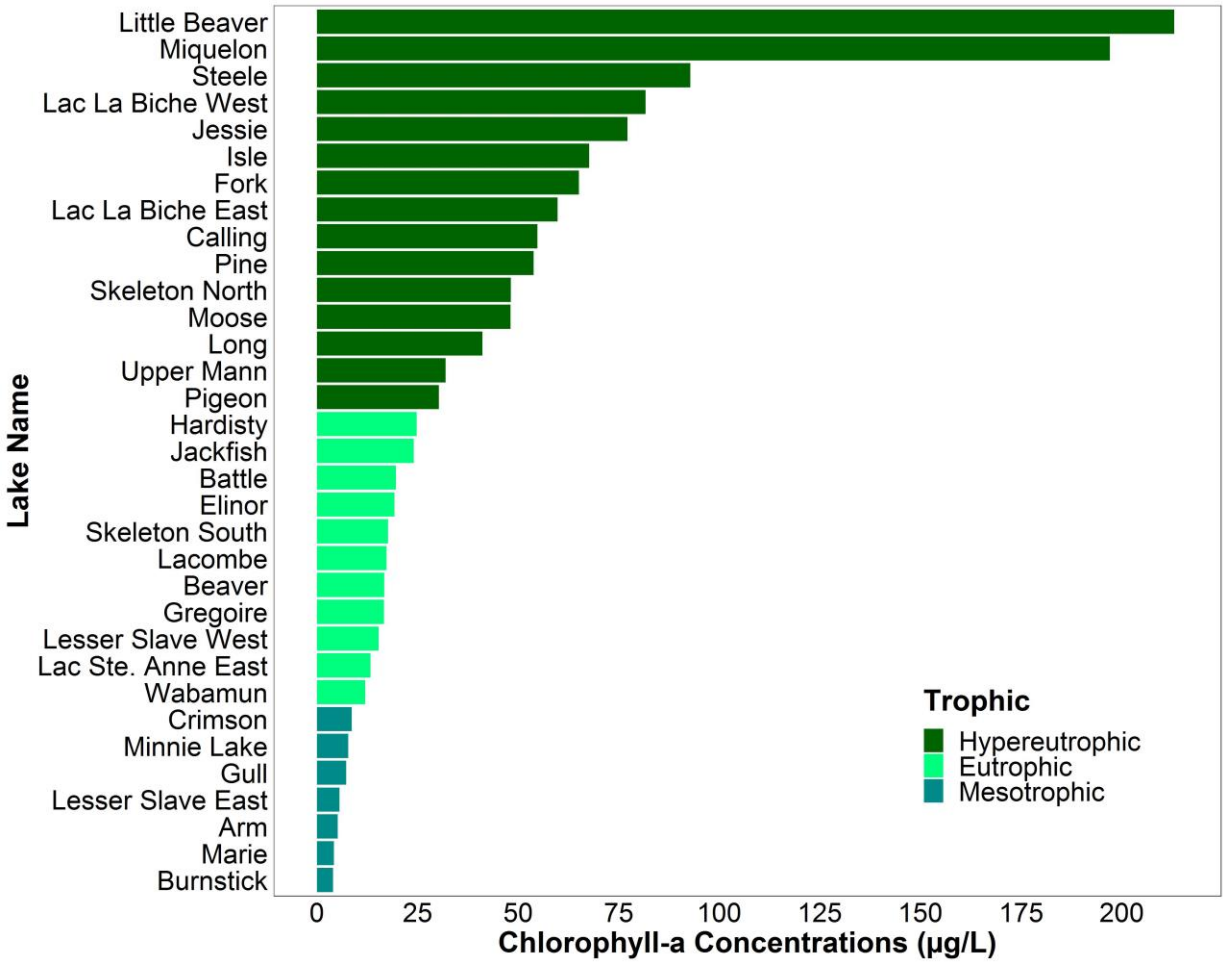

Figure 3. Average chlorophyll-*a* concentrations measured at 26 lakes sampled as part of the LakeWatch program, including Lesser Slave Lake (LSL) and lakes sampled by Lac La Biche County (LLBC) during the summer of 2021. Note that LSL and LLBC lakes were sampled three times each, generally not in September, and that chlorophyll-a data is only available during July and August sampling events for lakes sampled by LLBC.

WATER CHEMISTRY – 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 10 µg/L, and as of 2021, 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 fell below the minimum detection limit of 0.1 µg/L at Burnstick Lake, Lesser Slave Lake East, and Marie Lake (Figure 4). Microcystin was detected at every other lake, with the highest average concentration observed at Little Beaver Lake, measuring 17.57 µg /L. Little Beaver Lake and Skeleton Lake North were the only lakes sampled in 2021 to measure higher than the recreational guideline of 10 µg /L. Samples from discrete locations such as a surface grab sample from a thick bloom, or from a beach, may have toxin concentrations higher than the recreational guidelines, and caution should be observed when recreating in or around cyanobacteria blooms.

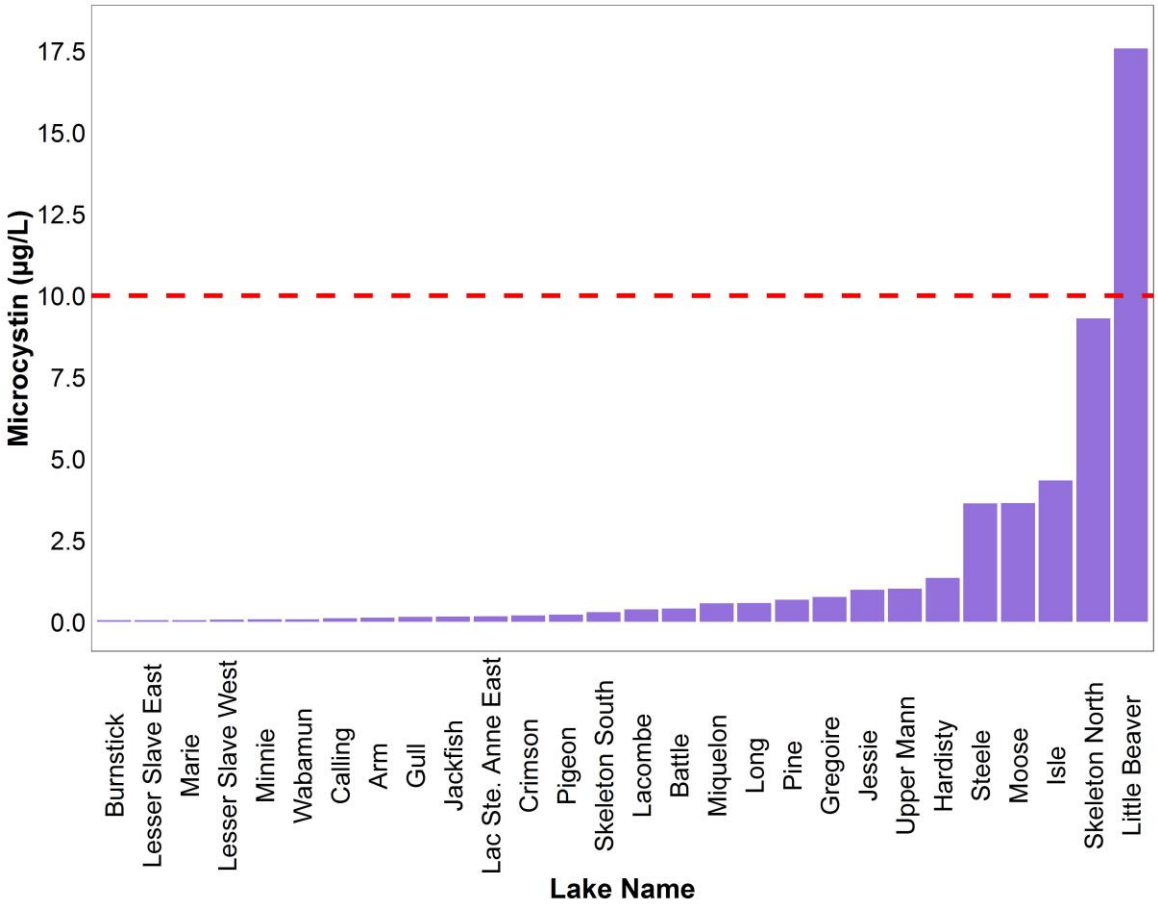

Figure 4. Average microcystin concentrations measured at 26 lakes sampled as part of the LakeWatch program during the summer of 2021, including Lesser Slave Lake (LSL). Note that LSL was not sampled in September. The dashed line indicates the recreational guideline of 10 µg/L.

WATER CHEMISTRY – Total Kjeldahl Nitrogen

As with phosphorus, nitrogen is a nutrient that primary producers require in order to grow. Some lakes in Alberta have naturally high levels of nitrogen due to nutrient-rich geology, while others experience eutrophication resulting from human-related activities. High levels of nitrogen may promote excessive cyanobacteria growth, although generally only if phosphorus levels are not limiting. Total Kjeldahl nitrogen represents the sum of organic forms of nitrogen, along with ammonia and ammonium.

Average total Kjeldahl nitrogen (TKN) concentrations ranged from a minimum of 0.43 mg/L at Burnstick Lake to a maximum of 11.85 mg/L at Miquelon Lake (Miquelon Lake not included in figure; Figure 5).

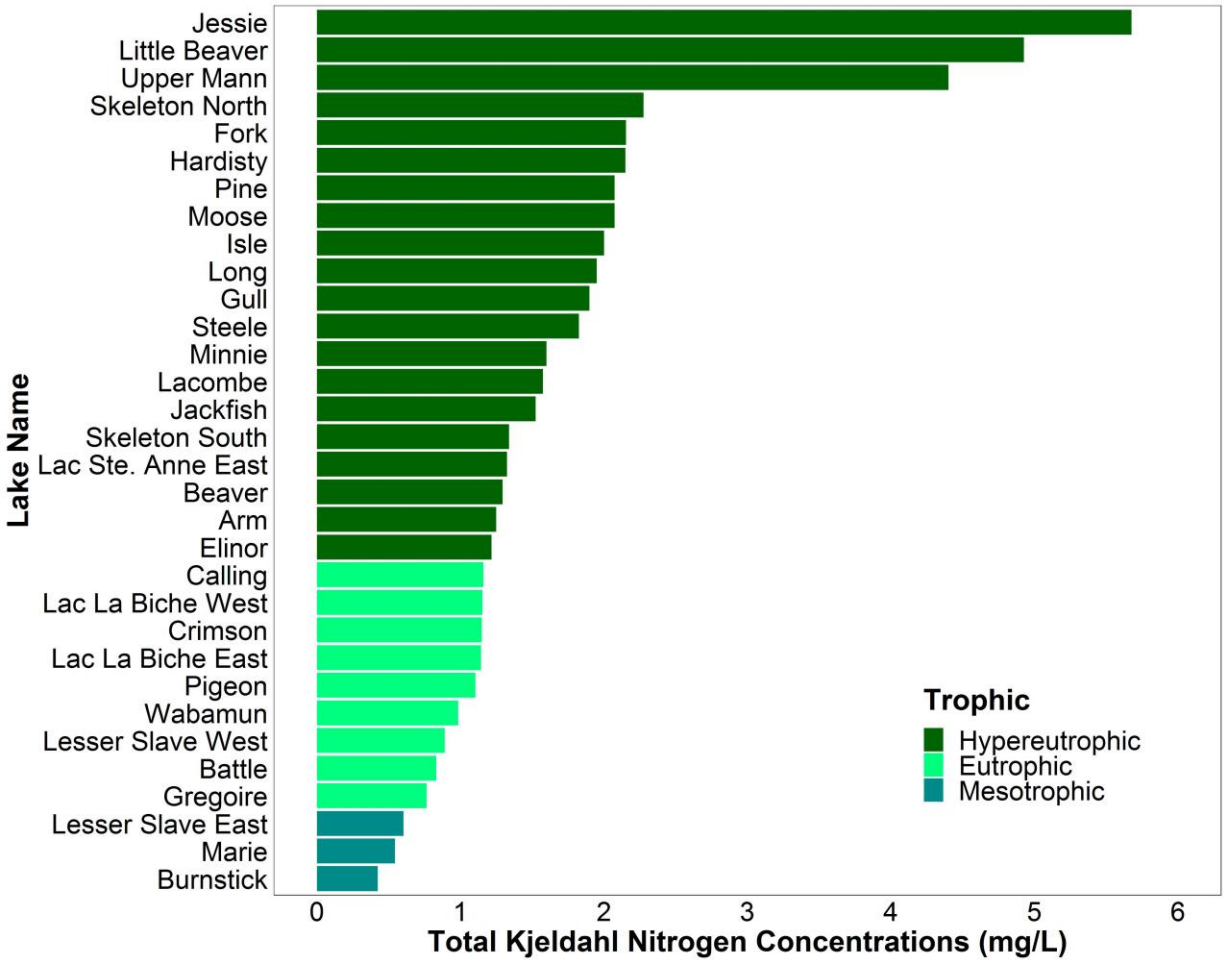

Figure 5. Average total Kjeldahl nitrogen (TKN) concentrations measured at 26 lakes sampled as part of the LakeWatch program, including Lesser Slave Lake (LSL) and lakes sampled by Lac La Biche County (LLBC) during the summer of 2021. Note that LSL and LLBC lakes were sampled three times each, generally not in September, and that Miquelon Lake is not included in the figure (TKN = 11.86 mg/L).

APPENDIX

Figure 6 compares the monthly sampling proportion, or sample effort, through the season between the Lac La Biche County's (LLBC) lake sampling program and Alberta Environment and Park's (AEP) sampling at Lesser Slave Lake (LSL), with samples collected through the LakeWatch program. Lakes sampled through the LakeWatch program were sampled fairly consistently once a month, between June and September. Each basin of Lesser Slave Lake was sampled by AEP, once a month, between June and August. Lakes sampled by LLBC were sampled once a month, with the exception of Fork Lake, which was sampled in September instead of August (Table 2).

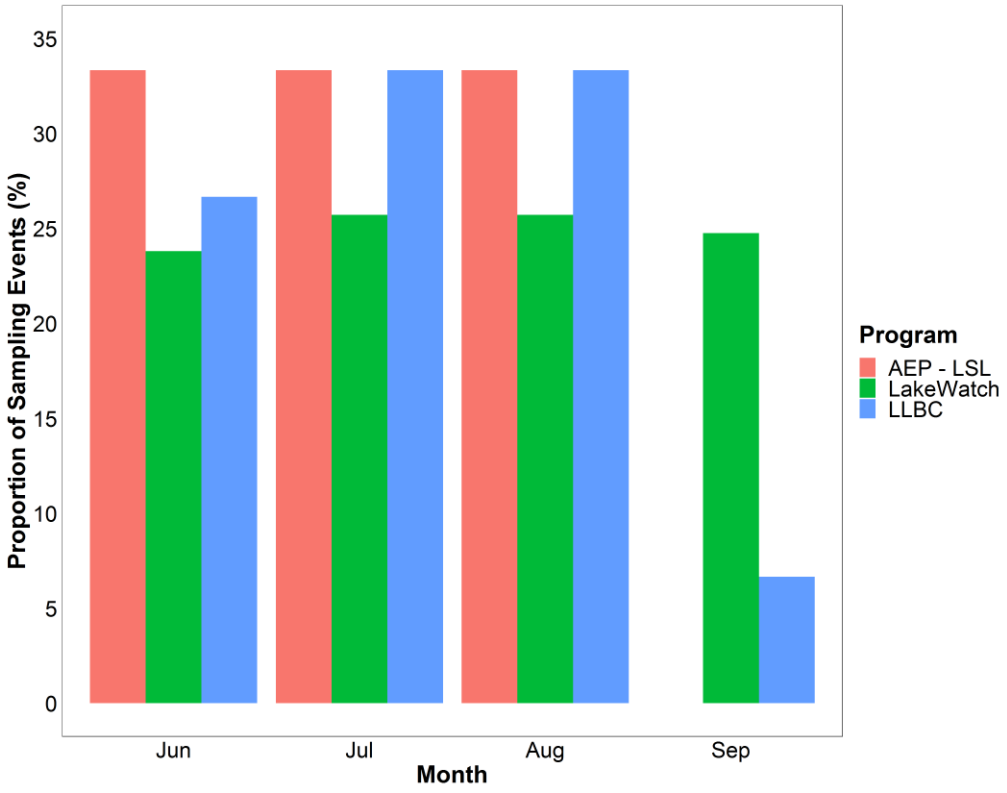

Figure 6. Proportion of sampling events completed monthly through the sampling season, from 26 lakes sampled as part of the LakeWatch program, the two basin of Lesser Slave Lake (LSL) sampled by Alberta Environment and Parks (AEP), and lakes sampled by Lac La Biche County (LLBC) during the summer of 2021.

Table 2. Lac La Biche County (LLBC) and Alberta Environment and Parks (AEP; Lesser Slave Lake only) sample completion record for 2021.

Program	Lakes	Trip 1	Trip 2	Trip 3
LLBC	Beaver	22-Jun	26-Jul	19-Aug
	Elinor	28-Jul	05-Aug	26-Aug
	Fork	24-Jun	28-Jul	09-Sep
	Lac La Biche East Basin	08-Jun	29-Jul	29-Aug
	Lac La Biche West Basin	21-Jun	29-Jul	25-Aug
AEP	Lesser Slave East Basin	02-Jun	07-Jul	04-Aug
	Lesser Slave West Basin	02-Jun	07-Jul	04-Aug