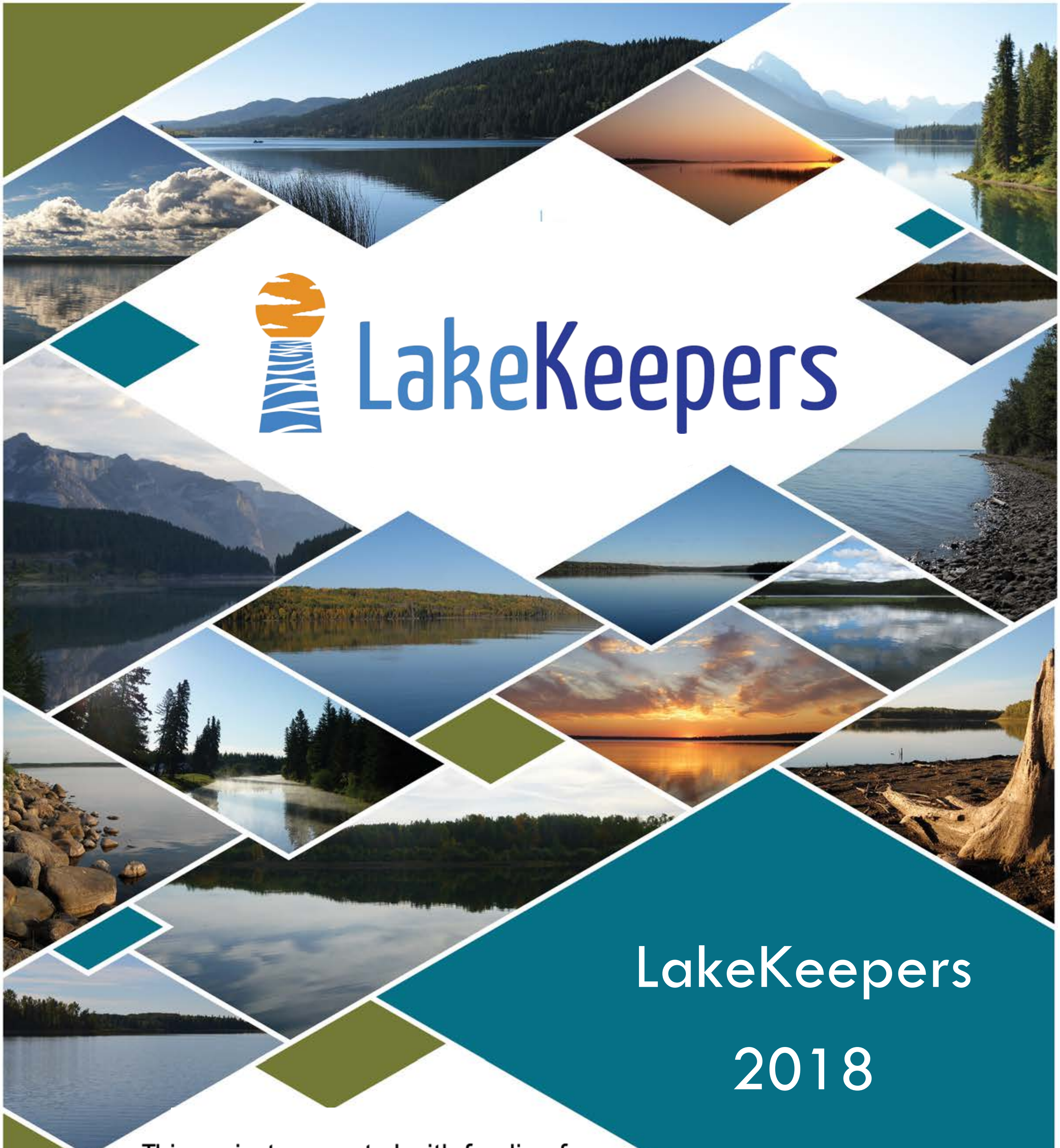

LakeKeepers

LakeKeepers

2018

This project supported with funding from

alberta ecotrust

ALBERTA LAKE MANAGEMENT SOCIETY'S OBJECTIVES

ALMS has several 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.

ALMS would like to thank all who express interest in Alberta's aquatic environments and particularly those who have participated in the LakeKeepers 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 LakeKeepers project was made possible with support from Alberta Ecotrust.

We would like to thank the volunteers from Calling Lake, Figure Eight Lake, Ghost Reservoir, Haig Lake, and Snipe Lake. We would also like to thank the Mighty Peace Watershed Alliance, the Alberta Conservation Association, and the Calling Lake Cottage Association for their assistance with coordinating volunteers and sample shipment.

A special thanks to Cerina Lee for developing the LakeKeeper training videos.
This report has been prepared by Bradley Peter and Caitlin Mader.

EXECUTIVE SUMMARY

In 2018, the Alberta Lake Management Society, with financial support from Alberta Ecotrust, piloted the LakeKeepers project. This project was designed to enable stewards to conduct lake monitoring by providing them with training and sampling equipment.

Five lakes participated in the LakeKeepers program in 2018: Calling Lake, Figure Eight Lake, Ghost Reservoir, Haig Lake, and Snipe Lake. In total, volunteers contributed 175 volunteer hours toward 14 monitoring trips.

Lakes were monitored for clarity, microcystin, total phosphorus, total nitrogen, and temperature. Results indicated that the five lakes fell into three trophic categories based on average total phosphorus (oligotrophic, mesotrophic, and eutrophic) and three categories based on average chlorophyll-*a* (oligotrophic, eutrophic, and hypereutrophic).

Volunteers provided feedback on the training documents, which will be incorporated into next summer's program. More quality control work is required to assess the agreement between volunteer samples and samples collected by ALMS staff. Future work may involve a comparison between LakeKeepers and LakeWatch sampling methods as well as the inclusion of additional parameters.

INTRODUCTION

In 2018, the LakeKeepers program was run as a pilot project by the Alberta Lake Management Society. This program is intended to compliment the existing LakeWatch program by bringing a less intensive monitoring program to lakes inaccessible by LakeWatch. In 2018, five lakes which exhibit a wide range in size and depth were selected for the LakeKeeper program based on volunteer availability: Calling Lake, Figure Eight Lake, Ghost Reservoir, Haig Lake, and Snipe Lake (Table 1, Figure 1).

Education day at Figure Eight Lake

Table 1. The major watershed, location, surface area (km^2) and maximum depth (m) of the five 2018 LakeKeepers Lakes.

Lake Data	Major Watershed	Site Lat & Long	Surface Area (km^2)	Max Depth*
Calling Lake	Athabasca River	55.25000, -113.33333	139.10	18
Figure Eight Lake	Peace River	56.30083, -117.90250	0.37	6
Ghost Reservoir	Bow River	51.20397, -114.73281	11.13	27
Haig Lake	Peace River	56.89444, -116.10806	9.15	9
Snipe Lake	Peave River	55.11667, -116.78333	42.11	6

**Max depth based on historical bathymetric surveys.*

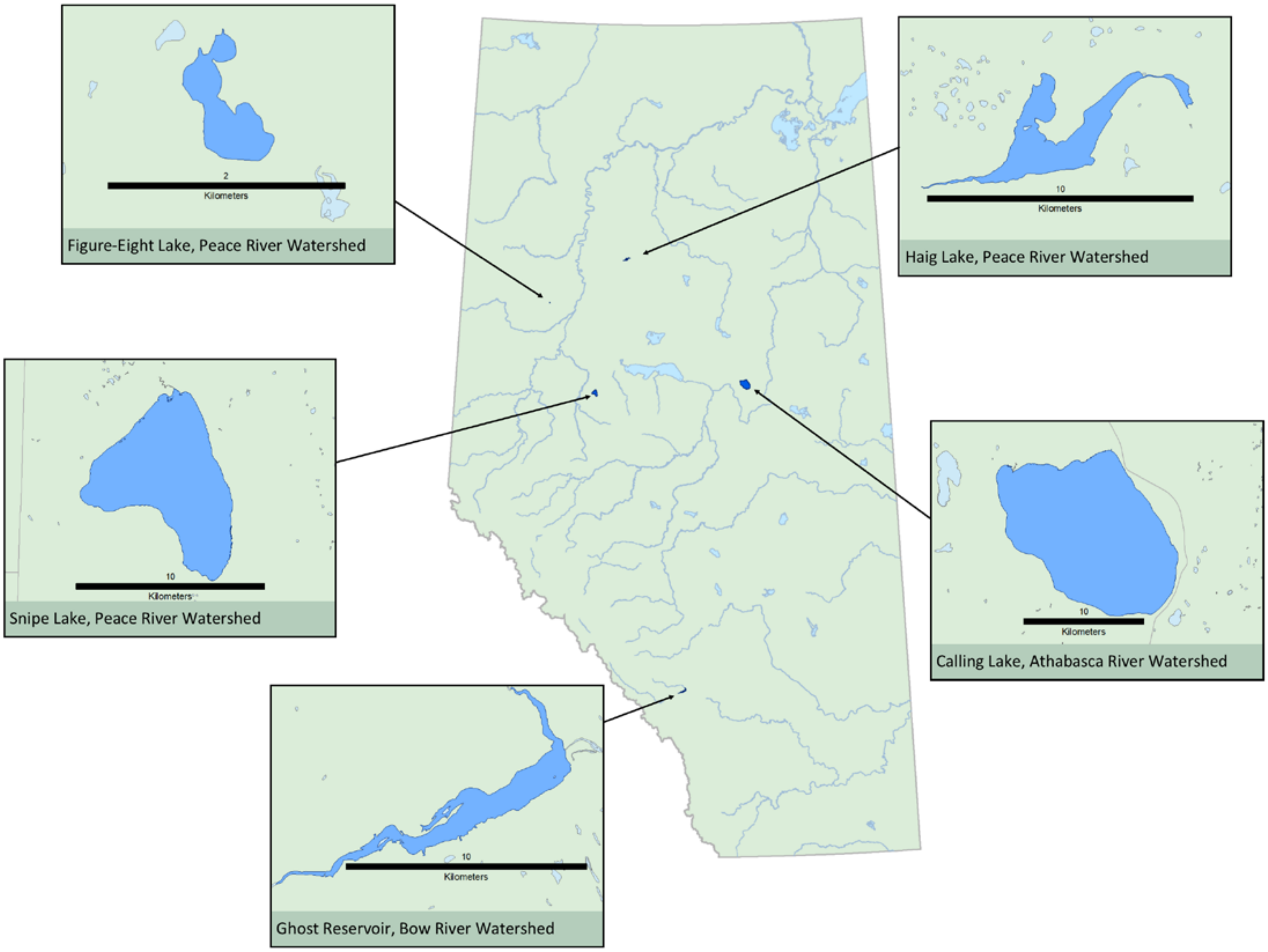

Figure 1. 2018 LakeKeeper Lakes.

METHODS

Volunteers were provided with a training manual and training videos (available at www.alms.ca/lakekeepers). Lakes were to be sampled three times each: once in June, once in August, and once in September. A single sample site was chosen for each lake, with as close as possible to the deep spot of the main basin as an ideal sample location. Volunteers were provided with field sheets, a lollipop thermometer, a tape and weight, a Secchi disk, a 3.2 L horizontal Van Dorn Beta sampler, a chlorophyll filtering apparatus, and bottle sets.

Discrete grabs for total phosphorus, total nitrogen, microcystin, and chlorophyll-*a* were collected at 1 m depths.

Discrete grabs for temperature were collected at 1 m, mid-depth, and 1 m off the bottom of the lake. Samples were filtered for chlorophyll-*a* onto Whatman GF-C filter papers. The Alberta Lake Management Society coordinated delivery of the samples to various analytical laboratories. Total phosphorus and total nitrogen were submitted to Maxxam Analytics in Edmonton, chlorophyll-*a* was submitted to Innotech in Vegreville, and microcystin samples were submitted to the Alberta Centre for Toxicology in Calgary.

RESULTS

Volunteers successfully completed 14 out of 15 planned sampling trips (Table 2). Trips occurred between June-October 2018. In total, 165 volunteer hours were contributed toward completing these sampling trips. In addition to measured parameters, volunteers also recorded environmental observations (Appendix Table 1).

Table 2. Sample dates for the 2018 LakeKeeper Lakes.

Trip	Calling Lake	Figure Eight Lake	Ghost Reservoir	Haig Lake	Snipe Lake
Trip 1	29-Jun	28-Jun	31-Jul	30-Jun	5-Jul
Trip 2	26-Jul	16-Aug	31-Aug	28-Jul	28-Aug
Trip 3	-	19-Sep	23-Sep	15-Sep	4-Oct

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

Secchi disk depth varied greatly between monitored lakes. Ghost Reservoir had the highest average water clarity measuring 4.21 m, while Snipe Lake had the lowest water clarity measuring 0.55 m (Figure 2). Increased growth of phytoplankton throughout the summer months likely had a negative impact on the Secchi disk depths at Calling Lake and Haig Lake.

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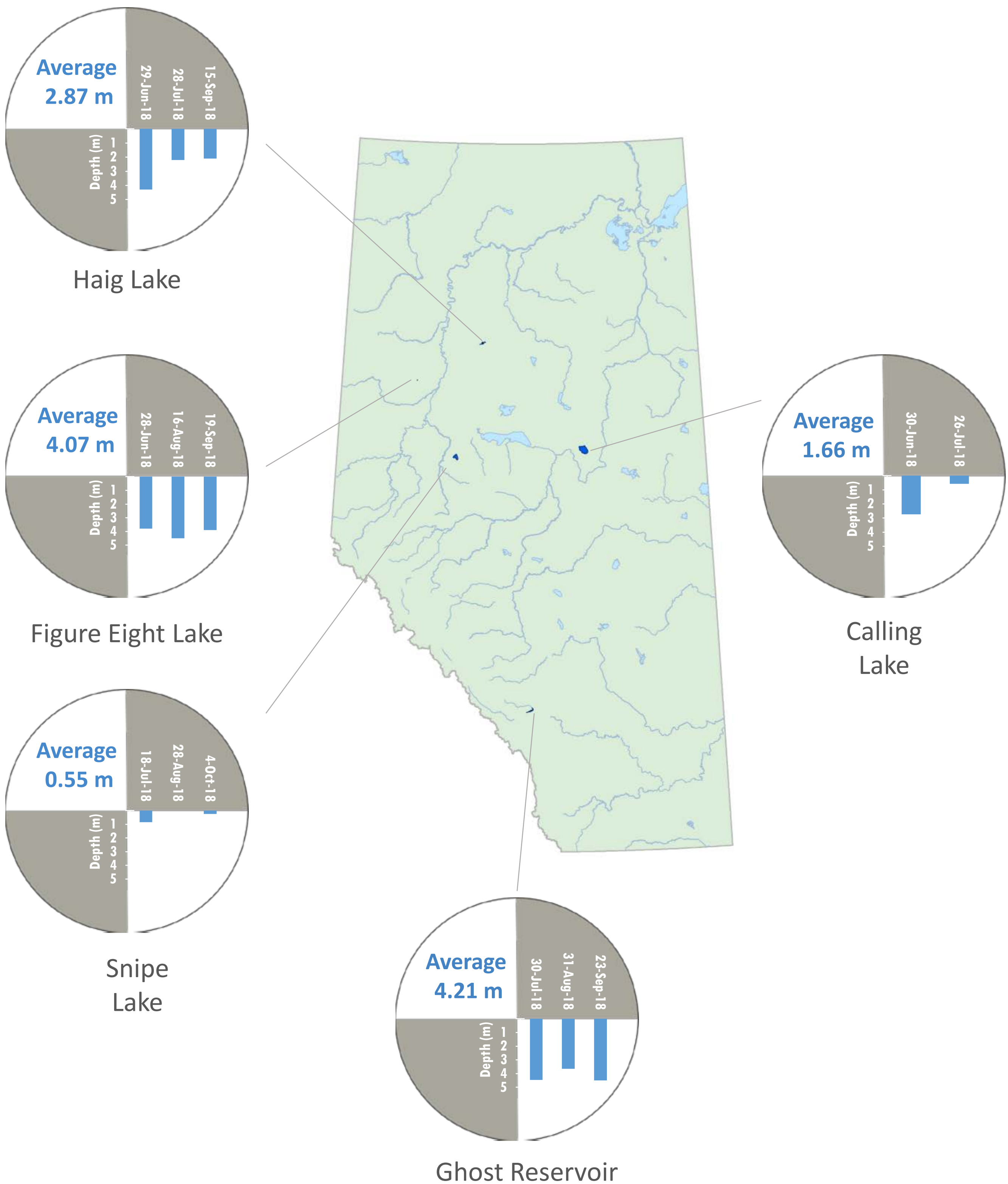
Fig. 2: Secchi Disk Readings



TOTAL PHOSPHORUS AND CHLOROPHYLL-A

ALMS measures a suite of water chemistry parameters. Phosphorus acts as one of the nutrients driving algae blooms in Alberta, while chlorophyll-a acts as an indicator of phytoplankton biomass, or how much algae is in the lake. These parameters together can help to identify the process of eutrophication, or excess nutrients, which can lead to harmful algae/cyanobacteria blooms. Taking these parameters together, lakes can be classified into oligotrophic (low nutrients), mesotrophic (moderately productive), eutrophic (productive) or hypereutrophic (highly productive).

Average total phosphorus values ranged from a maximum of 67 μg/L at Calling Lake to a minimum of 2 μg/L at Ghost Reservoir (Figure 3). Lakes spanned three trophic classifications according to their average total phosphorus values: oligotrophic (Ghost Reservoir), mesotrophic (Figure Eight Lake, Haig Lake) and eutrophic (Calling Lake and Snipe Lake). Lakes that mix regularly due to wind action are likely to have increasing phosphorus concentrations throughout the open water season as phosphorus released from the bottom sediments is incorporated into overlying waters.

Volunteers at Ghost Reservoir preparing for a sampling trip.

In most Albert lakes, phosphorus concentrations are closely correlated with chlorophyll-*a* concentrations. This was true for the LakeKeeper lakes, as Calling Lake had a maximum average chlorophyll-*a* concentration of 68 μg/L and Ghost Reservoir had a minimum chlorophyll-*a* concentration of 0.6 μg/L (Figure 4). Lakes spanned three trophic classifications according to their average chlorophyll-*a* values: oligotrophic (Ghost reservoir and Figure Eight Lake), eutrophic (Haig Lake and Snipe Lake), and hypereutrophic (Calling Lake).

Fig.3: Average Total Phosphorus Results

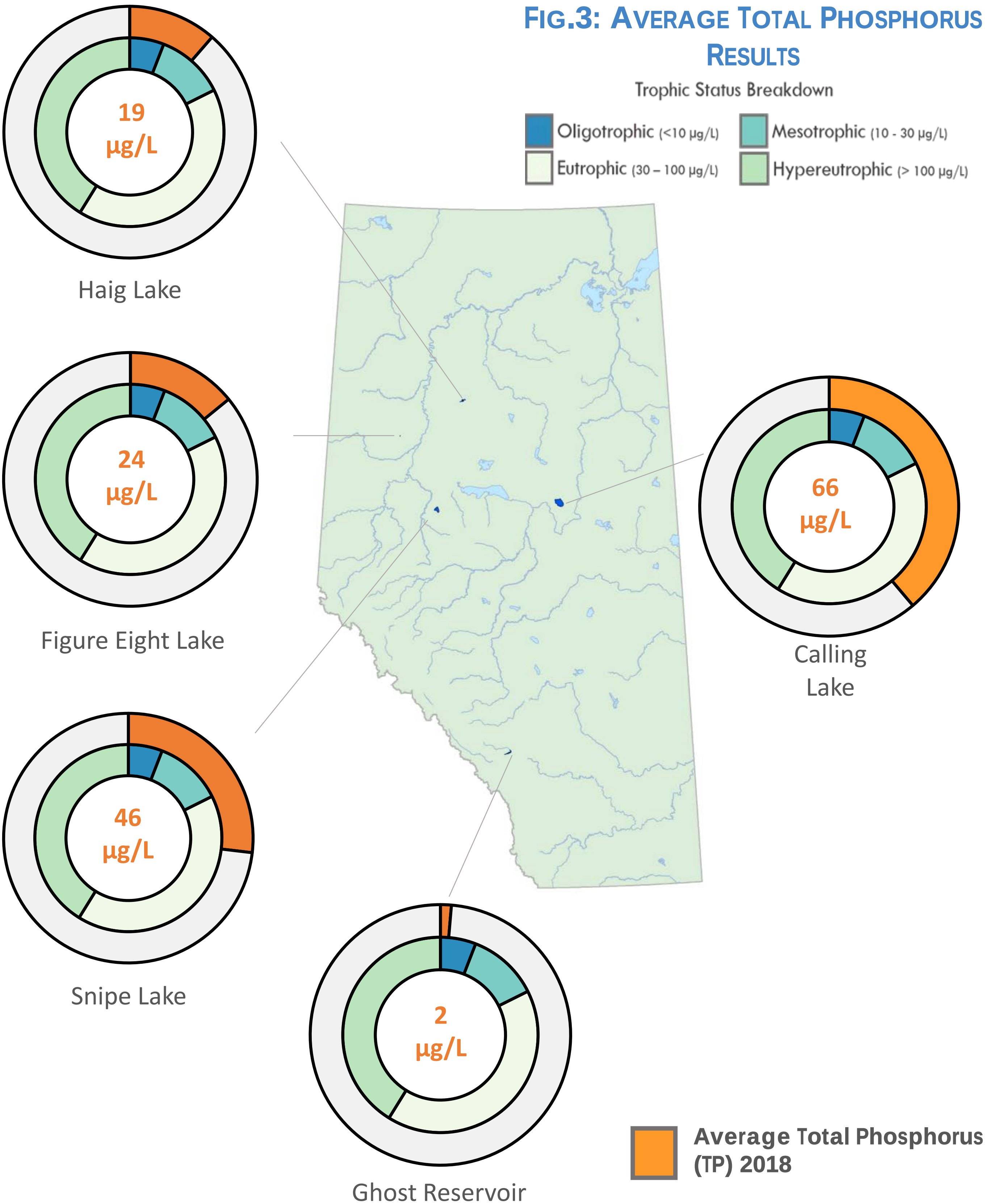


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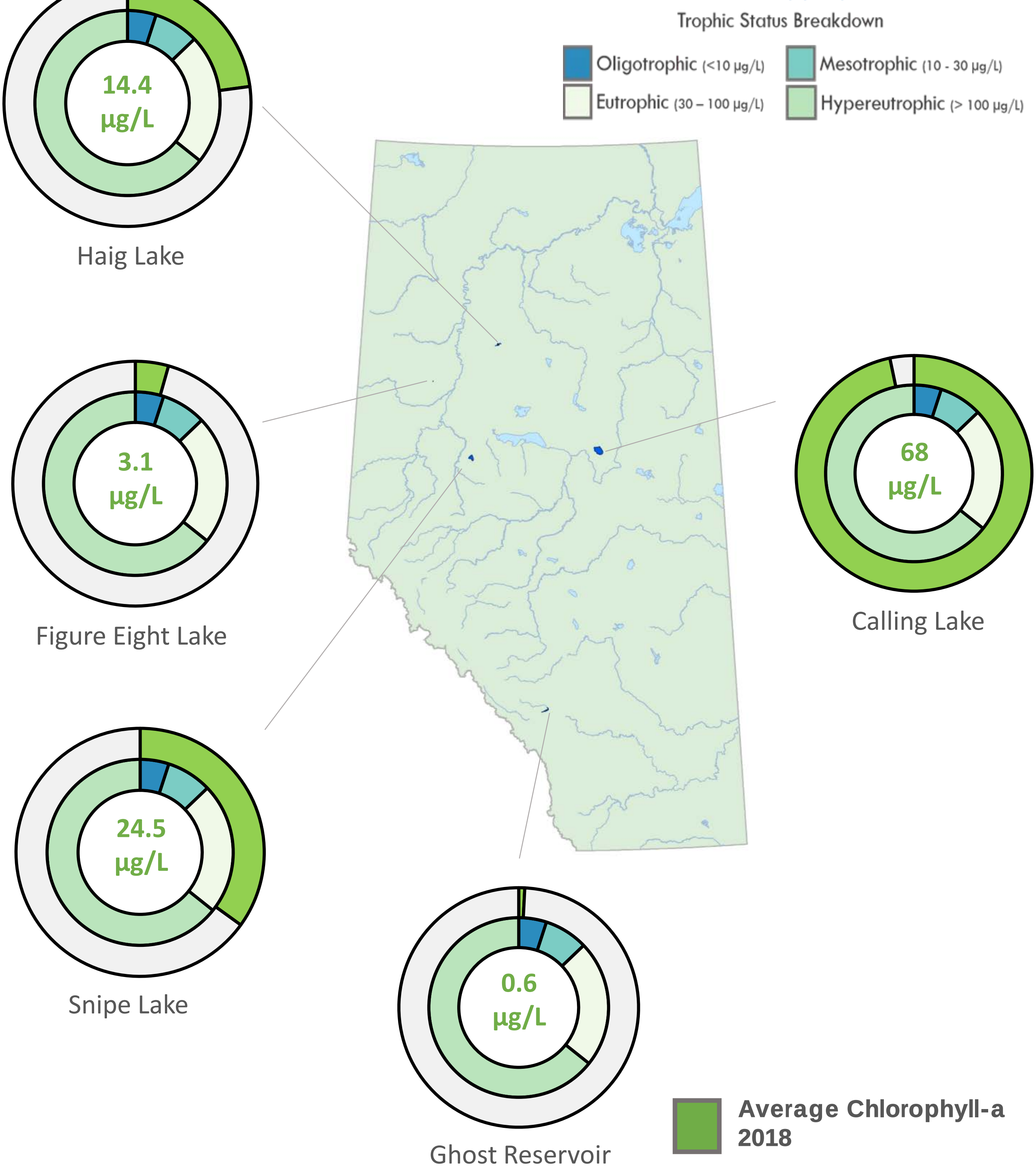
FIG. 4: AVERAGE CHLOROPHYLL-A RESULTS



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 maximum safe microcystin levels are set at 20 µg/L.

Average microcystin concentrations ranged from a maximum of 5.60 µg/L at Calling Lake to a minimum of 0.09 µg/L at Haig Lake (Figure 5). Microcystin concentrations are likely to be higher near shore where there are accumulations of cyanobacteria blooms. At Calling Lake, two samples collected on the southeast shore on July 16th and August 21st had microcystin concentrations of 214.31 µg/L and 331.01 µg/L, respectively.

It is unusual to note that on September 23rd, a microcystin concentration of 8.37 µg/L was detected at Ghost Reservoir despite low corresponding chlorophyll-*a* concentrations (Appendix Table 2). There also appears to be disagreement between visual evidence of cyanobacteria blooms and presence of microcystin toxin – more investigation is required.

Southeast shore cyanobacteria accumulation at Calling Lake, 2018.

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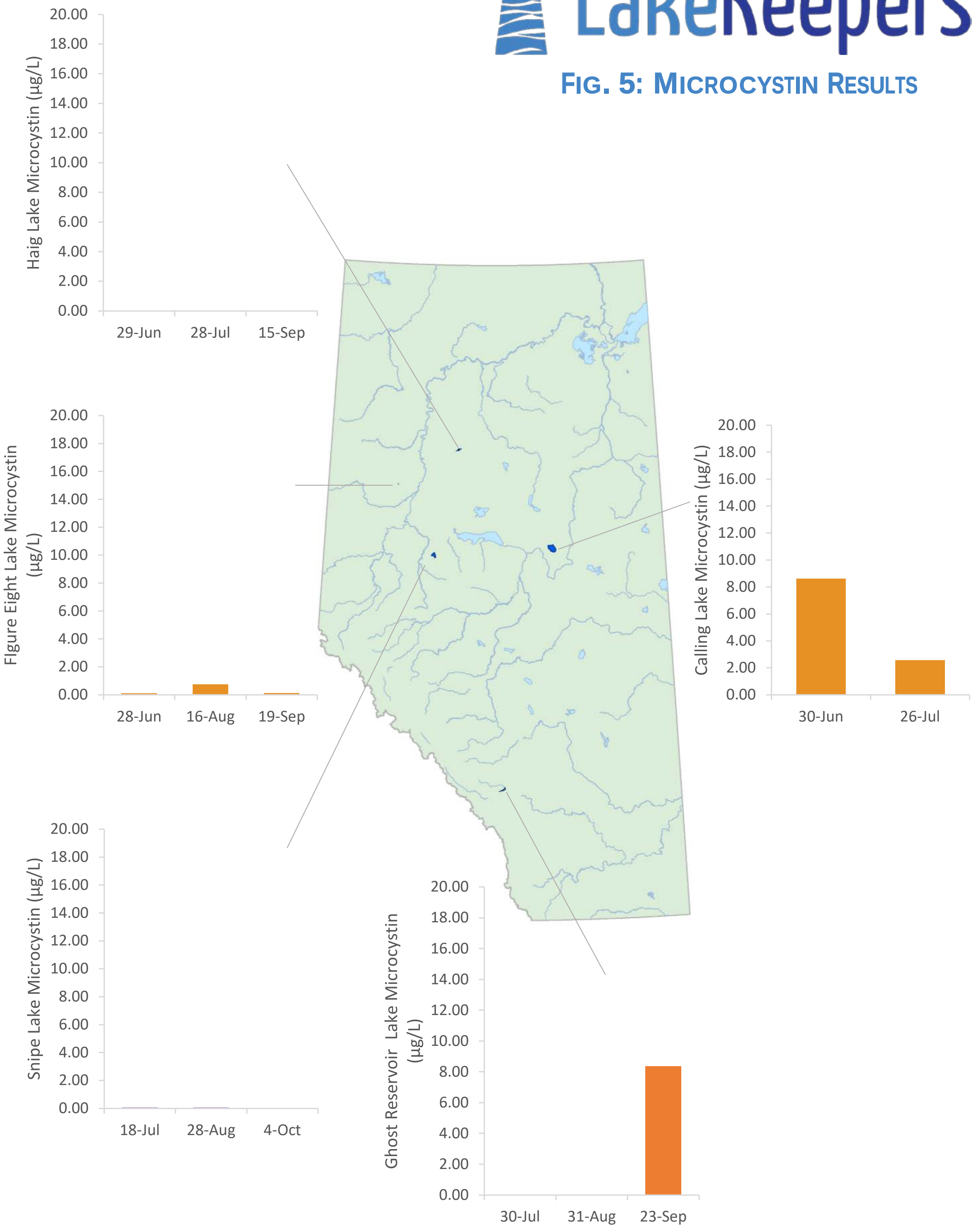
Fig. 5: Microcystin Results



TEMPERATURE AND DISSOLVED OXYGEN PROFILES

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.

Temperature profiles can indicate the extent to which a water column is mixed. This has important implications for the cycling of nutrients and oxygen throughout a lake. Strong thermal stratification was not indicated by any of the LakeKeeper lakes. Lakes with shallow depths or large surface areas are prone to mixing and have a lower likelihood of establishing significant stratification.

At the lakes' surfaces, maximum temperatures fluctuated around 20 °C, and in the fall, most lakes had become isothermal, with the entire water column measuring below 10 °C (Figure 6, Appendix Table 2).

LakeKeepers volunteers at Calling Lake, 2018.

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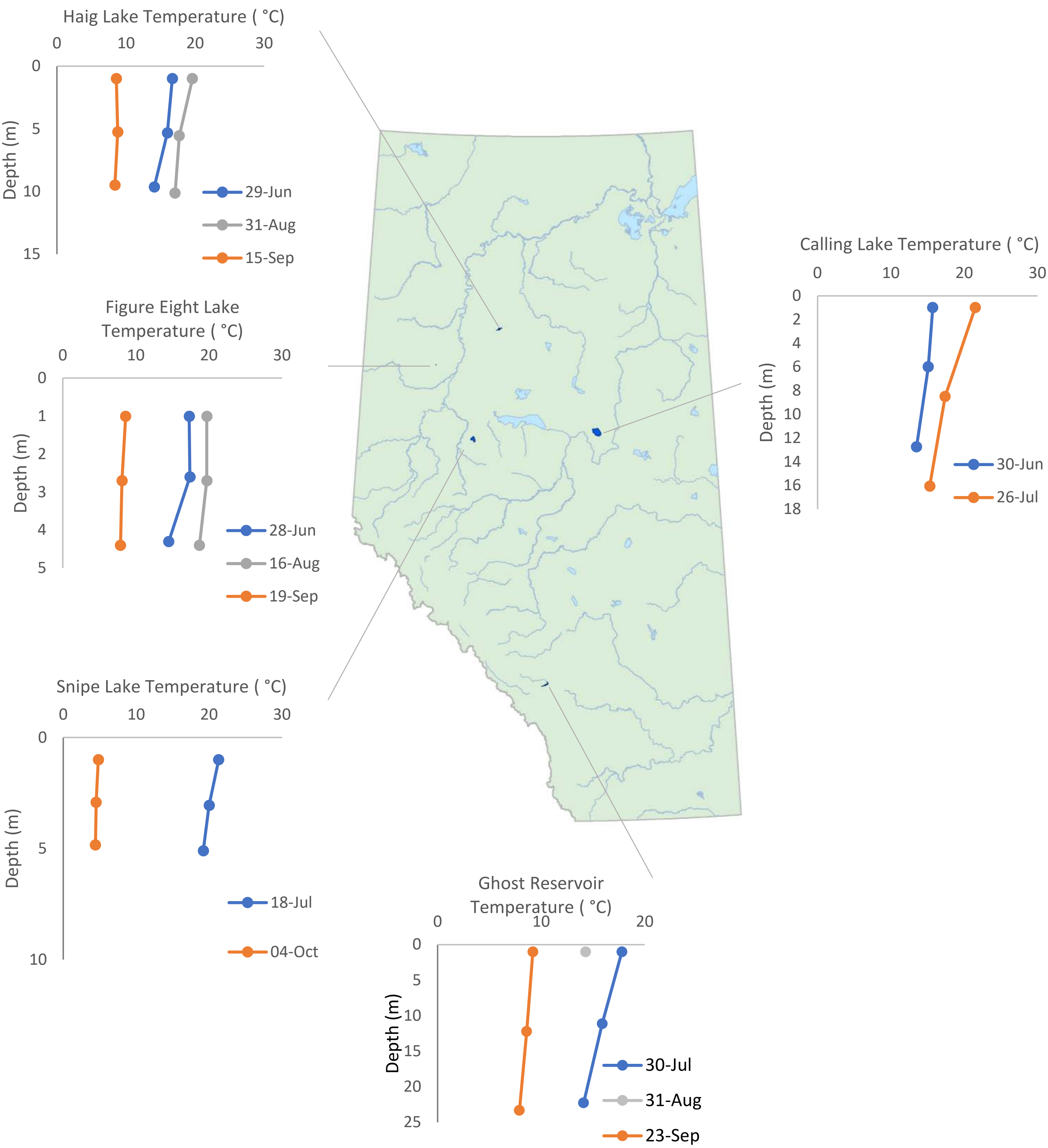
Fig. 6: Temperature Profiles



APPENDIX

Appendix Table 1. Observations made during sampling by LakeKeepers at five lakes in 2018.

Lake	Sample Date	Secchi Disk Colour	Bottom Depth (m)	Air Temperature (°C)	Cloud Cover (%)	Wind Direction	Wind Speed (km/h)	24 Hour Rainfall (mm)	Evidence of Cyanobacteria Bloom
Calling	30-Jun	Green	13.72	9	5	W	6	0	No Evidence
	26-Jul	Green	17.07	22	15	-	1.9	0	Scums on surface
Figure Eight	28-Jun	Green	5.33	19.4	90	NW	Moderate Wind	1-3 mm	No Evidence
	16-Aug	Green/Yellow	5.40	20.7	Smokey	-	Light Wind	0	Particles in Water
	19-Sep	Green	5.40	9	<5	SE	0	-	Particles in Water
Ghost Reservoir	30-Jul	Colourless	22.25	29	40	E	5	0	No Evidence
	31-Aug	Colourless	24.00	14.3	20	W	30	0	No Evidence
	23-Sep	Colourless	24.40	6	10	SE	5	1	No Evidence
Haig	29-Jun	Colourless	10.64	14	30	SW	15	4	No Evidence
	28-Jul	Brown	11.13	19.6	35	W	19	0	Particles in Water
	15-Sep	Green	10.50	0	0	E	11	0	No Evidence
Snipe	18-Jul	Brown/Green	6.10	25	40	SW	15	0	No Evidence
	28-Aug*	-	-	-	-	-	-	-	-
	4-Oct	Brown/Green	5.83	7	25	SW	8	0	No Evidence

*Missing field sheet.

Appendix Table 2. Water chemistry and Secchi disk depth values for five LakeKeeper lakes in 2018.

Lake	Sample Date	Total Phosphorus (µg/L)	Total Nitrogen (mg/L)	Microcystin (µg/L)	Chlorophyll-*a* (µg/L)	Secchi Disk Depth (m)	Euphotic Depth (m)
Calling	30-Jun	22	0.62	8.62	6.4	2.74	5.44
	26-Jul	111	2.2	2.57	129	0.57	1.14
	2018 Average	**67**	**1.4**	**5.60**	**68**	**1.66**	**3.29**
Figure Eight	28-Jun	27	1.3	0.11	2.6	3.80	7.60
	16-Aug	24	1.3	0.75	1.9	4.50	9.00
	19-Sep	21	1.2	0.13	4.7	3.90	7.80
	2018 Average	**24**	**1.3**	**0.33**	**3.1**	**4.07**	**8.13**
Ghost Reservoir	30-Jul	3.9	<0.050	<0.1	0.4	4.47	8.94
	31-Aug	<3[a]	0.0731[a]	<0.1	0.8	3.65	7.30
	23-Sep	<3	0.062	8.37	0.5	4.50	9.00
	2018 Average	**2**	**0.053**	**2.82**	**0.6**	**4.21**	**8.41**
Haig	29-Jun	13	0.52	<0.1	N/A	4.30	4.15
	28-Jul	22	0.80	<0.1	14.4	2.20	4.40
	15-Sep	23	0.77	0.18	17.6[b]	2.10	4.20
	2018 Average	**19**	**0.70**	**0.09**	**14.4**	**2.87**	**4.25**
Snipe	18-Jul	58	1.3	0.39	52.1	0.85	1.70
	28-Aug	54	0.98	0.16	14.2	N/A	N/A
	4-Oct	25	0.72	0.10	7.1	0.25	0.50
	2018 Average	**46**	**1.0**	**0.22**	**24.5**	**0.55**	**1.10**

[a] Samples received unpreserved.
[b] Samples received past laboratory hold time.