



LakeKeepers

Winter
LakeKeepers
2019

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 who made this program happen: Jon Pedlan, Ray Walker, Vien and Marielle Lam, Cam and Brittany Kereliuk, Kellie Nichiporik, Steve Hawryliw, and Blake Mills. 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 Caitlin Mader, Bradley Peter, Patrick Heney, and Caleb Sinn.



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.

In early 2019, this project was expanded to include winter under-ice sampling, with the cooperation of ice anglers. The addition of winter sampling to ALMS' programs addresses a gap in knowledge of year-round processes that affect eutrophication of Alberta Lakes.

In February and March 2019, volunteers monitored ten lakes for total phosphorus, dissolved oxygen, and temperature. Results indicated that in general, total phosphorus samples were lower in winter than in the open-water season total phosphorus concentrations. Additionally, four lakes, Bangs Lake, Manatokan Lake, Nakamun Lake, and North Buck Lake, all proceeded to hypoxia toward the lake bottom. Both Manatokan Lake and Minnie Lake displayed elevated dissolved oxygen at the surface. At Minnie Lake, this may have been related to a phytoplankton bloom occurring under the ice.

Volunteers provided feedback on the training documents, which will be incorporated into next winter's program. More quality control work is required to assess the agreement between volunteer samples and samples collected by ALMS staff. Future winter lake monitoring will strive to collect multiple samples from each lake throughout the winter season.

INTRODUCTION

In 2019, the Winter LakeKeepers program was run as a pilot project by the Alberta Lake Management Society. LakeKeepers was designed as an accessible citizen science program to allow anglers to collect data while they fish. LakeKeepers comprises two sub-programs, one in the summer season, and one in the winter season. In 2019, ten lakes were selected for the Winter LakeKeeper program based on volunteer availability (Table 1, Figure 1).

Table 1. The major watershed, location, surface area (km²) and maximum depth (m) of the ten 2019 Winter LakeKeepers Lakes.

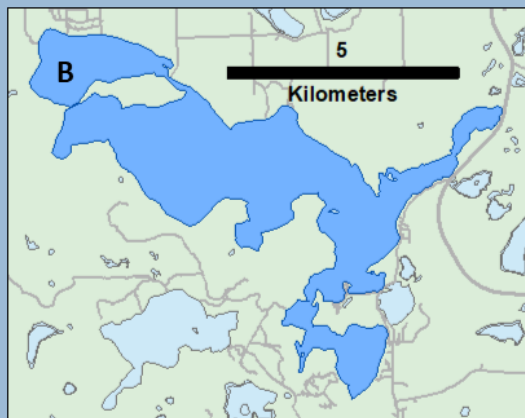
Lake Data	Major Watershed	Site Lat & Long	Date sampled	Surface Area (km ²)	Max Depth*
North Wabasca Lake	Athabasca River	56.04302, -113.912782	March 30 2019	112	18
Nakamun Lake	Athabasca River	53.885749, -114.206294	Feb 12 2019	3.2	8
Hope Lake	Athabasca River	54.658094, -112.661526	March 10 2019	2.8	13
North Buck Lake	Beaver River	54.683802, -112.555715	March 14 2019	20.7	5
Long Lake	Beaver River	54.444931, -112.751371	March 15 2019	6.5	9
Bangs Lake	Beaver River	54.155552, -111.032867	March 13 & 17 2019	1.8	--
Manatokan Lake	Beaver River	54.465039, -110.948989	March 9 2019	4.4	--
Minnie Lake	Beaver River	54.285536, -111.10394	March 17 2019	0.9	21
Moose Lake	Beaver River	54.24888, -110.917692	March 26 2019	40.5	19
Lac Santé	North Saskatchewan River	53.841323, -111.557693	March 9 2019	11.3	25

*Max depth based on historical bathymetric surveys or previous LakeWatch reports. – Bathymetry data not available.

2019 Winter LakeKeepers Locations



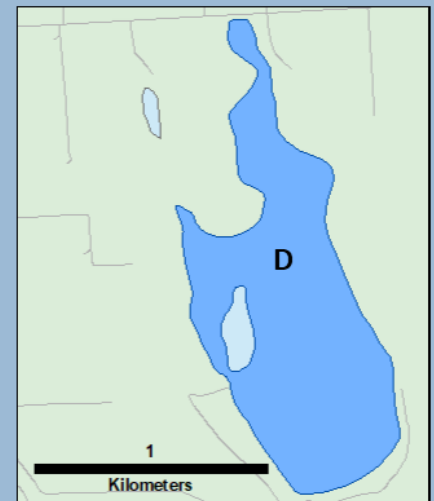
North Wabasca Lake, Wabasca Sub Basin



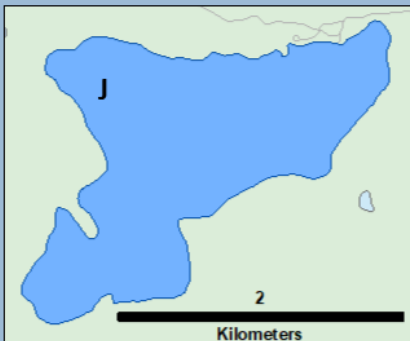
North Buck Lake, Beaver River Sub Basin



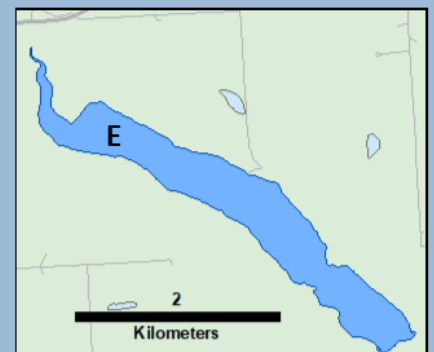
Manatokan Lake, Beaver River Sub



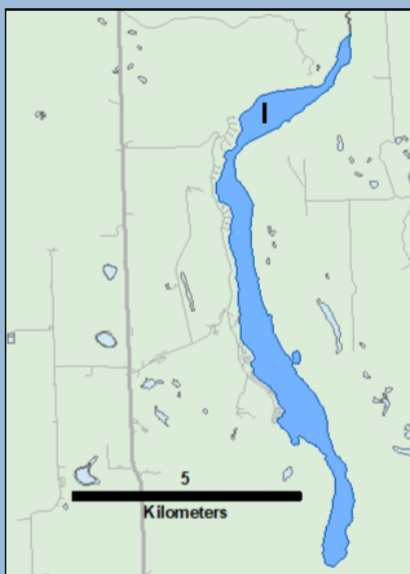
Minnie Lake, Athabasca Sub basin



Hope Lake, Athabasca River Sub basin



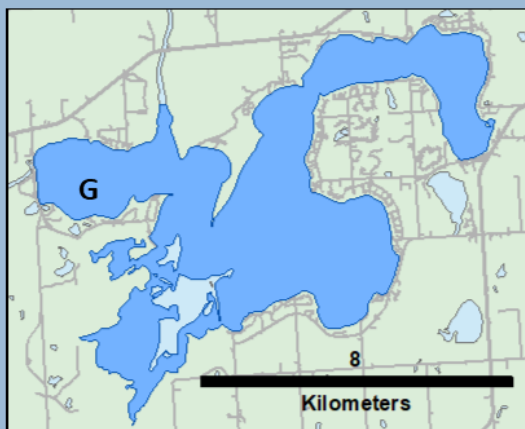
Bangs Lake, Beaver Sub basin



Long Lake, Beaver River Sub basin



Nakamun Lake, Pembina Sub Basin



Moose Lake, Beaver River Sub basin



Lac Santé, North Saskatchewan Sub Basin

METHODS

Volunteers were provided with a training manual and training videos (available at www.alms.ca/lakekeepers). Lakes were to be sampled at least once during the ice-on period. Volunteers chose their own locations for sampling, generally based on their desired location for ice fishing. This meant that unlike other programs, Winter LakeKeepers measurements were not taken at the deepest point in the lake. Volunteers were provided with field sheets, a YSI ProODO dissolved oxygen and temperature meter, and a nutrient sample bottle with a vial of sulfuric acid preservative.

Discrete grabs for total phosphorus were collected by hand at 0.5 m and preserved with 2 mL of sulfuric acid. The Alberta Lake Management Society coordinated delivery of total phosphorus samples to Bureau Veritas Analytics in Edmonton.



Volunteer Vien Lam collecting data at Lac Sante.



RESULTS

Volunteers successfully completed 11 sampling trips at 10 unique lakes (Table 1). Trips occurred between February and March 2019. 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).

TOTAL PHOSPHORUS

ALMS measures a suite of water chemistry parameters. Phosphorus acts as one of the nutrients driving algae blooms in Alberta. Measuring total phosphorus during the winter can help to identify the process of eutrophication, or excess nutrients, which can lead to harmful algae/cyanobacteria blooms in the summer. Total phosphorus concentration is one way that lakes can be classified into oligotrophic (low nutrients), mesotrophic (moderately productive), eutrophic (productive) or hypereutrophic (highly productive).

Average total phosphorus values ranged from a minimum of 15 µg/L at Hope Lake to a maximum of 185 µg/L at Bangs Lake (Figure 3). While total phosphorus is often used to categorize lakes by trophic status (how biologically productive they are), this classification is generally based on measurements from the open water season. While winter measurements are important, they are likely to be lower than the total phosphorus content of the same lakes in the summer, as particulates including cyanobacteria settle to the lakebed in the calm under ice conditions.

In two cases, winter total phosphorus samples were higher than expected. Minnie Lake had a TP measurement of 150 µg/L compared to an average summer value of 28 µg/L (2018). This is likely because at the time the winter sample was collected, the volunteers noticed a pink cyanobacteria bloom under the ice. These bacteria will elevate both the oxygen and nutrient readings. In Lac Santé, a winter phosphorus value of 93 µg/L was recorded. This is much higher than an average summer value of 43 µg/L (2015). The elevated nutrient level may be associated with biological activity under the ice, mixing of the water column, or contamination from surface snow melt. More information is required to better understand this TP value.

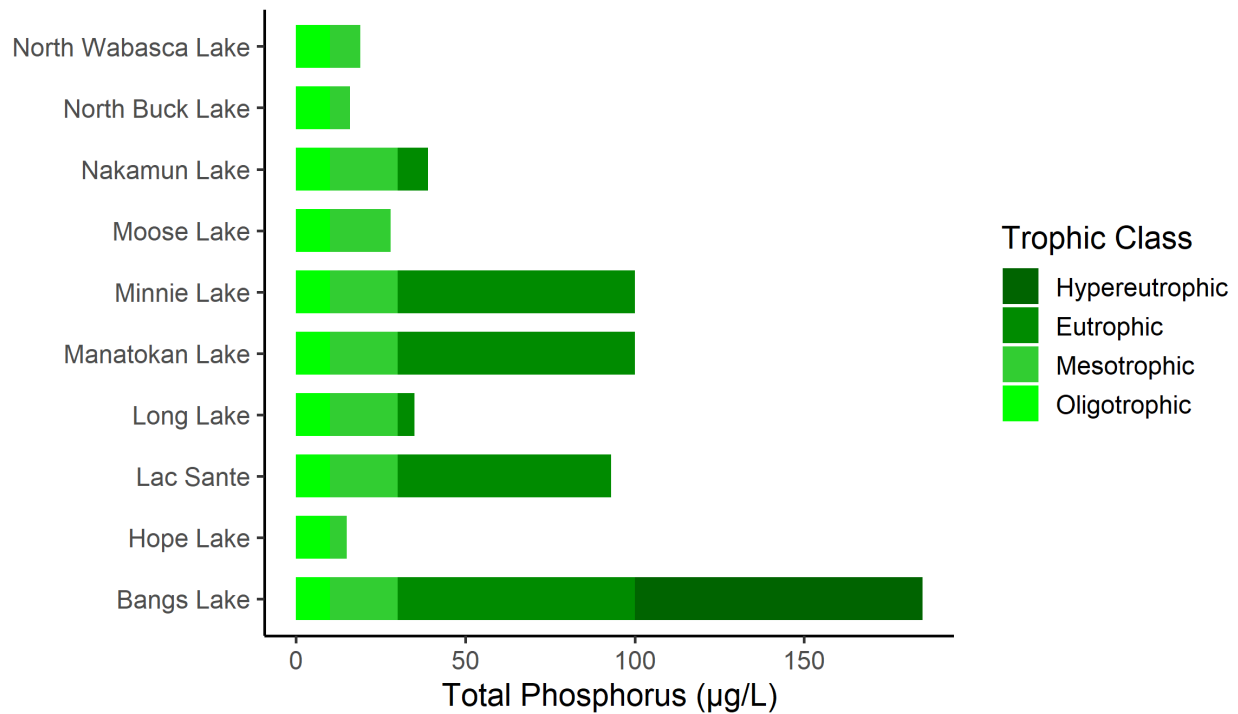


Figure 1: Total phosphorus concentrations in the 10 Lakes sampled in w 2019. Each is based on a single grab sample from 0.5 m depth, between February and March 2019.



TEMPERATURE AND DISSOLVED OXYGEN PROFILES

Water temperature and dissolved oxygen profiles are measurements taken at regular intervals going down the water column. This information is important for understanding water quality and fish habitat. In the winter, the transfer of dissolved oxygen into a lake is reduced due to ice cover, limited photosynthesis, and a lack of physical mixing. Low oxygen concentrations through the winter months may lead to winter fish kills. Deeper lakes may be less prone to fish kills as they hold a higher volume of dissolved oxygen.

Temperature profiles under the ice may be inverted when compared to summer profiles. In the winter, the coldest water appears at the surface (floating ice) whereas the warmer water (4°C) will be found at the lake bottom.

Temperature:

Inverted temperature profiles were observed on nearly all sampling trips. Temperature ranged between 0-5°C throughout the lake water columns.

Oxygen:

Oxygen profiles showed a general pattern of declining with depth. Oxygen concentrations proceeded to hypoxia (<2 mg/L) in four lakes: Bangs Lake, Manatokan Lake, Nakamun Lake, and North Buck Lake. Due to inclement weather, data is not available from earlier in the season to demonstrate the change in oxygen concentration throughout the winter. In 2020, ALMS hopes to collect early winter and late winter samples to better understand how oxygen concentrations change over time under the ice.

In two lakes, Mantokan Lake and Minnie Lake, elevated oxygen concentrations were observed at 1.0 m depth. In Minnie Lake, this elevated measurement coincided with an observation of 'pink water'. The pink water is likely a result of a phytoplankton bloom under the ice. The photosynthesis from this bloom will create elevated dissolved oxygen concentrations. Summer samples from Minnie Lake, a deep mesotrophic lake, have shown evidence of metalimnetic blooms and lake whiting. As such, it is not surprising to see under ice blooms of phytoplankton. It is unclear what caused the elevated dissolved oxygen concentrations in Manatokan Lake.

Due to a malfunctioning dissolved oxygen meter, a dissolved oxygen profile for Moose Lake is not included in this report.

TEMPERATURE

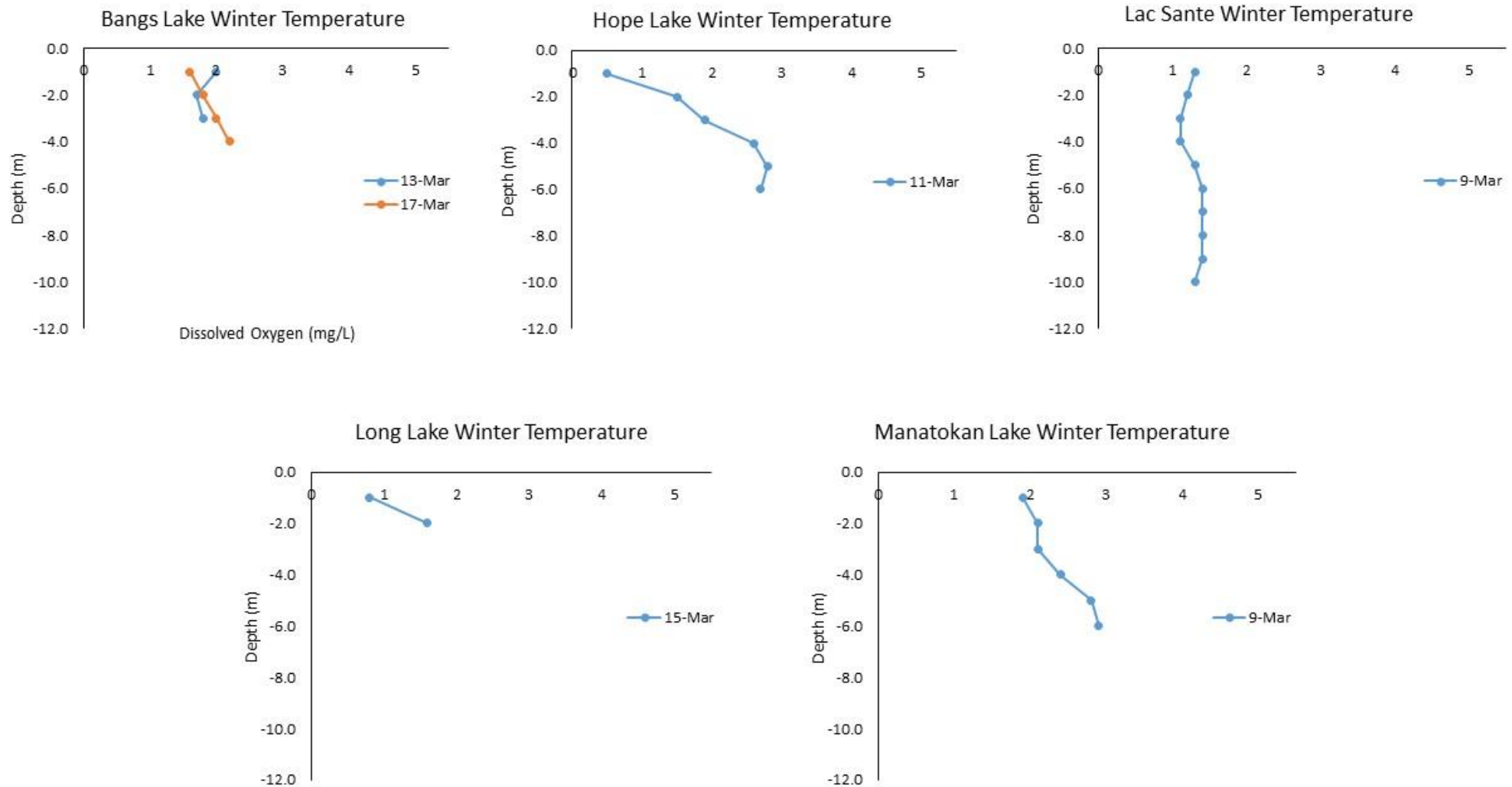


Figure 2a. Temperature profiles for LakeKeeper 2019 lakes at angler selected locations on each lake. Axes extents standardized for comparability.

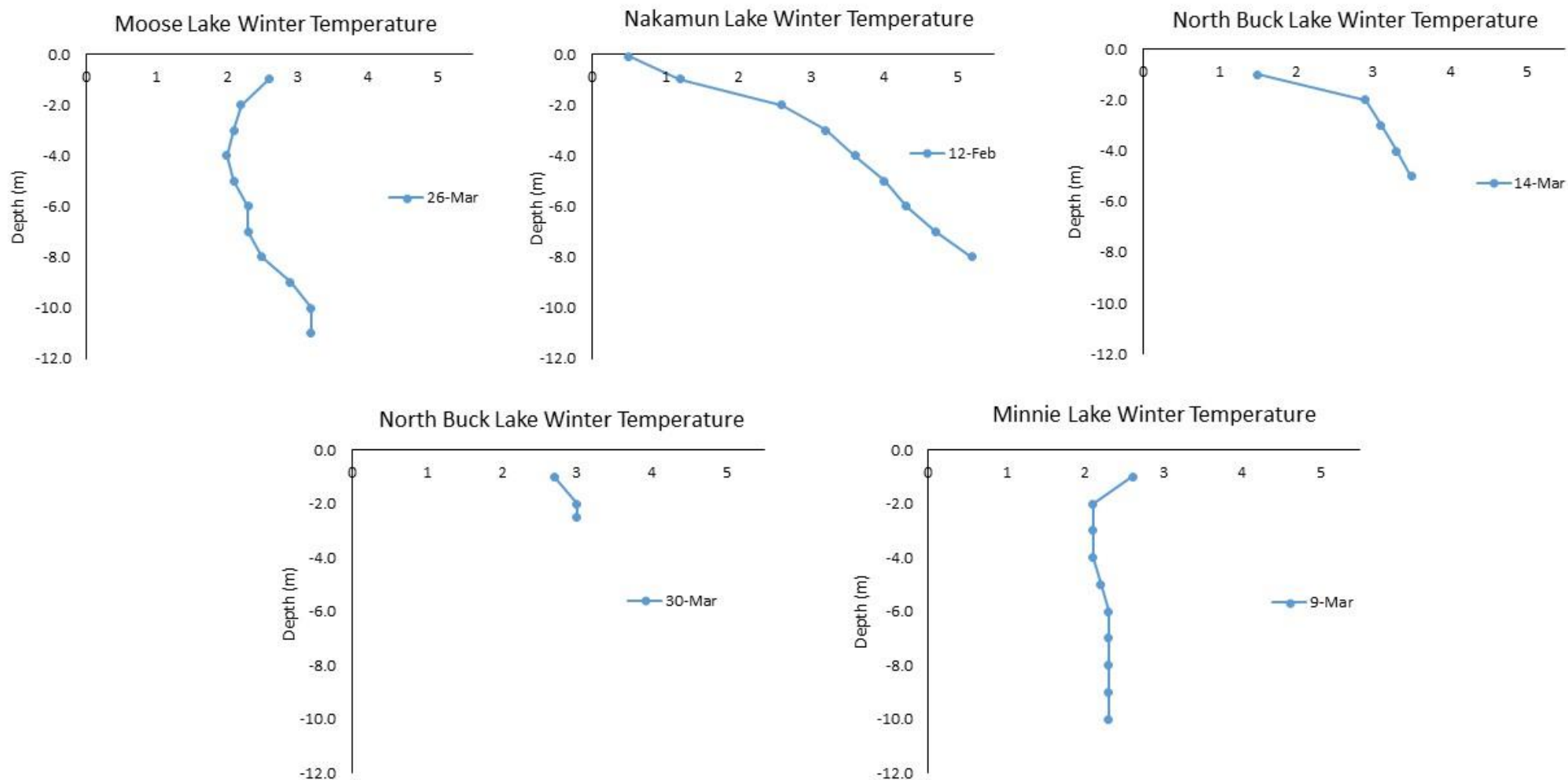


Figure 2b. Temperature profiles for LakeKeeper 2019 lakes at angler selected locations on each lake. Axes extents standardized for comparability.

DISSOLVED OXYGEN

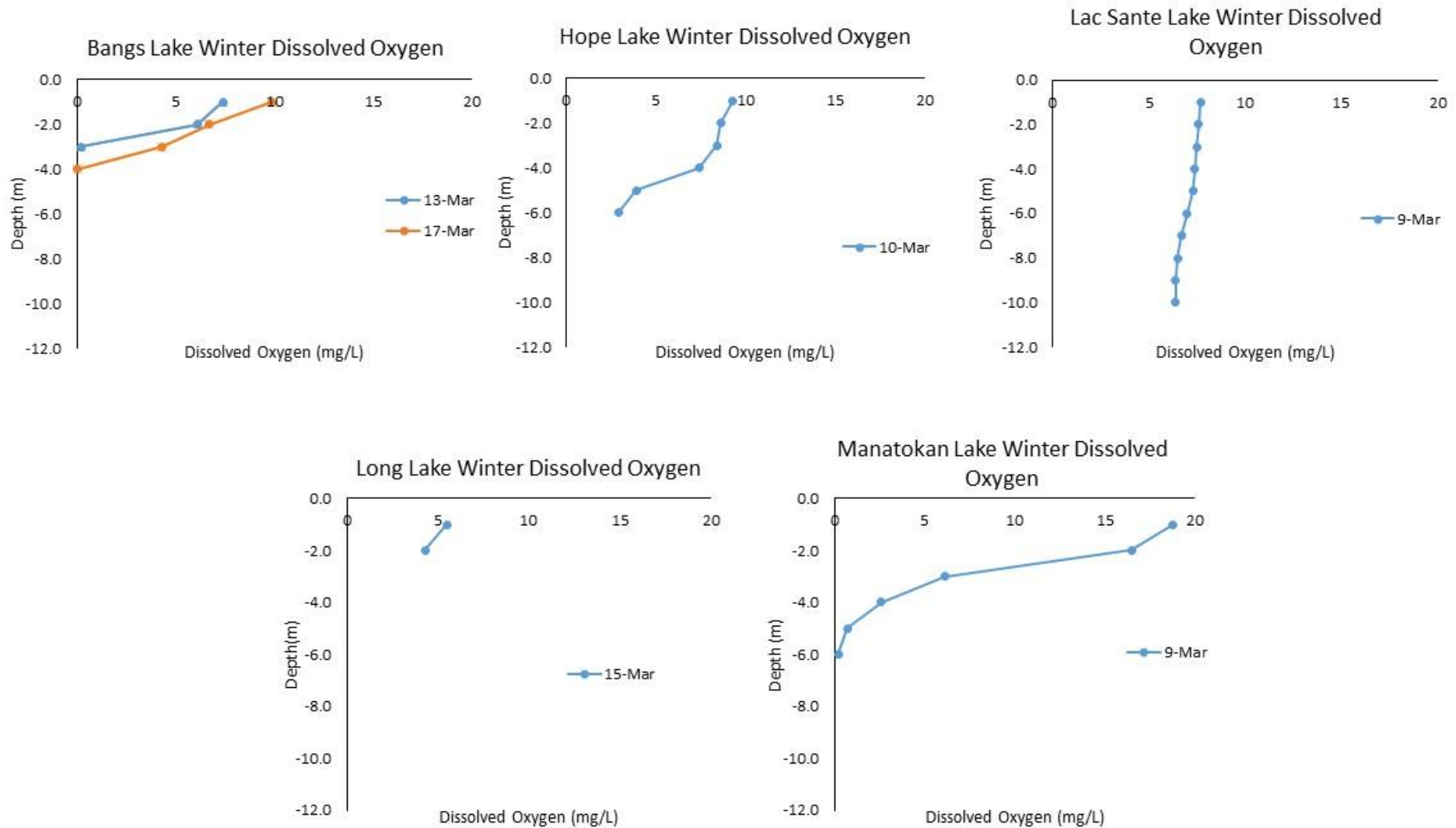


Figure 3a. Dissolved oxygen profiles for LakeKeeper 2019 lakes at angler selected locations on each lake. Axes extents standardized for comparability.

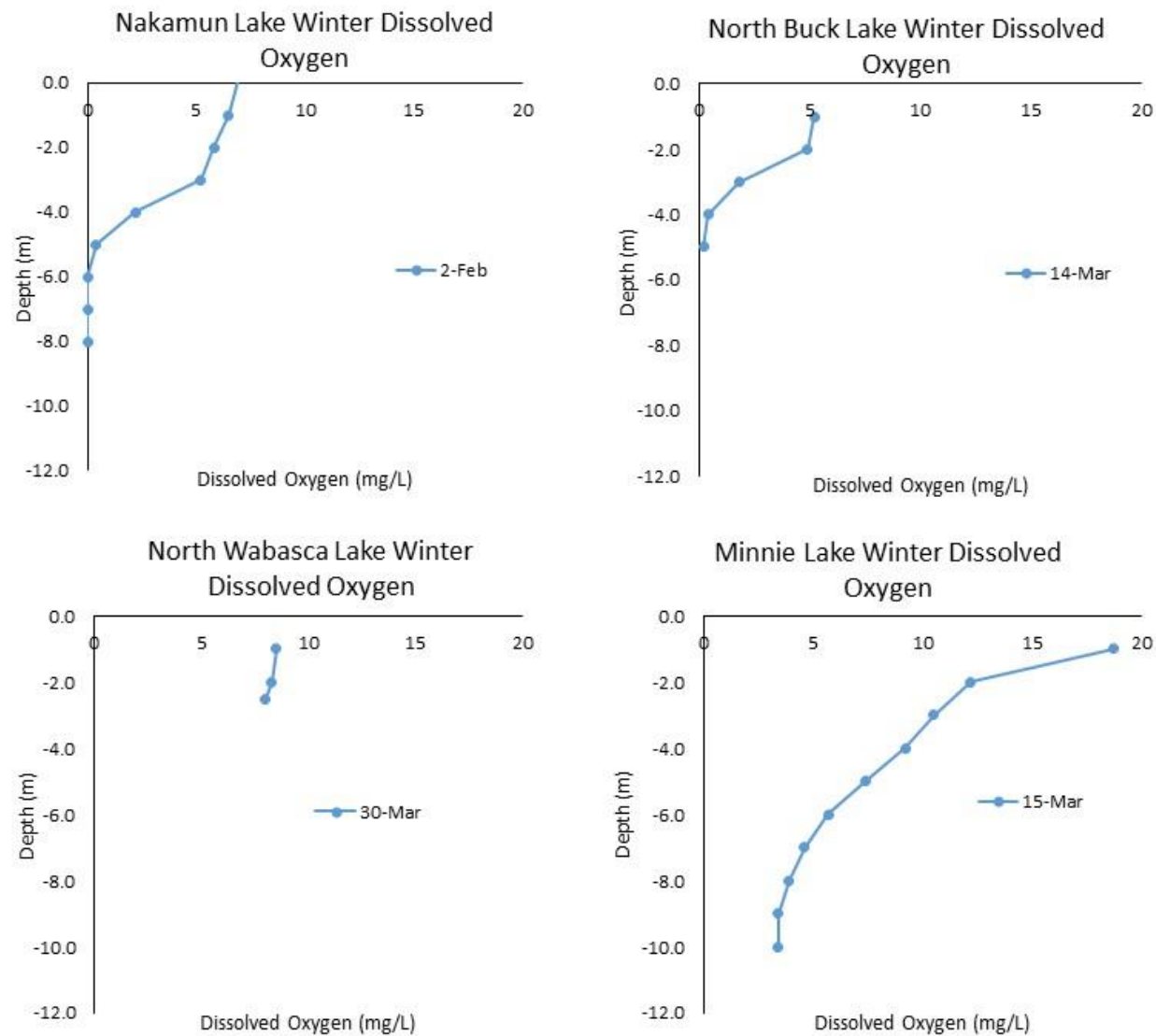


Figure 3b. Dissolved oxygen (DO) profiles for LakeKeeper 2019 lakes at angler selected locations on each lake. Axes extents standardized for comparability. Moose Lake DO profile not included due to malfunctioning DO meter while sampling.

APPENDIX

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

Lake	Sample Date	Bottom Depth (m)	Air Temperature (°C)	Snow Cover	Ice Thickness (cm)	Turbidity	Water colour	Fish Species Caught	Total Phosphorus (ug/L)	Open Water Total Phosphorus (ug/L) (year measured)
Bangs Lake	13-Mar-19	3	2.5	Yes	71	None	Colourless	<i>Esox lucius</i>	190	-
Bangs Lake	17-Mar-19	4	5	Yes	58	None	Colourless	NA	180	-
Hope Lake	10-Mar-19	6.25	-15	Yes	57	None	Green	NA	15	18 (1986)
Lac Sante	9-Mar-19	10.7	11	Yes	-	None	Colourless	<i>Lota lota</i>	93	53 (2015)
Long Lake	15-Mar-19	3	-8	Yes	71	None	Colourless	NA	25	9.2 (2018)
Manatokan Lake	3-Mar-19	6.5	-5	Yes	61	None	Colourless	<i>Esox lucius</i>	100	80 (1993)
Minnie Lake	17-Mar-19	12	3	Yes	61	Yes	Pink	NA	15	28 (2018)
Moose Lake	26-03-2019	11.5	2	Yes	66	None	Colourless	<i>Perca flavescens, Esox lucius</i>	28	91 (2018)
Nakamun Lake	12-Feb-19	8.7	-36	Yes	50	None	Green	NA	39	75 (2018)
North Buck Lake	14-Mar-19	5.5	-1	Yes	53	None	Colourless	NA	16	22 (2003)
North Wabasca Lake	30-Mar-19	2.8	4	No	69	Yes	Green	<i>Esox Lucius, Sander vitreus</i>	19	34 (2016)

"-" measurement not available