

2022 Winter Dissolved Oxygen Survey

Summary of Results

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MLBMS

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INTRODUCTION

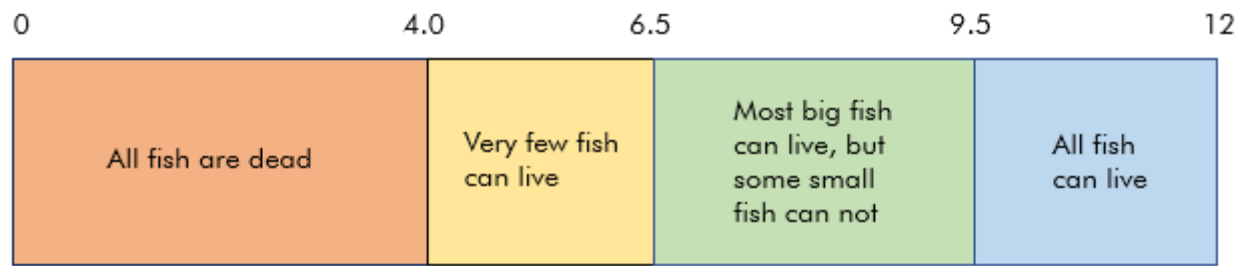
Background

The Muriel Lake Basin Management Society (MLBMS) is a charitable, not-for-profit water stewardship association that aims to address declining water levels and fish spawning habitat, in addition to water quality issues in Muriel Lake, Alberta. Muriel Lake is located 13 km south of Bonnyville, about 225 km northeast of Edmonton. The MLBMS has conducted monitoring for dissolved oxygen (DO) by measuring levels at the deepest point in Muriel Lake annually, beginning in the winter of 2018.

Sampling equipment for this project was provided by LICA-Environmental Stewards. LICA is a non-profit community association focused on environmental monitoring, environmental management, and community education and outreach in the Lakeland region of Alberta. Among other roles, LICA is the Watershed Planning and Advisory Council (WPAC) for the Beaver River Watershed, which includes Muriel Lake (LICA, n.d.).

In 2018, MLBMS began monitoring oxygen levels in the lake to determine options for improving fish habitat to support year-round fish survival. Oxygen is essential for fish survival and different species have varying oxygen needs, which may change depending on their life stage. DO is the amount of oxygen dissolved in water and thus, available for aquatic species. The Environmental Quality Guidelines for Alberta Surface Waters list the minimum short-term DO level at 5 mg/L, with the long-term (7-day mean), minimum at 6.5 mg/L for the protection of freshwater aquatic life (GOA, 2018).

The amount of DO available for fish is dependent on the amount of oxygen entering the lake and the amount being used by aquatic species. There are several natural methods where oxygen is added to a lake. Points of oxygen entry are also determined by whether the lake is open or frozen (AEP, 2021). The amount of dissolved oxygen available to fish in the winter depends on water temperature, the amount of ice and snow cover, daylight hours, plant activity, and the breathing rate of fish (MN, 2010). In this case, winter DO is measured to determine if Muriel Lake can support fish life while the lake is frozen.



Dissolved Oxygen (ppm)

(GNWT, n.d.)



Figure 1. Aerial image viewing Muriel Lake (Google Earth, 2022).

METHODS

Data recorded during the 2022 winter sample program was collected utilizing a YSI Professional Plus probe which measures temperature, dissolved oxygen, pH, conductivity, and total dissolved solids (TDS). The YSI probe was calibrated as needed following YSI protocols (YSI Inc., 2019) and inserted, lowering the probe into a hole cut in the ice of the Lake.

Measurements were recorded at the deepest known location of Muriel Lake. A depth of 4.5 meters (m) is the deepest known depth, and measurements recording water parameters were recorded at every 0.5 m interval of depth.



Figure 2. Viewing MLBMS members sampling during the Winter 2022 program.

In addition to standard water parameters recorded, additional recorded information included: the date of the sampling event, GPS coordinates of the location, air temperature, wind speed and direction, percent cloud cover, and ice thickness.

Four monitoring events were completed by the MLBMS, in December 2021, January, February, and March 2022.

To complement this winter monitoring program, water samples were also collected this year, and sent to Alberta Lake Management Society (ALMS) for lab analysis of a variety of water quality parameters. Please refer to the MLBMS website to see the complete report detailing the results of this sampling.

RESULTS

2022 Results

DO concentrations were reported above 6.5 parts per million (ppm) at all sample depths, during December 2021 sampling event. The greatest level was recorded at the surface with a reading of 13.63 ppm, and the lowest reading was recorded at 3.5 m with a recording of 8.34, although, still within the minimum threshold to sustain freshwater aquatic life.

January 2022 was found to have acceptable levels of DO from the surface to 3.0 m below the surface, with the greatest level being 8.77 ppm. 3.5 m - 4.0 m below the surface was found to have low levels of DO that result in the survival rate for fish species being very low. The DO level at 4 m was 4.18 ppm, below the threshold limit for fish survival. Inclusively, February and March 2022 were found to have very low levels of dissolved oxygen. 5 mg/L is listed at the minimum short-term DO level according to Alberta Guidelines, and all values recorded during sampling events that took place during these months fall below this level, with the exception of the March 2022 surface value (6.71 ppm). Due to the very low values recorded during February and March, this would indicate that very few fish, if any, would survive with the depleted level of Oxygen recorded. *Please refer to Figure 3 and Table 1 for the 2022 data collected.*

Although the winter starts with DO levels enabling fish survival, they are found to deplete as the winter progresses. Please note that 1 mg/L is approximately equal to 1 ppm.

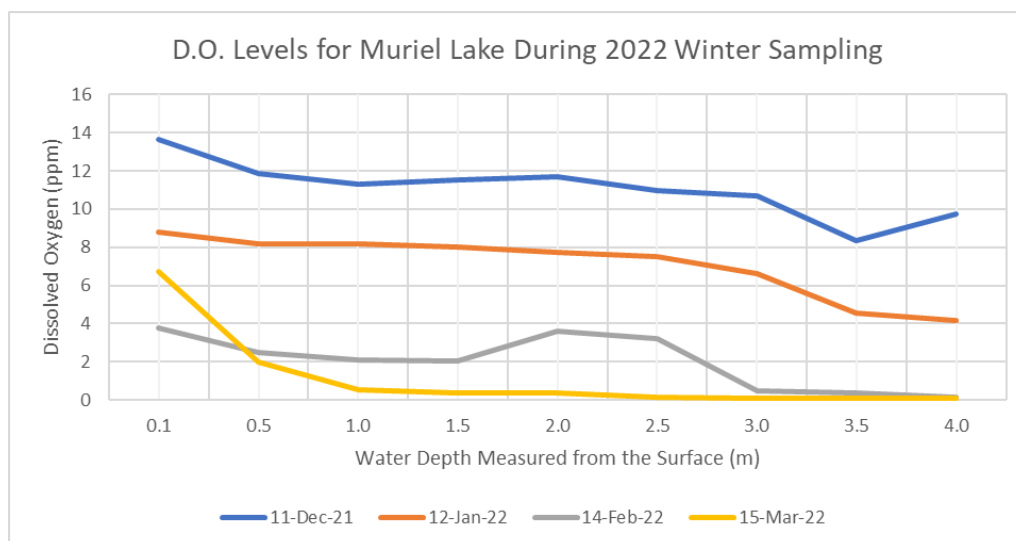


Figure 3. Viewing the comparison of December, January, February, and March pertaining to dissolved oxygen and depth sampled at Muriel Lake in 2022.

Table 1. Viewing field data recorded during the Winter of 2022 regarding depth and correlating dissolved oxygen value (ppm), recorded.

Muriel Lake Field Data 2022					
	Depth	DO (ppm)	Date	Depth	DO (ppm)
11-Dec-21	0.1	13.63	14-Feb-22	0.1	3.78
	0.5	11.85		0.5	2.49
	1	11.30		1.0	2.11
	1.5	11.52		1.5	2.07
	2	11.72		2.0	3.63
	2.5	10.99		2.5	3.21
	3	10.70		3.0	0.48
	3.5	8.34		3.5	0.37
	4	9.73		4.0	0.15
12-Jan-22	0.1	8.77	15-Mar-22	0.1	6.71
	0.5	8.17		0.5	1.99
	1.0	8.17		1.0	0.55
	1.5	8.00		1.5	0.37
	2.0	7.75		2.0	0.35
	2.5	7.50		2.5	0.14
	3.0	6.64		3.0	0.07
	3.5	4.57		3.5	0.07
	4.0	4.18		4.0	0.08

2018 - 2022 Trend Analysis

In comparing data collected from 2018 - 2022, it was noted during December, that 2019 was found to have the greatest levels of DO, followed by 2021, then 2018. *Please refer to Figure 4.*

January was found to decrease in DO levels for each year sampled in comparison to December. January 2019 was found to have the lowest DO levels, especially related to increase depth. *Refer to Figure 5.*

The four-year comparison for February showed a range of results between the years sampled. 2019 was found to have low DO levels, contrary to 2021 which had more consistent higher values. 4.0 m was found to have very low DO levels for all four years sampled. *Refer to Figure 6.*

Consistent between the four years, March presented the lowest dissolved oxygen values for all years sampled. *Refer to Figure 7.*

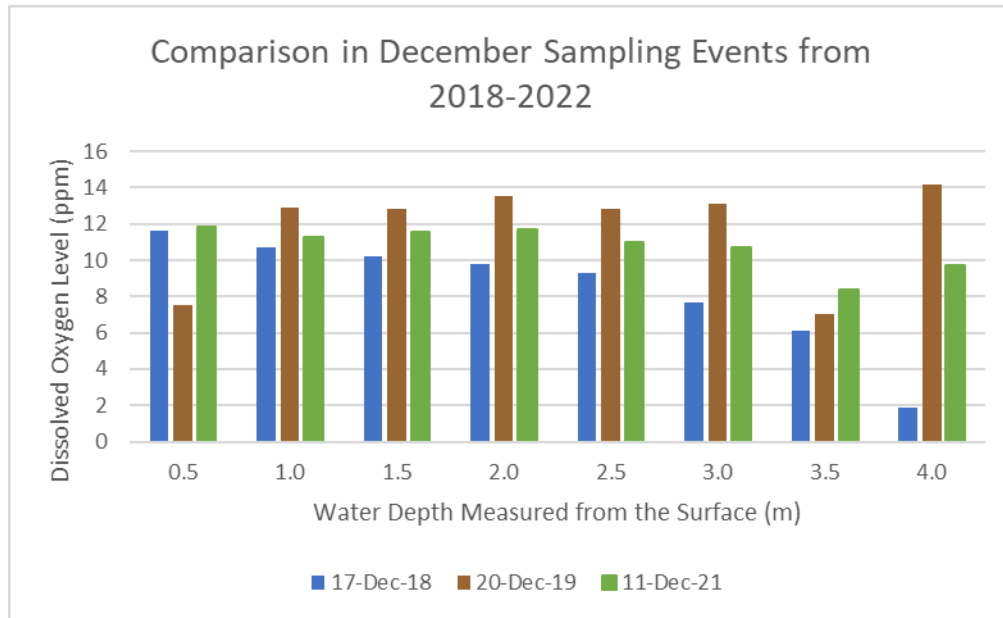


Figure 4. Comparison of December sampling events during the years 2018-2022, at Muriel Lake.

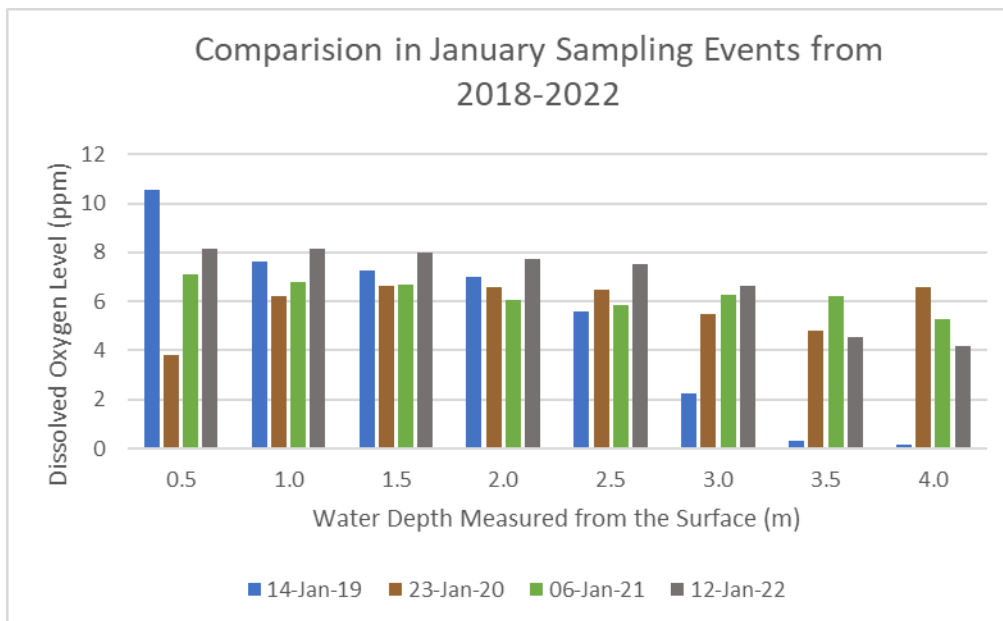


Figure 5. Comparison of January sampling events during the years 2018-2022, at Muriel Lake.

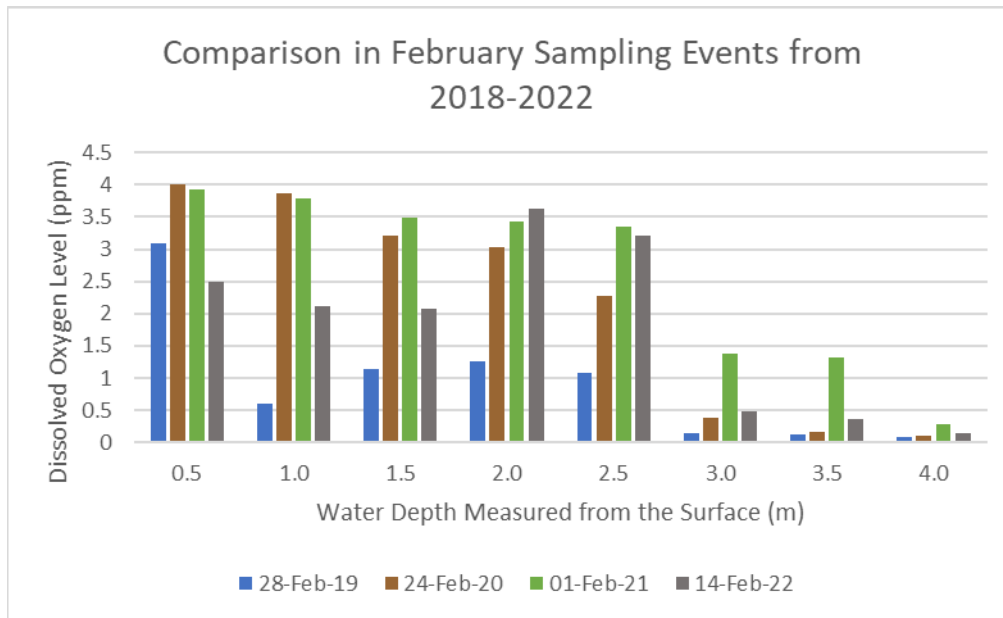


Figure 6. Comparison of February sampling events during the years 2018-2022, at Muriel Lake.

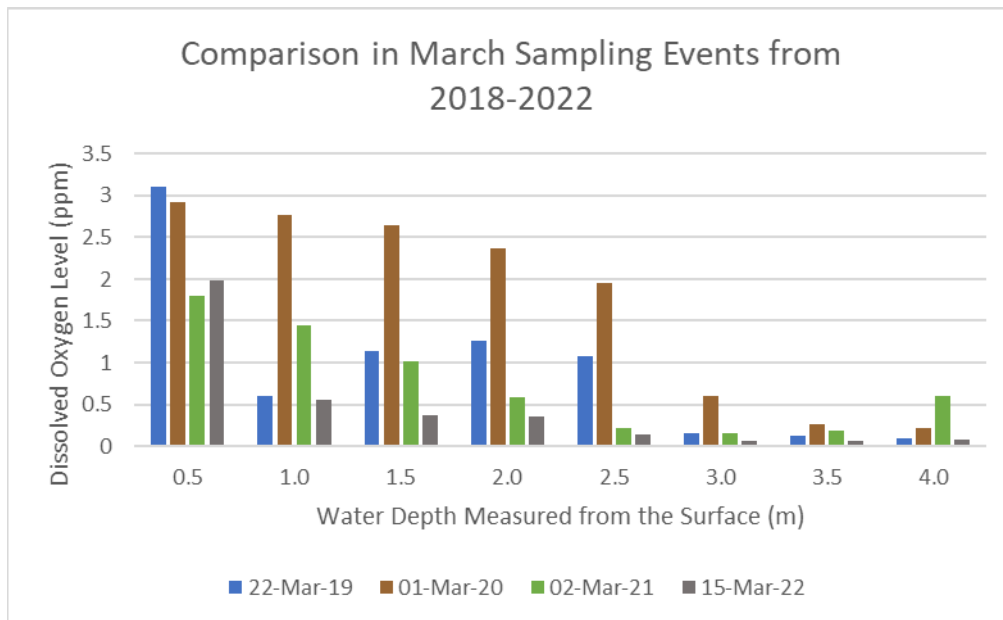


Figure 7. Comparison of March sampling events during the years 2018-2022, at Muriel Lake.

CONCLUSION

In conclusion, it was observed that due to the low levels of dissolved oxygen specifically in February and March, Muriel Lake could not support winter survival fish in 2021-2022. Low levels of dissolved oxygen in later winter may be caused from increasing ice depths overlying a declining water depth. Further investigation may be warranted to determine the root of the cause.



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