Muriel Lake Winter 2018/19 Dissolved Oxygen Summary

Introduction

Muriel Lake has lost almost 60% of its water volume and is no longer usable as a recreational lake. The dropping water level prevents the proper use of power boating and swimming is unpleasant due to the muddy bottom (Save Muriel Lake 2016). The most significant impact from the drop in water levels is the loss of sport and game fishing as a result of winter kills from low oxygen levels in Muriel Lake. However, with the increased precipitation over the past couple of years the lake levels of Muriel has reached 556 meters above sea level for the first time since 2008 (Save Muriel Lake 2019).

An eager water stewardship group, Muriel Lake Basin Management Society (MLBMS), has taken it up on themselves to address Muriel Lake's water levels, water quality and diminishing fish spawning habitat. Along with increasing community awareness, MLBMS has recently contributed to collecting citizen science to fill in the data gaps of Muriel Lake's winter dissolved oxygen levels. As Muriel Lake is within the Beaver River Watershed, the Watershed Planning and Advisory Group (WPAC) of LICA – *Environmental Stewards* has lent its equipment to MLBMS for their citizen science project.

Dissolved oxygen (DO) is a very important value to measure because oxygen is needed to sustain life within a body of water. When looking at DO in parts per million (ppm) a healthy level is 8 ppm, at this level there should be an abundant level of life and high diversity. With a lower DO of 4 ppm there is a moderate amount of life and less diversity. If you ever have a reading of 3 ppm or less that body of water is unable to support life and is highly susceptible to disease and toxins (Alberta Lake Management Society 2002).

DO can be added to a body of water in several ways. Most oxygen is added by diffusion from the atmosphere (Oram 2014). Cooler waters can hold more DO, so shaded banks can help keep temperatures down and oxygen in. Oxygen is also added to water by photosynthesis, just like on land. Aquatic plants take in CO_2 from its surrounding environment and release O_2 as a byproduct of photosynthesis (Fondriest Environmental, Inc. 2013). Therefore, by adding more plant life along the riparian area (the shoreline area when water turns into land) more oxygen can be added to the water. DO levels can also be affected by salinity, the higher the salinity the less oxygen the water can hold (Fondriest Environmental, Inc. 2013). Another benefit of the riparian area is it helps to stabilize the shoreline with its root system and prevents sediment from washing into the body of water.

Another very important way DO is added is by being physically mixed into the water with help from winds, streams, waterfalls, and fountains. With this movement it takes oxygen from the

air around us and mixes it in with the water (Alberta Lake Management Society 2002). Once the lake freeze over no new oxygen can be mixed into the lake and life must support itself from the oxygen which was dissolved in the water during the summer months (Fafard 2018). If not enough oxygen is available to sustain life it creates a "dead zone" and results in winter fish kills (Dybas 2005).

With the increased water levels in Muriel Lake over the past two years residents are curious to see if the winter oxygen level can support fish life once again. This summary report shares the data collected by MLBMS during the 2018-2019 winter to determine the dissolved oxygen levels in the lake during the winter months.

Procedure

The data was collected using a YSI Professional Plus probe which measures temperature, dissolved oxygen, pH, conductivity, and total dissolved solids (TDS). The YSI probe was calibrated as needed. The MLBMS tested the water at the deepest known part of Muriel Lake, 4.5 meters, which is located at 54° 122' 15", -110° 646' 29". The water was tested once in December, January, February, and March for a total of four samples. The date for sampling was selected for convenience of the MLBMS volunteers. The water was measured in the water column at 0.5 meter intervals until it reached the bottom of the lake. The weather conditions were noted on the data sheet to include the air temperature, wind speed and direction, as well as percent of cloud cover.

Results

Depth (m)	Temperature	DO (ppm)	Conductivity (us/m)	TDS	pH
0.5	0	11.63	1383	1722.5	9.8
1	0.1	10.73	1386	1716	9.83
1.5	0.5	10.18	1399	1703	9.82
2	0.8	9.8	1411	1703	9.83
2.5	1.3	9.27	1437	1694	9.85
3	1.9	7.7	1451	1683.5	9.84
3.5	2.4	6.1	1471	1683.5	9.83
4	2.8	1.84	1499	1690	9.81

Table 1: *December 17, 2018. The air temperature of -10 degrees Celsius, wind speed of 5 km/h from the North and 70% cloud cover. Bottom Depth 4.3m*

Depth (m)	Temperature	DO (ppm)	Conductivity (us/m)	TDS	pH
0.5	0.2	10.55	2309	2853.5	9.29
1	0.5	7.63	2340	2840.5	9.3
1.5	1.9	7.25	2367	2834	9.31
2	1.1	7.01	2379	2840.5	9.32
2.5	1.4	5.59	2396	2834.5	9.31
3	2.4	2.25	2460	2814.5	9.3
3.5	3.1	0.31	2518	2808	9.29
4	3.6	0.15	2582	2834	9.26
4.5	3.7	0.1	2605	2860	9.26

Table 2: *January 14, 2019. The air temperature of -8 degrees Celsius, wind speed of 8 km/h from the South and 60% cloud cover. Bottom Depth 4.5m*

Depth (m)	Temperature	DO (ppm)	Conductivity (us/m)	TDS	pH
0.5	0.1	3.1	1247	1547	9.29
1	0.2	0.6	1253	1547	9.32
1.5	0.7	1.14	1279	1553.5	9.33
2	1	1.26	1312	1573.5	9.34
2.5	1.2	1.08	1339	1599	9.35
3	2	0.15	1371	1592.5	9.33
3.5	2.1	0.12	1383	1612	9.33
4	1.8	0.09	1332	1625	9.31

Table 3: *February 28, 2019. The air temperature of -6 degrees Celsius, wind speed of 8 km/h from the North and 10% cloud cover. Bottom depth 3.96m*

Depth (m)	Temperature	DO (ppm)	Conductivity (us/m)	TDS	pH
0.5	0.5	1.32	1564	1911	8.9
1	0.7	0.21	1625	1963	8.94
1.5	1.1	0.1	1646	1963	8.97
2	1.3	0.09	1656	1963	8.98
2.5	1.7	0.08	1671	1956	8.98
3	2	0.07	1702	1976	8.97
3.5	2.2	0.06	1729	1995	9.98
4	1.9	0.07	1736	2015	8.99

Table 4: *March 22, 2019. The air temperature of +8 degrees Celsius, wind speed of 8 km/h from the South East and 0% cloud cover. Bottom depth 4.2m*

The DO levels deceased at greater depths within the water column with the lowest DO values at the bottom of the lake. December showed the highest levels of DO in all layers of the water

column at 11.63 ppm, with the DO levels steadily decreasing throughout the winter months, with the lowest DO values in March at 0.06 ppm.

It is important to note the accuracy of the YSI probe is ± 2% of the reading or 0.2 ppm when reading in range of 0 to 20 ppm, with the ideal functioning temperatures between -5 and 45 degrees Celsius (Xylem 2018).

Conclusion

It is natural to have the DO levels steadily decrease the deeper down you go in the water column, finding the lowest levels of oxygen at the bottom of a water body. The lake bottom has the least amount of interaction with the atmosphere, limiting the amount of DO. Additionally, the densest state of water is 4 degrees Celsius, which sits at the bottom of the lake and is typically the warmest water temperature during the winter, holding less oxygen than colder water (Fondriest Environmental, Inc. 2013). The surface of the water has the highest amounts of oxygen because it has the most interaction with the atmosphere and typically holds colder waters during the winter. In this study, the very high DO levels at the surface are most likely due to agitating the waters during the drilling into the ice. Otherwise, the data collected supports this natural layering within a waterbody. This can be seen in Figure 1.

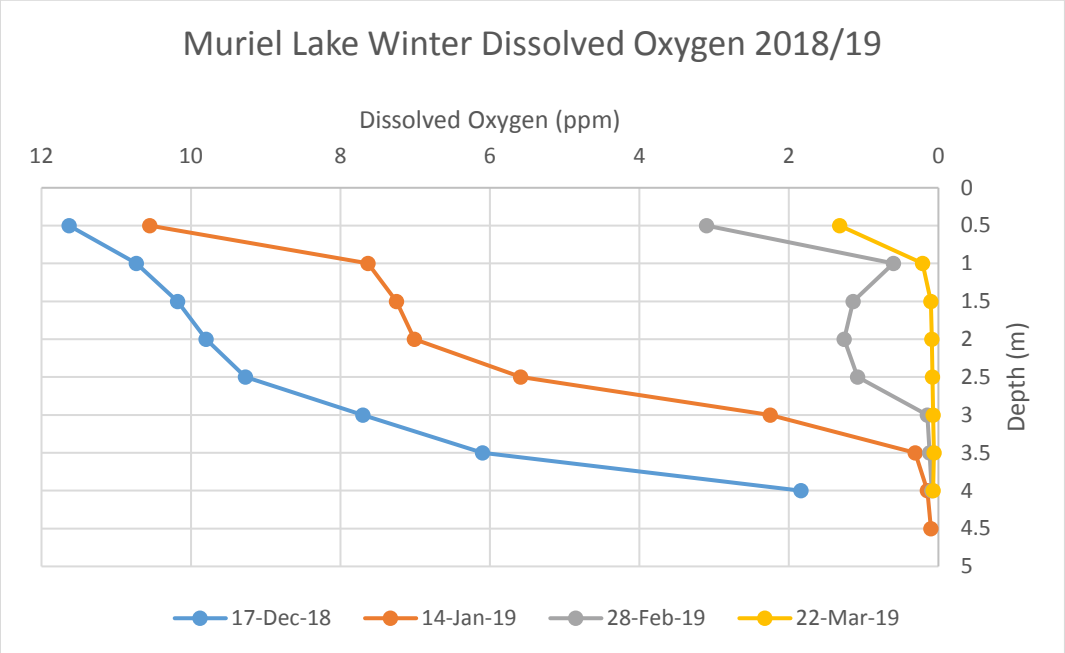

Figure 1. *DO levels in Muriel Lake in relation to the measured depth.*

The drastic change of DO levels outside the natural layering in February in the first 1.5 meters is an outliner data point. Mostly like due to a malfunction with the YSI probe.

The oxygen gets mixed into a body of water during the spring, summer and fall months mainly through winds and photosynthesis. Once the ice forms on the body of water during the winter, very limited amounts of oxygen are added into the water and will continuously decrease

throughout the winter as living organisms use it up. Without the interaction with the atmosphere and the lack of plant growth new oxygen being adding to the water is limited. Additionally, decaying plant matter will also remove oxygen that could be available to fish.

Freshwater fish start to have health issues when the DO hits levels below 4 ppm. December and January had adequate levels of DO to sustain fish life in the higher reaches of the lake, however, February and March did not have any values above 3 ppm in the entire water column which would lead to winter kill (Oram 2014).

In conclusion, the data collected from Muriel Lake during the 2018/19 winter shows it is not able to sustain fish over the winter. Management practices to improve the DO levels within the lake, along with increasing water levels could potentially lead to the necessary oxygen level required to sustain fish life.

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Contact

To learn more about the Muriel Lake Basin Management Society and to get involved visit their website at http://www.savemuriellake.com/ and follow their Facebook Page @savemuriellake.

To learn more about LICA visit our website www.lica.ca and follow us on Facebook @infoLICAonline.

If you wish to start your own citizen science project and wish to utilize equipment please contact lica2@lica.ca.

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