Naltesby (Bobtail) Lake

2001-2002, 2018-2019 Summary Report

Release Date

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Level of Study

Level 3

Volunteer Monitoring

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Photo 1 – Naltesby (Bobtail) Lake

The BC Lake Stewardship Society (BCLSS) and the Ministry of Environment and Climate Change Strategy (ENV) partner with local volunteers and stewardship groups to characterize lake water quality through the **BC Lake Stewardship and Monitoring Program (BCLSMP)**.

The BCLSMP's focus is on understanding water clarity, temperature, oxygen, and nutrients as these provide a basic understanding of lake processes and influence biological productivity. Concerns about productivity are common, specifically because high productivity can affect recreation and drinking water due to harmful algal blooms and can also impact aquatic organisms, such as fish.

Raw data collected for Naltesby Lake can be accessed through the BCLSMP Interactive Map: https://arcg.is/1G9LG40

The Importance of Naltesby Lake & its Watershed

Naltesby Lake is located in the Omineca Region approximately 100 km west of Prince George on the traditional and unceded lands of the Dekelh peoples including the Saik'uz First Nation, the Nazko First Nation and the Lheidli T'enneh First Nation (ISC, 2024).

Naltesby Lake consists of one large basin with a small centre island. The lake has many small drainages entering it which first pass through harvested and/or wildfire affected areas, both of which have the potential to impact water quality. The main outflow is located at the southeast end of the lake (ENV, 2011).

Table 1 below provides a summary of the physical characteristics for the lake. According to the Freshwater Atlas, Naltesby Lake's watershed (a land area that moves water it receives to a common water body) drains an area of 208.9 km^2. Roughly 27.8% of the watershed is considered disturbed, which includes forestry (logging), agricultural or wildfire burned areas. There are approximately 50 lots around the lake that have been developed for seasonal and full-time residences and cabins. There is also a forestry campground on the lake, which offers a boat launch, and the Ulkah Indian Reserve is located at the southeast end of the lake. Approximately 72.2% of the watershed remains in a natural state (waterbodies, riparian areas and forested areas) (**Figure 1**).

Naltesby Lake is popular with local anglers and was stocked with rainbow trout (*Oncorhynchus mykiss*) between 1988 and 2004 but has not been stocked since. Sport fish identified in the lake include burbot, kokanee, lake whitefish, and mountain whitefish as well as several additional coarse fish species. (FFSBC, 2024).

Table 1. Physical Characteristics of Naltesby Lake (BC Habitat Wizard, 2024).

Lake Name	Naltesby (Bobtail) Lake
Elevation	813 masl
Surface Area	840.56 m^2
Perimeter	28621 m
Maximum Depth	20.1 m
Mean Depth	10.8 m
Ice Over	Yes
Biogeoclimatic (BEC) Zone	Sub-Boreal Pine - Spruce
ENV Region	Omineca
Watershed Code (Trimmed)	180-069000-58000

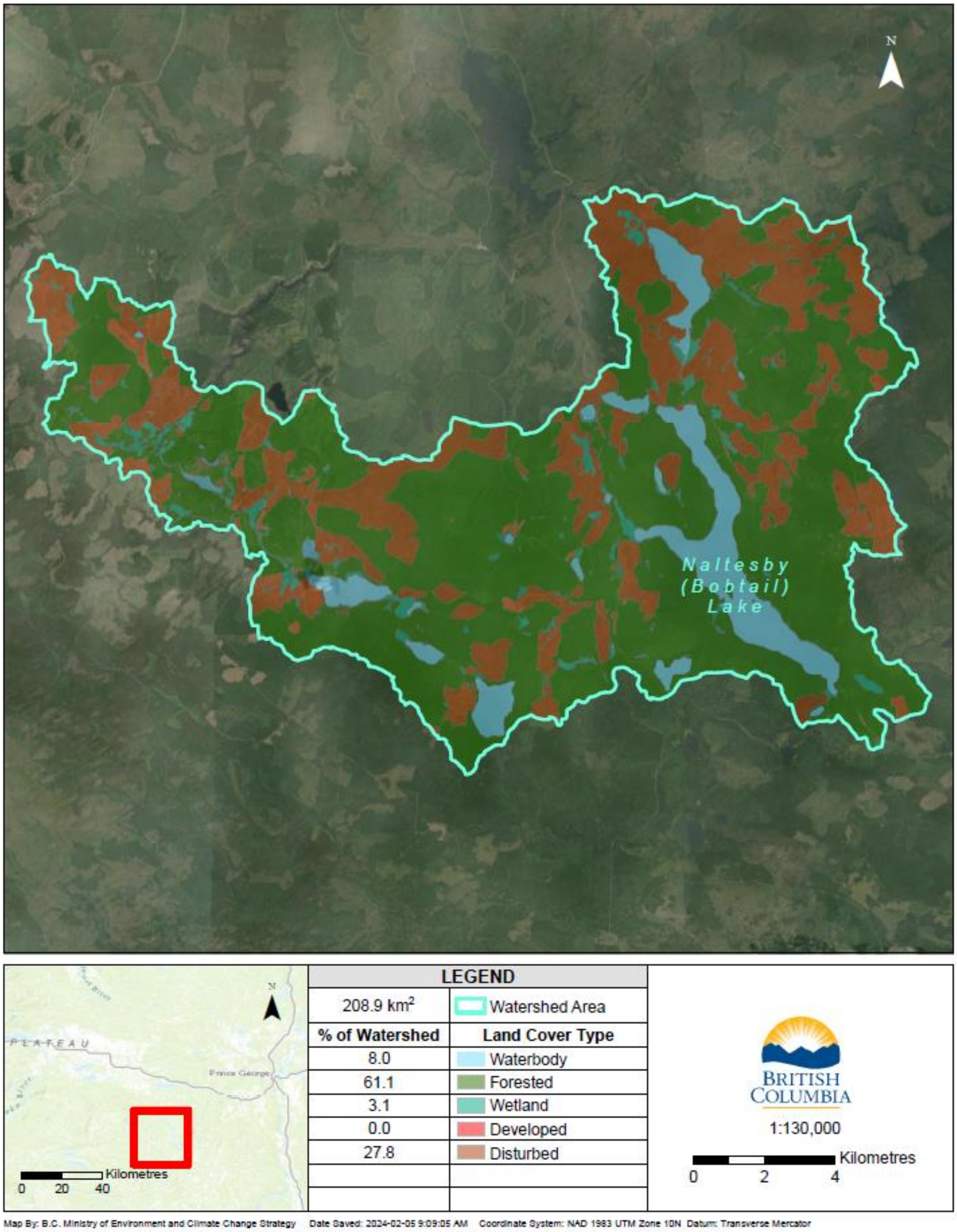


Figure 1. Map showing Naltesby Lake watershed and associated land uses.

Monitoring Approach

Naltesby Lake monitoring was conducted at a Level 3 BCLSMP study level during 2001 and 2002, and again in 2018 and 2019. A Level 3 BCLSMP study is typically conducted at the deepest location in the lake, and includes monitoring of dissolved oxygen, temperature, water clarity, algal productivity, and nutrient levels (e.g., phosphorus). Information on these parameters is collected at least twelve times during the open water season ideally for three years to characterize the natural variability between years that is typical of lake systems. Sampling across multiple years can help to identify issues such as summer oxygen depletion, internal nutrient loading, and times of high algal productivity.

Level 3 water quality information was collected from Naltesby Lake Deep Station, Environmental Monitoring Systems (EMS) ID: E206955, during all four sampling years (**Figure 2**). In total, 39 sampling events occurred with 9 sampling dates for 2001 between May and September and 10 sampling dates occurring in 2002 (Jun - Oct), 2018 (May - Oct) and 2019 (May - Oct). Water samples were collected for chemical analyses at three depths (1 m below surface, mid-depth, and 1 m above bottom) from this station during each sampling event.

Water samples were submitted to an accredited laboratory for analysis of phosphorus (at all three depths) and chlorophyll-*a* (shallow samples only). At each sampling event, full temperature and dissolved oxygen profiles were collected (i.e., data was collected at 1 m depth intervals throughout the water column). Secchi depth was also recorded as a measure of water clarity during all sampling visits.

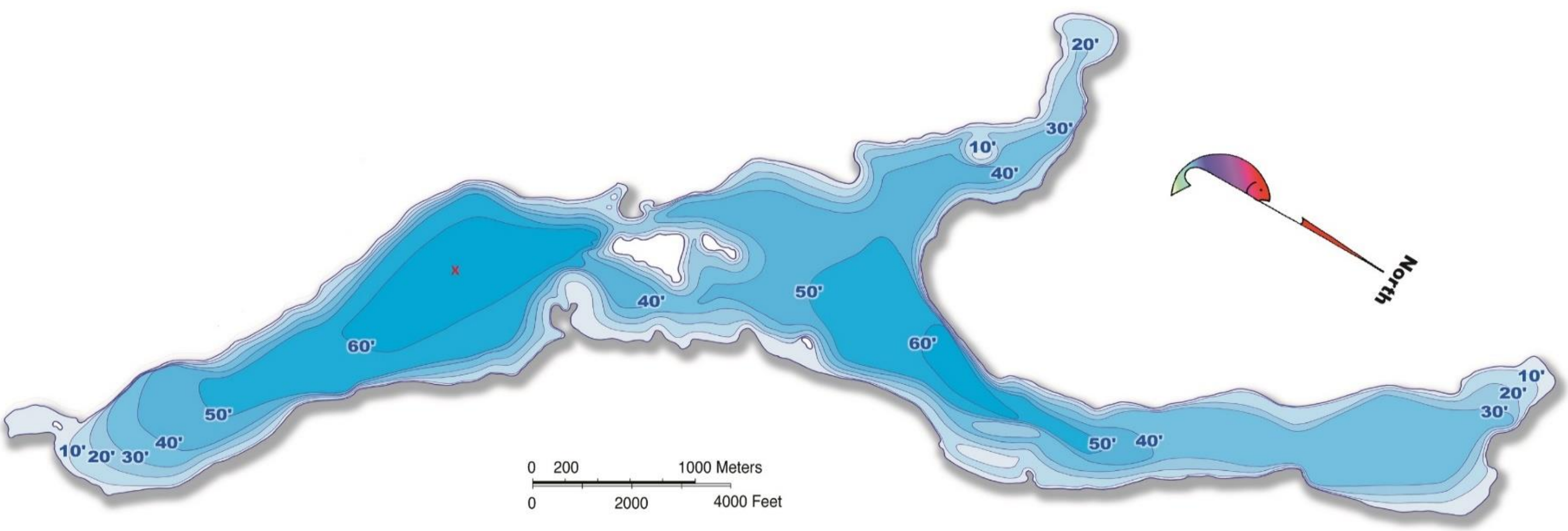
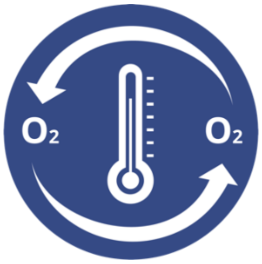


Figure 2. Bathymetric Map of Naltesby Lake, including deep station sampling location identified by the **red x** (AnglersAtlas.com, 2006).

Temperature and Dissolved Oxygen



Temperature and dissolved oxygen (DO) strongly influence physical, chemical, and biological processes in lakes. Annual temperature and oxygen patterns vary depending on local climate, lake shape, prevailing wind direction and lake depth (BCLSS, 2022). Water is most dense and therefore heaviest at 4°C and less dense (i.e., lighter) at both colder and warmer temperatures. During the summer, lakes more than 6 m deep usually experience a layering effect called stratification, with the warmer, less dense water (epilimnion) sitting on top of the cooler and heavier water (hypolimnion). Stratification keeps the bottom cool water isolated from top warmer water which also traps nutrients released from the bottom sediments in the bottom layer until the layers begin to mix in the fall. This mixing is also called lake overturn and can occur one to multiple times per year. During the mixing process, the bottom waters get recharged with oxygen, and nutrients are brought up to the surface.

Temperature and DO data collected at the Naltesby Lake Deep Station in 2001, 2002, 2018 and 2019 indicate stable summer stratification where distinct layers of warm and cold water formed in Naltesby Lake in all sampling years. Sampling in 2001 and 2019 captured the spring overturn conditions (values at all depths are the same) and samples in 2018 and 2019 captured the fall overturn (**Figure 3**). Surface temperatures peaked at 18°C in 2001 (Jul-Aug) and 2018 (Jun), 16°C in 2002 (Jul) and 17°C in 2019 (Jul-Aug).

The DO levels in Naltesby Lake were influenced by the seasonal temperature stratification in all sampling years (**Figure 3**). DO values in the spring of 2002 and 2018 indicate that either the lake stratified quite early or may not have experienced a spring mixing event. The highest DO (11 mg/L to 15 mg/L) concentrations were observed in the spring at the surface of the lake. During the sampling season DO concentrations in Naltesby Lake occasionally dropped to less than 4 mg/L at the mid depths and were consistently below 4mg/L at the bottom from Jun/Jul to Sept in all years.

During the height of summer, the low oxygen levels at the mid and bottom depths of the lake would force fish closer to the surface of the lake. However, since the lake did not exceed surface temperatures of 18°C in any year it is likely that Naltesby Lake still had sufficient suitable habitat for fish when the lake was stratified. Many fish species, especially salmonids, show signs of stress at temperatures greater than 18ºC and dissolved oxygen concentrations less than 4 mg/L (Truelson, 1997). These values are indicated by hashed lines in **Figure 3** below.

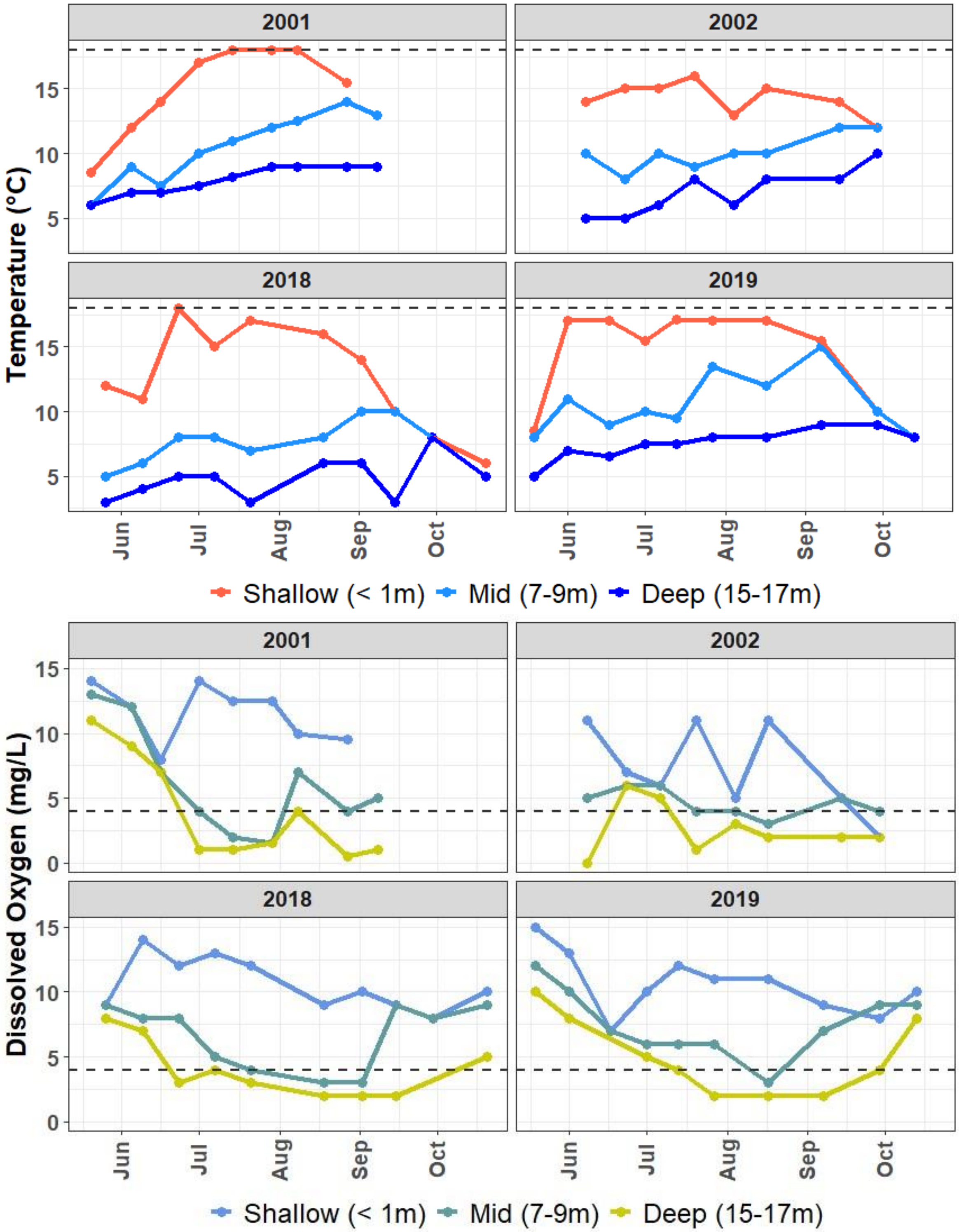


Figure 3: Temperature and DO results at the Naltesby Lake Deep Station in 2001, 2002, 2018 and 2019.

Water Clarity and Algal Biomass

Water clarity is an indicator of algae, suspended sediments, and other particles in the water. It is measured using a Secchi disc to see how far light can penetrate through the water column. Chlorophyll-*a* is a common pigment found in almost all plants. It captures light energy and drives the process of photosynthesis. In open water areas of lakes, it occurs in free-floating microscopic algae (phytoplankton), which are important parts of the lake food-web. Chlorophyll-*a* in lake water is an indicator of the algal biomass present in the water. In highly productive systems, algal biomass can become excessive, causing aesthetic concerns, and impacting water quality.

The average Secchi depth in Naltesby Lake for 2001-2002 was 1.4 m, and for 2018-2019 was 2.8 m. The deepest Secchi depth (i.e., clearest water) occurred in June of 2001 (2.5 m) and 2019 (5.0 m), and in Jul of 2002 (1.5 m), and 2018 (3.6 m). The shallowest values (i.e., poorest water clarity) values were during the spring in 2001 (1.0 m) and 2018 (1.5 m), and during the summer in 2002 (0.7 m) and 2019 (2.3 m).

Elevated concentrations of chlorophyll-*a* corresponded with shallower Secchi depth readings in all years, showing that poorer water clarity in Naltesby Lake was due in-part to increased algal biomass (**Figure 4**). The maximum values captured for chlorophyll-*a* were observed in September which is a common time for late summer algae blooms to occur because of the nutrients being brought to the surface waters of the lake with spring mixing. Chlorophyll-*a* values were significantly elevated in 2002 (max = 36.1 µg/L) compared to 2018 (max = 11.9 µg/L) and 2019 (max = 17.4 µg/L). This is likely due to high nutrient values in the lake in 2002, which are discussed in the next section.

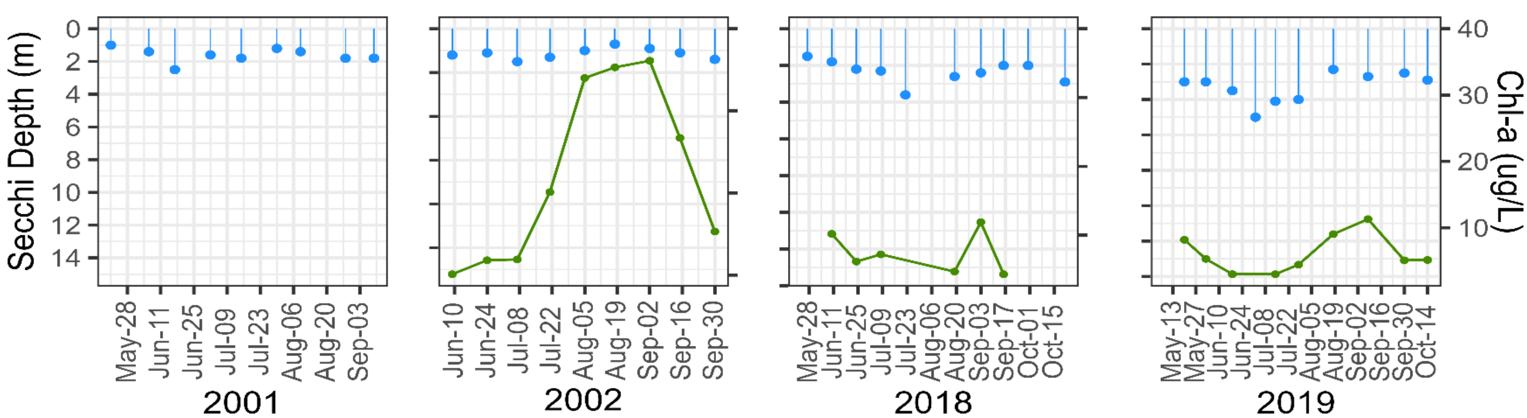
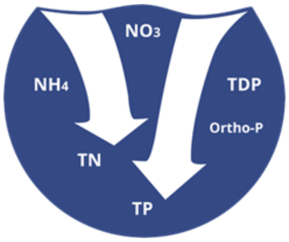


Figure 4. Secchi depth (blue lines with circles, scale on the left) and chlorophyll-*a* (green line, scale on the right) measured at the Naltesby Lake Deep Station in 2001, 2002, 2018 and 2019.

Phosphorus



Phosphorus is typically the limiting nutrient for most lakes in BC, meaning that phosphorus concentration strongly influences biological production in aquatic environments (BCLSS, 2022). Nitrogen is also an important nutrient in aquatic environments but is generally second to phosphorus as the most limiting nutrient. There are several forms of phosphorus present in lake water. Dissolved phosphorus in the form of ortho-phosphate (PO_4) is the most readily available form of phosphorus for algae and aquatic plants. Total phosphorus (TP), stored in sediments and organic matter, can be converted to PO_4 in low oxygen conditions. Total dissolved phosphorus (TDP) is another bioavailable form of phosphorus. Monitoring the different forms of phosphorus is helpful for understanding how much is, or could be, available for plant and algal growth. Phosphorus (TP, TDP, and Ortho-P) concentrations from the Naltesby Lake Deep Station collected at the three sampling depths are listed in **Table 2** and shown by year in **Figure 5**.

Table 2. Minimum, maximum, and average phosphorus results from samples collected in 2001-2002 and 2018-2019 in Naltesby Lake.

			Phosphorus					
			2001-2002			2018-2019		
Station	**Depth Sampled (m)**	**Summary Statistics**	**TP (µg/L)**	**TDP (µg/L)**	**OP (µg/L)**	**TP (µg/L)**	**TDP (µg/L)**	**OP (µg/L)**
Naltesby Lake @ Deep Station	Shallow (0-1 m below surface)	Min	18.5	4.5	≤ 1	11.7	6.5	≤ 1
		Max	71	11.5	4.5	31.1	21	7.5
		Average	30	7.3	3.2	20.6	9.3	2.5
	Mid (1-8 m below surface)	Min	23	3	≤ 1	9.3	4.6	2.5
		Max	50.5	20.5	12	31.8	26.1	13.9
		Average	32.8	8.7	4.5	20.2	11.8	4.9
	Deep (8-14 m)	Min	39.5	5	≤ 1	23.9	12.7	4.3
		Max	281	134	115	75.9	46.1	38.4
		Average	154.1	58.4	42.8	45.9	24.3	18.7

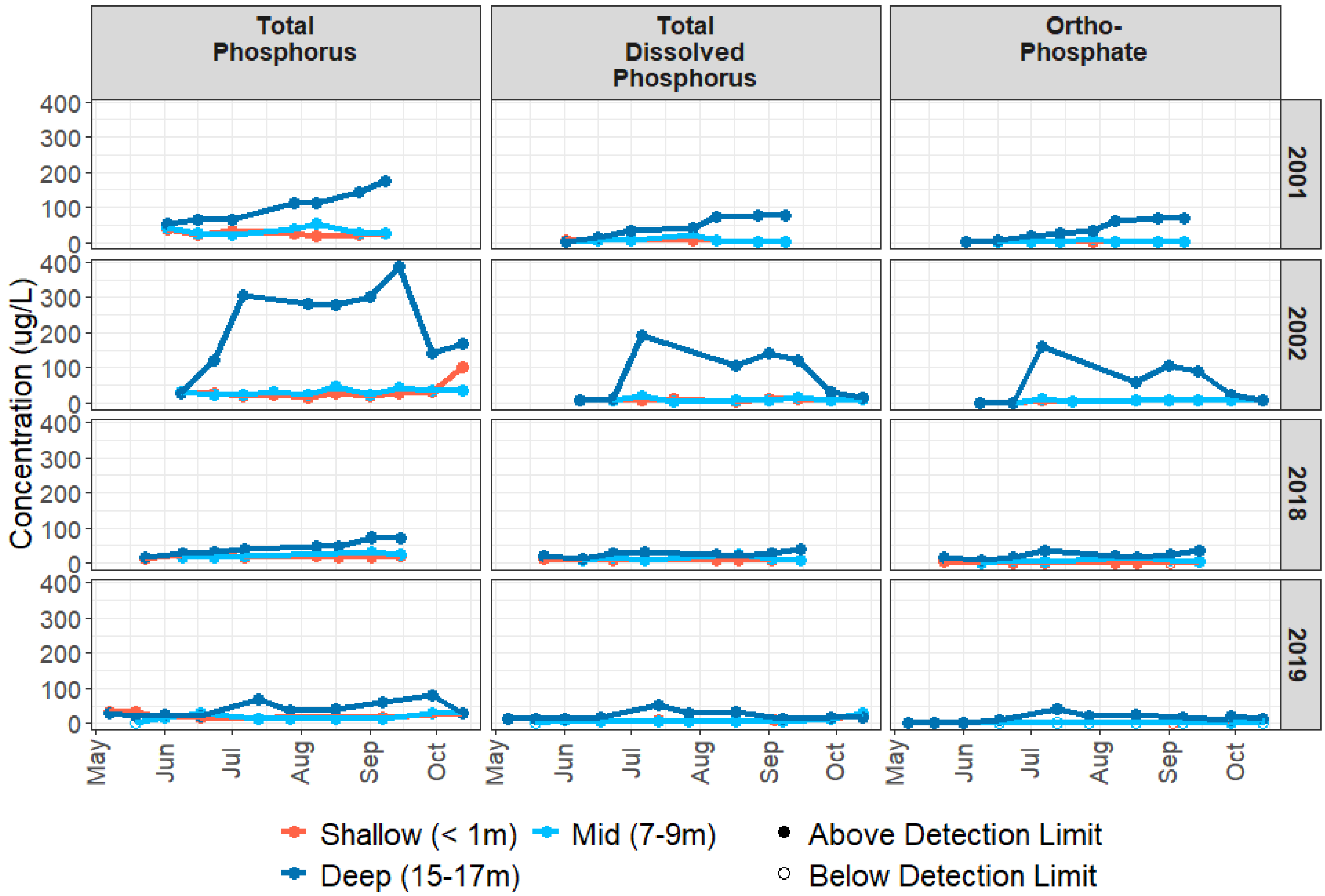


Figure 5. Naltesby Lake total phosphorus (TP), total dissolved phosphorus (TDP), ortho-phosphate (PO_4) results for 2001, 2002, 2018 and 2019.

Phosphorus values from the deepest depth were significantly elevated in 2002 (max TP = 389 µg/L) compared to other years (max TP = 174 µg/L in 2001, 74 µg/L in 2018 and 78 µg/L in 2019). **Figure 3** shows that the DO values in 2002 were somewhat unique compared with the other sampling years. In 2002 the lake experienced minimal spring mixing and therefore the bottom of the lake was depleted in oxygen through winter and spring and remained so for most of the sampling season. Low oxygen levels (i.e., hypoxic, 2-3 mg/L) can cause PO_4 to be released from the sediments, also called internal phosphorus loading. The longer the bottom of a lake is depleted in oxygen, the greater potential there is for increased internal nutrient loading. We can also see from **Figure 3** evidence from the fluctuations in temperature and oxygen that the lake may have experienced two partial mixing events during the summer. These brief partial mixing events would have brought some of these released nutrients to the surface and resulted in the high chlorophyll-*a* concentrations shown in **Figure 4**. While phosphorus in 2001 was also slightly elevated, the values in 2018 and 2019 are lower suggesting that phosphorus concentrations in Naltesby Lake may have been decreasing.

In May of 2015 a massive wildfire occurred near Naltesby Lake called the "Little Bobtail Lake Fire". This fire began on May 9th and burned over 25,000 ha of land at a severity which has impacted forest regrowth for many years (Murray, 2021). Wildfires can have significant impacts to lake ecosystems. Wildfire smoke can alter light penetration and affect water temperatures, as well as deposit ash, which is high in nutrients, into aquatic systems. As well, the loss of vegetation in the watershed can lead to increased overland flow and the additional deposition of nutrients into lakes and streams.

Trophic Status

Trophic status describes the level of biological productivity within a waterbody and is measured by using Secchi depth, chlorophyll-*a*, and total phosphorus concentrations (Nordin, 1985). Low productivity lakes are called *oligotrophic* and tend to have clear water and sufficient oxygen for aquatic life throughout the year. Lakes with moderate productivity are called *mesotrophic*. *Eutrophic* lakes have high productivity and often have high densities of aquatic plants and/or algae. Algal blooms may occur in these lakes frequently, reducing recreational opportunities and potentially impacting aquatic habitat.

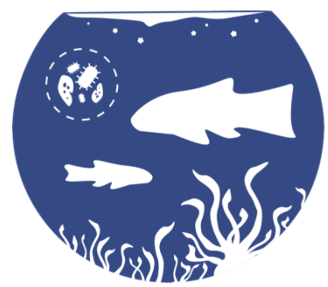


Table 3. Naltesby Lake trophic indicator results (as per Nordin, 1985).

Parameters	Trophic Categories			Naltesby Lake			
	Oligotrophic	Mesotrophic	Eutrophic	2021	2002	2018	2019
Secchi Depth (m)[1]	>6.0	3.0 - 6.0	<3.0	1.61	1.13	2.33	3.30
Chlorophyll-*a* (µg/L)[1]	0 - 2	2 – 7	>7	-	22.37	6.58	7.42
Total Phosphorus (µg/L)[1]	1 - 10	10 - 30	>30	61.4	89.3	30.9	26.8

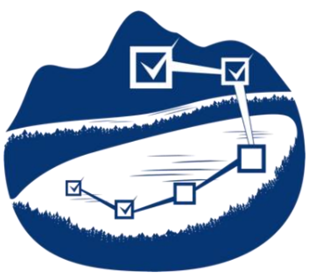
[1]Summer (May to October) average.

The results show that Naltesby Lake is a high productivity system depending based on the trophic indicators (**Table 3**). Chlorophyll-*a* data was not available for 2001, however available summer water clarity (i.e., Secchi depth), chlorophyll-*a* and total phosphorus concentrations from all years indicate the lake is eutrophic.

Summary

The key results of this study indicate that Naltesby Lake is stratified during the ice-off season. The moderate summer surface temperatures provide sufficient suitable fish habitat during the summer when oxygen levels are low in the bottom waters. Key parameters (i.e., chlorophyll-*a*, water clarity, and phosphorus concentration) suggest that Naltesby Lake is a highly productive system (eutrophic) that may be prone to experiencing more productive years under certain climatic conditions, such as heat waves and longer periods of high temperatures. Phosphorus data collected from Naltesby Lake suggests internal phosphorus loading occurs and therefore the lake gains phosphorus from the bottom sediments during times of low oxygen in the bottom waters.

Going Forward



There is strong evidence that climate change is exacerbating existing issues in lakes that are already experiencing problems. One climate change impact already observed in many northern hemisphere lakes is earlier onset and longer periods of stratification, which may make internal nutrient loading more problematic (Woolway et al., 2020). If there is volunteer interest and capacity, continued monitoring at a less intense BCLSMP study level (e.g., Level 1: regular temperature and Secchi depth measurements at Naltesby Lake Deep Station from spring to fall overturn) would be beneficial to help increase our understanding of variability in Naltesby Lake stratification and productivity. These data are important for long-term lake condition records and will provide early warning signs of deterioration in water quality. It is also recommended that monitoring include ice-on and off dates. A follow up Level 3 study can be conducted again in 5-10 years to track potential changes in lake water quality.

Lake Monitoring Resources and Education
See links under Monitoring Resources on: www.gov.bc.ca/lakestewardshipmonitoring, including tips to keep your lake healthy. BCLSS's LakeKeepers Manual, a guide to lake stewardship and ecology in British Columbia: https://www.bclss.org/programs#lake-keepers-manual Find lake monitoring resources, educational resources for youth, stewardship resources, funding information, stewardship community and more in the BCLSS library: https://www.bclss.org/document-library

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