Yukon

Canadian Lake Pulse Network

Yukon Lakes Summary

November 2023

Canadian Lake Pulse Network - Yukon Lake Summary

Government of Yukon
Water Resources Branch

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Summary

LakePulse is a scientific program supported by NSERC and managed by the University of Sherbrooke which aims to provide Canada's first national assessment of lake health. Between 2017 and 2019, 664 lakes across Canada were sampled once during the open water season to provide a national snapshot of lake health. This document provides a summary of the Lake Pulse Network, followed by a summary of results from all the Yukon Lakes that were sampled as part of the network.

Midnight Sunset at Little Salmon Lake

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Introduction

Canada has more lakes than any other country in the world. Despite their importance for drinking water, agriculture, recreation, tourism, aquatic habitat, and ecosystem function, there is a lack of systematic evaluation of the health of these lakes. Since lakes integrate and reflect landscape changes, with increased development and climate change, understanding lake health and impacts is increasingly important. The NSERC Canadian Lake Pulse Network was created to address this knowledge gap. The program's goals are to evaluate the health status of freshwater lakes across Canada, determine how they have changed over time, and identify how they may continue to change in future. LakePulse defines lake health as the extent to which ecosystem services can be delivered and the degree of deviation from pristine conditions. Between 2017 and 2019, LakePulse sampled 664 lakes across 12 Canadian ecozones (Figure 1). Each lake was sampled only once, during an open water season, for a variety of variables representing lake health. This document provides a summary of results and an indication of lake health for all of the lakes sampled in Yukon in 2019 as part of the LakePulse program.

Key Water Quality Metrics

Over 100 biological, physical, and chemical variables were collected or measured in each LakePulse lake, in addition to lake morphometry and land use characteristics (See Huot et al., 2019 for the full list of variables sampled). However, not all variables were available for all Yukon lakes at the time of writing this report (see Data Uncertainties section). Here we present the variables measured for each Yukon lake. We then grouped these variables to create several metrics representing overall lake health.

These metrics are: (1) Aquatic ecosystem health (described by water colour and transparency; chlorophyll a, nutrients and trophic status; and food chain health); (2) Contamination (including pharmaceutical products, pesticides, and fecal coliforms); (3) Temporal changes and (4) Physical water properties (temperature and oxygen). Reasoning for use of each metric and their relevance to lake health are outlined below.

Water colour and transparency

Dissolved organic Carbon

Organic carbon in the water comes mainly from the landscape. Runoff and rainwater that percolates into soils carry organic compounds from decomposing soils, leaves, and litter. This leaching of organic matter into lakes can cause lakes to have a yellow brown colour, and in this sense a lake can be compared to a cold brew of tea from the forests. Once in the lake, organic matter continues to decompose, facilitated by bacteria, eventually producing methane and carbon dioxide. Because of this, lakes naturally produce a considerable amount of greenhouse gases into the atmosphere. A lake with higher dissolved organic carbon concentrations will emit more greenhouse gasses to the atmosphere, in addition to having a darker colour that could limit photosynthesis. Lakes with low dissolved organic carbon are considered to be healthier than lakes with higher dissolved organic carbon.

LakePulse Mobile Field Lab

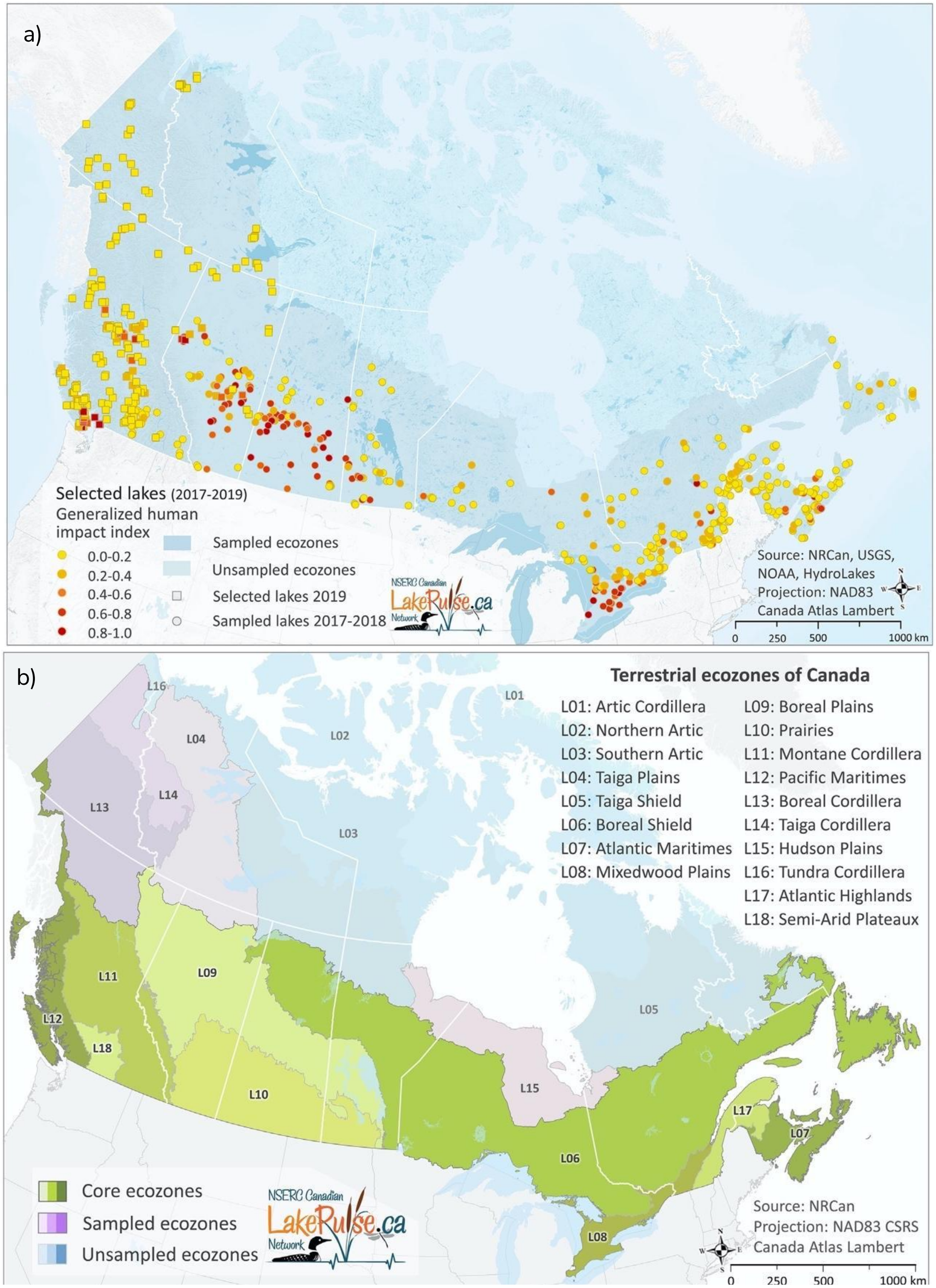


Figure 1. a) Lakes sampled across Canada as part of the NSERC Canadian Lake Pulse Network in 2017 and 2018, as well as 2019 pre-selected sites. 2019 final sampling locations may differ; see Figure 2 for map of sampled sites in Yukon. Lake selection methods are described in LakePulse Methods section. b) Selected Canadian ecozones for lake sampling. “Core ecozones” had more intense sampling, while “Sampled ecozones” had reduced sampling. Note that the sampling in ecozone L15 had to be cancelled due to logistical limitations.

Colour
Water colour is an index of light availability, or of how deep the light can penetrate into the water column. This has an important impact on aquatic life which depends on light, such as aquatic plants, algae and phytoplankton. Lake colour is influenced by many factors, including plant decomposition, metals, and industrial waste. The Canadian guideline for drinking water is <15 mg/L Pt (Pt stands for platinum, which is an element used to estimate water colour).

Transparency
Water transparency is defined as the degree of visibility in the water column and one way it can be measured is with a Secchi disk. The depth (from lake surface) at which the disk disappears/reappears when lowered/pulled back up through the water column (viewed from above) is used as an estimation of lake transparency. This is influenced by suspended sediments in the water, algae, minerals, metals, turbidity and dissolved organic carbon. The Secchi depth can vary from a few centimeters in hypereutrophic lakes to many meters in oligotrophic lakes (see Eutrophication and trophic status section for description of hypereutrophic and oligotrophic lakes).

LakePulse Field Team Sampling at Jackfish Lake

Chlorophyll *a*, nutrients and trophic status

Total phosphorus and nitrogen
Several natural phenomena (such as runoff and atmospheric deposition) supply lakes with both phosphorus and nitrogen, but it is often the contribution from human activities that causes excessive fertilization in lakes. Fertilizers consisting of phosphorus and nitrogen and used on agricultural or residential land enter lakes via erosion and water runoff. These nutrients can also come from detergents rejected by purification stations, or via septic sources.

While phosphorus is essential for all life forms, there is naturally very little of it in lakes. Therefore, as soon as it is added to a lake, it is quickly taken up and used by plants or phytoplankton. Nitrogen is also a critical nutrient for plant growth, but an excess of nitrogen can result in overgrowth of algae.

Chlorophyll *a*

Chlorophyll *a* is the most common pigment of photosynthetic organisms and is found in microscopic algae and phytoplankton. Chlorophyll *a* concentrations thus provide an estimate of algae abundance. Chlorophyll *a* concentration is also directly related to phosphorus concentration and can be used to evaluate lake trophic status.

According to the World Heath Organization guidelines, a chlorophyll *a* concentration of 10 μg/L poses an intermediate risk to human health, while 50 μg/L poses a high risk level to human health.

Eutrophication and trophic status

Eutrophication is defined by an excess of nutrients. Lakes naturally accumulate sediment over time, and eutrophication is a natural phenomenon of lake aging that normally occurs over tens of millions of years. However, human activities accelerate eutrophication via the excessive fertilization of lakes by additional inputs of nutrients, especially phosphorus.

A lake with low levels of phosphorus (<10 μg/L) is said to have an oligotrophic status, with little nutrient content. At intermediate levels of phosphorus (10-20 μg/L), lakes are defined as mesotrophic or meso-eutrophic (20-35 μg/L of phosphorus). Eutrophic, or even hyper-eutrophic lakes have high concentrations of phosphorus (>35 and >100 μg/L, respectively).

Eutrophication produces an increase in the abundance of algae, a decrease in the transparency of the water, and a decrease in oxygen in deep or bottom water layers. Fish that require oxygen-rich waters could be negatively impacted by lakes becoming eutrophic.

Food chain health

While fish are a main component of lake biodiversity, many other equally important but smaller organisms also live in lakes. In one cup of lake water, it is possible to find up to 100,000 plankton individuals, 1 billion bacteria and 10 billion viruses. Plankton community composition is an excellent indicator of water quality and thus of lake health.

Phytoplankton are found at the bottom of the aquatic food chain. Phytoplankton are food for zooplankton, which in turn serve as food for fish. Because of the close relationships between phytoplankton, zooplankton and fish, the loss of certain plankton species can have important consequences to overall ecosystem health. Ecosystems that are more resilient have greater plankton species diversity (i.e., richness). In the context of LakePulse, fish sampling was unrealistic, as each lake was only sampled over a single day. A report on Yukon's Lake Trout monitoring program (Fish and Wildlife Branch, Sinclair et al. 2021) and other fisheries information are available on Yukon.ca.

Phytoplankton

Phytoplankton are microscopic algae in suspension in the water column. They are capable of photosynthesis, which means they can use sunlight to produce chemical energy. In freshwater lakes, their growth will be mainly limited by light and nutrient (phosphorus and nitrogen) availability. Because phytoplankton abundance and diversity respond to its environment, it can be used as an indicator of water quality and lake health.

Cyanobacteria and toxicity potential

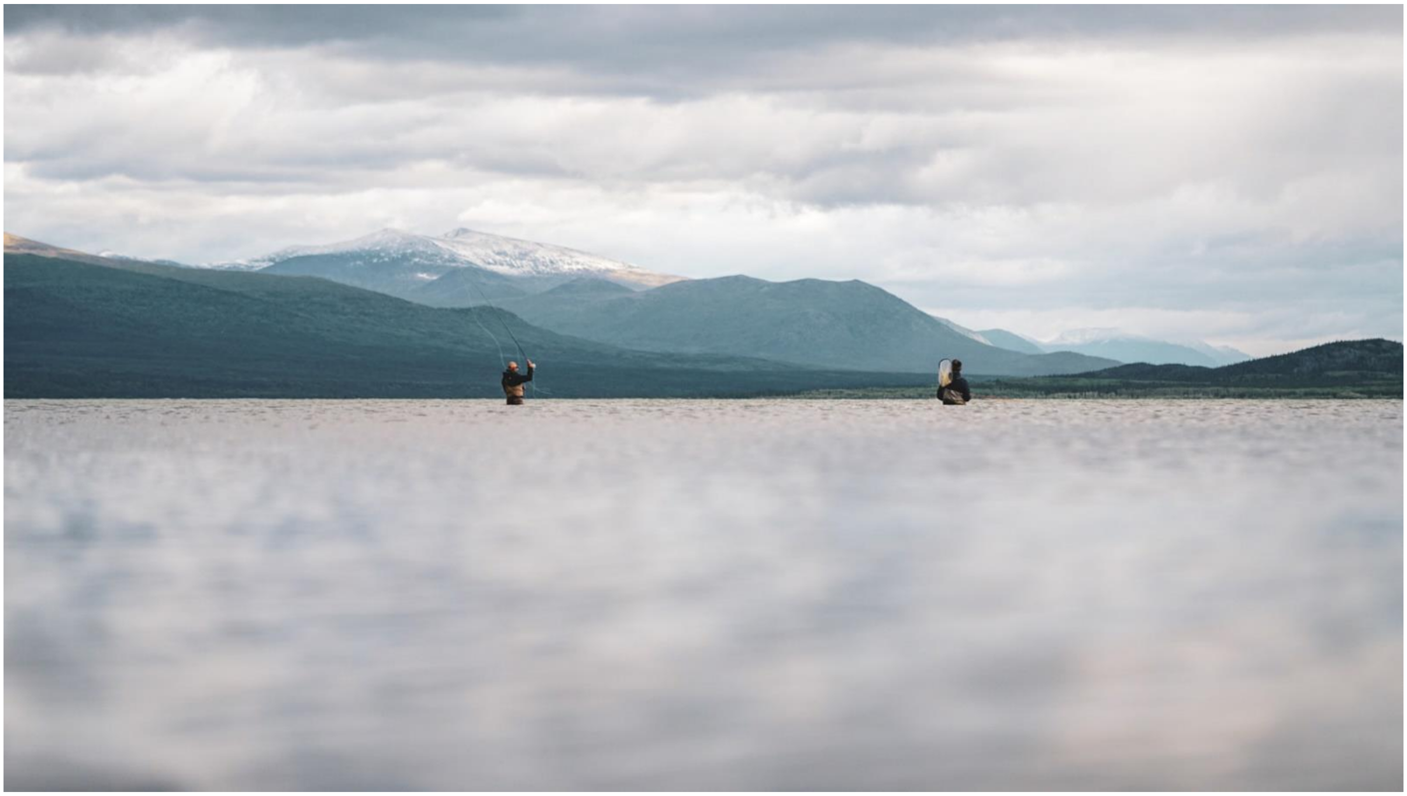
Cyanobacteria (commonly called blue-green algae) are bacteria that have the capacity to photosynthesize. They also have the ability to fix dissolved nitrogen from the atmosphere. Cyanobacteria are naturally found in lakes.

There are more than 3500 species of cyanobacteria, but their abundance is usually controlled by the presence of other species. When phosphorus levels increase, cyanobacteria are very competitive and can dominate the phytoplankton community. Some cyanobacteria species also produce toxins. When these species proliferate to the point of accumulating on the surface of the water, they form what is called a bloom. Eventually, the concentration of toxins in blooms can become high enough to render the water unsuitable for drinking or swimming.

According to the World Heath Organizations guidelines, water with <20,000 cyanobacteria cells/mL has low risk of cyanotoxin exposure, while >1,000,000 cyanobacteria cells/mL has a high exposure risk.

Zooplankton

Zooplankton make up the primary consumer planktonic group that feeds on the main primary producers (phytoplankton and bacteria) in pelagic lake food webs. As primary consumers, zooplankton are the food supply for macroinvertebrate and fish predators, and thus a critical trophic link in the upward transfer of energy. Changes in zooplankton communities can be critical to whole lake ecosystem functioning given their central food web position. Zooplankton are also sensitive to anthropogenic impacts and can be good indicators of water quality. Because the diet of small fish is often mainly composed of zooplankton, zooplankton health is directly associated with fish health.



Recreational fishing at Dezadeash Lake

Contaminants

A substance that can have a harmful impact on an ecosystem is considered a contaminant. Contaminants end up in lakes if they are not properly disposed of by water treatment stations or septic tanks, and can have a significant impact on lakes, even at minimal concentrations.

Even lakes that are very far from human activities can have significant concentrations of contaminants, since some of them can travel as airborne particles before being deposited. Contaminants can also have synergistic effects on each other, even if their individual concentrations are low.

Pesticides

In agricultural areas, traces of pesticides are often found in lakes. Even trace amounts of pesticides can impact the flora and fauna of lakes. The presence and amount of pesticides in a lake can be estimated using land use data for a watershed, since the amount of agricultural activities in the watershed is highly correlated to pesticides found in lakes.

Chemicals and emerging contaminants

Detecting traces of chemical and emerging contaminants in lakes is critical, since these contaminants can disturb the hormonal balance in both humans and animals. In the context of LakePulse, we measured caffeine (found in products such as coffee and tea), DEET (often a primary ingredient in insect repellants), UV filters (found in sunscreen), sucralose (a common artificial sweetener), and several classes of ubiquitous pharmaceuticals (antibiotics, painkillers, antihypertensives, antidepressants, antihistamines, synthetic hormones, etc.). We tested for trace organic contaminants, defined as synthetic or natural chemicals that can be found at very low concentrations in the environment where they are not anticipated to be (e.g., industrial additives such as synthetic oil and antioxidants). We also searched for emerging contaminants, defined as pollutants for which there is recent concern, including some personal care products, pharmaceuticals, and industrial chemicals like flame-retardants.

Fecal coliforms

Fecal coliforms (including *E. coli*) are bacteria that are found in feces. Contamination from fecal bacteria (i.e. thermotolerant) usually occurs when sewage treatment plants or septic tanks are inadequate and cannot eliminate these microorganisms. Contamination can also occur from animal feces via runoff. *E. coli* is known to be harmful to human health and is therefore included as an indicator of lake health.

Land use

Because lakes receive and accumulate inputs from their watershed and because different types of land use impact aquatic nutrients and contamination, land use has a direct correlation and significant impact on overall lake health. Different types of land use will have different influences on lake water quality. For example, lakes found in watersheds dominated by natural landscapes will likely have little contamination from fertilizers or pesticides. In contrast, lakes found in agriculturally dominated watersheds are more likely to have higher rates of contamination from fertilizers and pesticides.

Temporal changes

Over time, anything both in suspension or living in a lake's water column will settle to the bottom of the lake and accumulate as sediment. Organisms (such as cladoceran zooplankton and diatom phytoplankton), metals and chlorophyll a can all be found in lake sediments. Sediment cores are often compared to time capsules, allowing for investigation into the history of lakes and their catchments by providing information on historical climate, trophic changes and water quality. If sediment layers accumulate slowly and sediment cores are long enough, they can be used to examine changes over a long temporal scale. Because of the historical data they provide, sediment cores offer complimentary information to the LakePulse single day sampling data. Core samples were collected in all of the sampled lakes, but not all of these cores were dated and analyzed due to fiscal limitations as well as core quality and age.

Sediment Core from 14-584 – Tombstone Territorial Park

Changes in diatom assemblage over time

Diatoms are microscopic algae, which are found in all lakes. They have a cell wall composed of silica (called the frustule) which is preserved in lake sediments after they die. Sediment cores can be sectioned and examined under a microscope to identify diatom species, which can be used as indicators of environmental change. For instance, changes in the diatom assemblage over time (otherwise known as diatom temporal dissimilarity) can be related to changes in water temperature, trophic shifts, or climate change. We quantified diatom changes over time using a dissimilarity scale from 0 to 1, where 0 represented no change in species composition between top and bottom of the sediment core, and 1 represented a complete change in diatom assemblage between the top (present day conditions) and bottom (past conditions) of the core. A lake with a low diatom dissimilarity likely remained relatively stable through time, while a lake with a high diatom dissimilarity suggests important changes in the lake and its catchment over time. Given the time-consuming nature of diatom identification, temporal change was only investigated in 9 of the sampled Yukon lakes.

Physical properties of water

Temperature

During the open-water season, deeper lakes often stratify, meaning their surface waters warm and sit above colder, denser, thermally-stable waters deeper in the water column. The warmer surface waters and deeper colder waters are connected via a thermocline, defined as the gradient between surface waters and deeper waters. Lake temperature is primarily influenced by climate, but other factors are important including lake size, depth, morphometry, inflow sources, ice phenology, lake colour, etc. Water temperature directly affects aquatic life including fish. It also controls phytoplankton growth, nutrient releases, and dissolved gas concentrations.

Dissolved oxygen

There is a natural equilibrium between oxygen levels in the atmosphere and oxygen levels in a lake. Like humans, fish and other organisms need oxygen to breathe. Oxygen enters lakes by (1) wind and water mixing, and (2) photosynthesis from aquatic plants and phytoplankton. Because these two mechanisms are more important at lake surface during the open water season, oxygen is typically found in greater concentrations at lake surface in summer. Due to summer-stratification and consumption of oxygen by organisms in the water column, deeper water layers become less and less oxygenated, or can become depleted of oxygen at the end of the open-water season. With lake eutrophication, dissolved oxygen levels decrease due to the accumulation of dead organic material. The water becomes turbid, and organic matter and sediments accumulate at the bottom of the lake. In contrast, high concentrations of oxygen at the bottom of lakes are an indication of non-eutrophic waters and are associated with healthy fish habitat. Dissolved oxygen concentration in the water can be measured either in mg/L or as a percentage. Percentage values can exceed 100% since water can be supersaturated in oxygen. Healthy lakes generally have between 80-120% of dissolved oxygen.

Collecting Littoral Sample from Gravel Lake (Pond)

Lake Pulse Methods

Lake selection

Lakes sampled as part of the Lake Pulse Network were chosen randomly and required the following criteria: lake size (three size classes: 0.1-1km^2, 1-10km^2, 10-100km^2) and human impact (three classes of human influence in the watershed: low, moderate, high). An equal number of lakes within 1km of road access were randomly selected in each of these categories and in each of the different ecozones (Figure 1). See Huot et al. 2019 for the full description on how lakes were selected. A total of 664 lakes were sampled across Canada, among which 24 were in Yukon (Figure 2). Sampled lakes in Yukon were either part of the Boreal cordillera, or the Taiga cordillera ecozones.

Water quality measurements

Water samples

Surface water samples were collected at the deepest point of each lake with an integrated PVC tube sampler, (the sample included water from the surface to twice the Secchi depth, up to a maximum of 2m depth) and analyzed for nutrients, contaminants, extracted chlorophyll a, dissolved organic carbon, water colour, and phytoplankton. Integrated water column zooplankton samples were collected at the same site using a 100μm mesh Wisconsin net hauled vertically from 1m above sediments up to lake surface.

For additional details on zooplankton sampling and identification, see Paquette et al. (2021) and for phytoplankton sampling, see Mackeigan et al. (2022).

Depth profiles

Physico-chemical measurements including temperature and dissolved oxygen were performed on site using an RBR maestro multi-logger (field protocols described in NSERC Canadian Lake Pulse Network 2021).

Lake depth (also referred to as maximum depth or sampling depth throughout LakePulse) was measured with a depth finder at the sampling location. The average lake depth was estimated from the HydroLakes database (https://www.hydrosheds.org/page/hydrolakes). Occasionally, the estimated average depth could be more than the measured maximal depth if sedimentation rates were very high or if sampling did not occur at the lake's deepest point.

The depth of the thermocline was defined in this study as the specific depth with the greatest density gradient. This depth was identified using rLakeAnalyzer for each lake.

Sediment cores

Sediment cores were collected at each lake with a gravity-type sediment corer. Samples were collected using a vertical extruder. A "top-bottom" approach was used in this study, which means only the uppermost surface layer and bottom layer of the core were analyzed. The top sediment layer was defined as the first centimeter of the surface of the sediment core, which integrates the last few years of sediment deposition. The bottom layer was defined as the centimeter between 3 and 4 centimeters from the base of the core (i.e., for a core of 22 cm long, the bottom sample would represent the 18-19 cm layer). This approach allowed us to characterize the historical state of lakes and to identify how diatom community composition have changed over time. For additional detail on diatom preparation and sediment core collection, see Griffiths et al. (2021). Sediment cores were also analyzed for cladoceran zooplankton, chironomids, metals, chlorophyll *a* and mercury concentration, among others (see Huot et al. 2019 for full list), although this data is not presented in this report.

While lake cores were collected at each lake, they were not necessarily all analyzed nor presented in this report due to fiscal and logistical reasons including the quality and length of cores.

Watershed characterization

The Lake Pulse Network watersheds were delineated using flow direction, which was calculated with the Canadian Digital Elevation Model. Arc Hydro extension was used to delineate each individual (immediate) lake watershed. Immediate lake watersheds were delineated by the total surface area flowing into a lake.

Land use estimation

To assess localized human impact, 7 classes of land use were examined in each lake watershed: urban (including buildings, roads, pitch, golf courses and commercial/industrial areas, among others), mines and wells, agriculture, pasture, forest losses over the five years prior to the sampling (2014-2019; excluding losses attributed to forest fires), grassland, and natural landscape. Land use rasters were created using a combination of open data: Canvec Manmade Features. Canvec Resources Management Features, Agriculture and Agri-Food Canada Annual Crop Inventory and Land Use 2010, Canadian Forest Service Earth Observation for Sustainable Development of Forests (EOSD), Global Forest Watch Forest Loss, Natural Resources Canada National Burned Area Composite, USDA Crop Data Layer, and North American Land Change Monitoring System Land Cover.

LakePulse Team Sampling Preparation

Yukon Lakes Results Overview

The results of the LakePulse Yukon lakes are appended to this report in alphabetical order of lake name and by watershed (Figure 2). These results provide a status overview of the water quality within each lake, including; lake trophic status, food chain information, land use, temperature and dissolved oxygen profiles as well as lake contamination and temporal change.

Spatial patterns across Yukon lakes

A map of the 24 lakes sampled in Yukon is presented in Figure 2 and spatial patterns of nutrients, phytoplankton, zooplankton and chlorophyll a are presented in Figure 3. Gravel Lake (Pond) was excluded from spatial pattern analysis and comparison to other Yukon lakes (see next section for explanation). Across all lakes (excluding Gravel Lake (Pond), nutrients (nitrogen and phosphorus) were the highest in lake 13-587 (unnamed small lake next to Marsh Lake). Phytoplankton and zooplankton diversity, as well as chlorophyll a did not display any discernible spatial patterns. Each individual lake was compared with the mean of all Yukon lakes (excluding Gravel Lake (Pond)) for each of these variables, and are presented as radar plots (Figure 2 of each individual lake report). The minimum, maximum and mean of key variables included in the report are summarized in Table 1. Note that the minimum, maximum and mean temperature and oxygen values were not included because of the spatial and temporal disparity in these variables within a lake as well as throughout the depth of the water column (see individual profiles in Figure 4 of the lake reports).

LakePulse Team Sampling at Gravel Lake

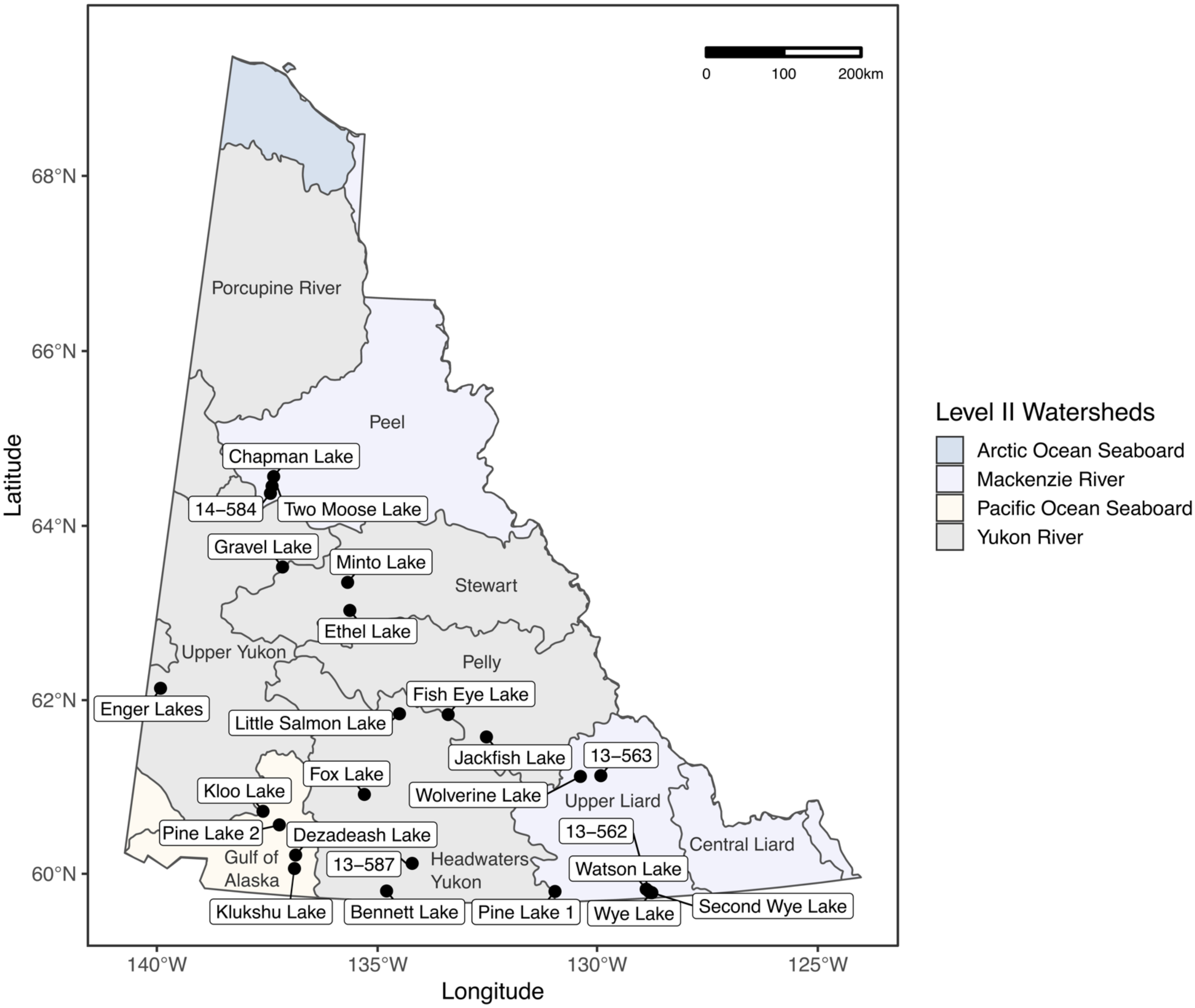


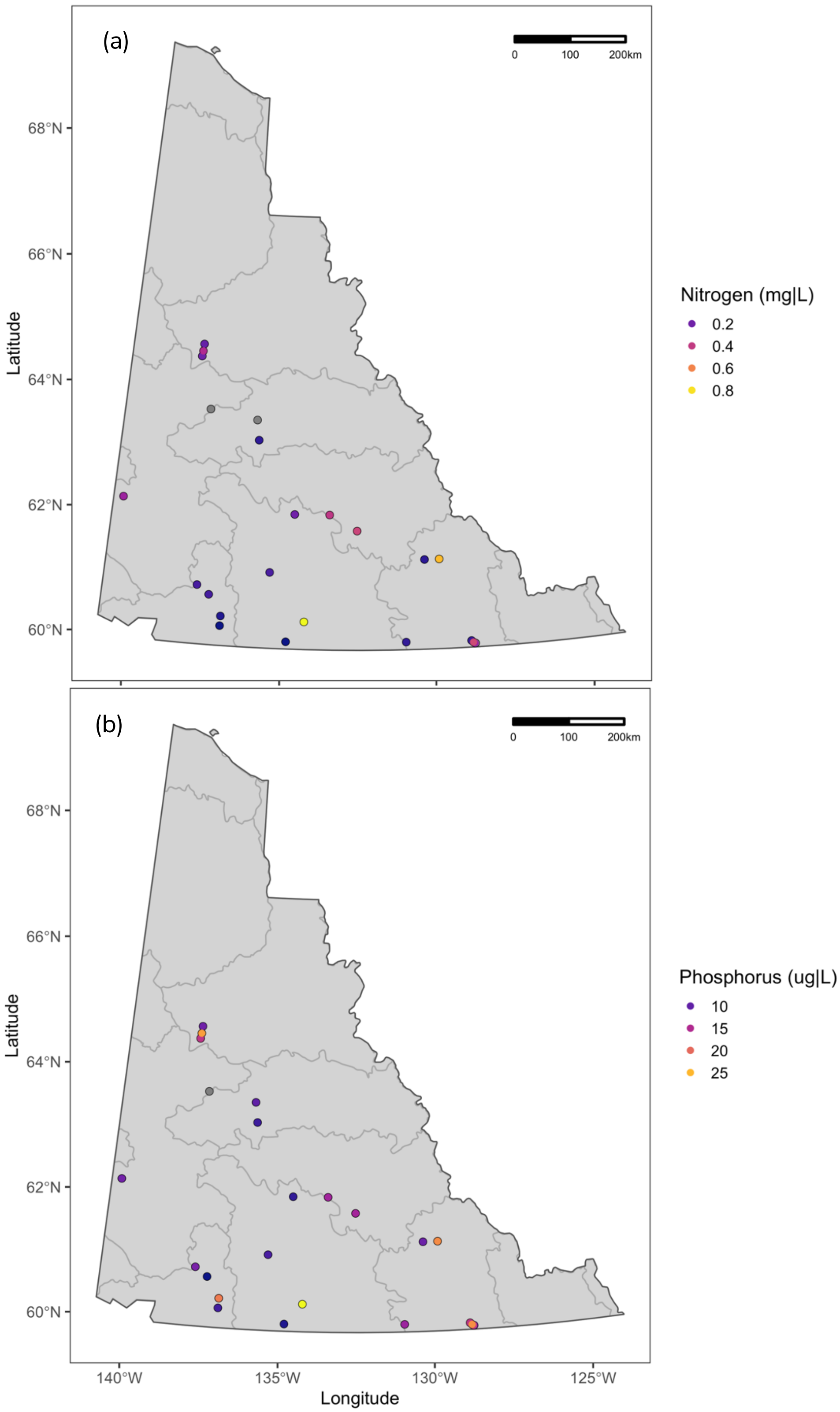
Figure 2. Map of lakes sampled by the NSERC Canadian Lake Pulse Network in the Yukon Territory. Lakes are contoured by the differently coloured level II major watersheds. Minor level IV watersheds are indicated and delineated on the map. Lake names appear in the white boxes. The map was created using Canada Atlas Lambert projection (NAD83 CSRS).

Gravel Lake (Pond)

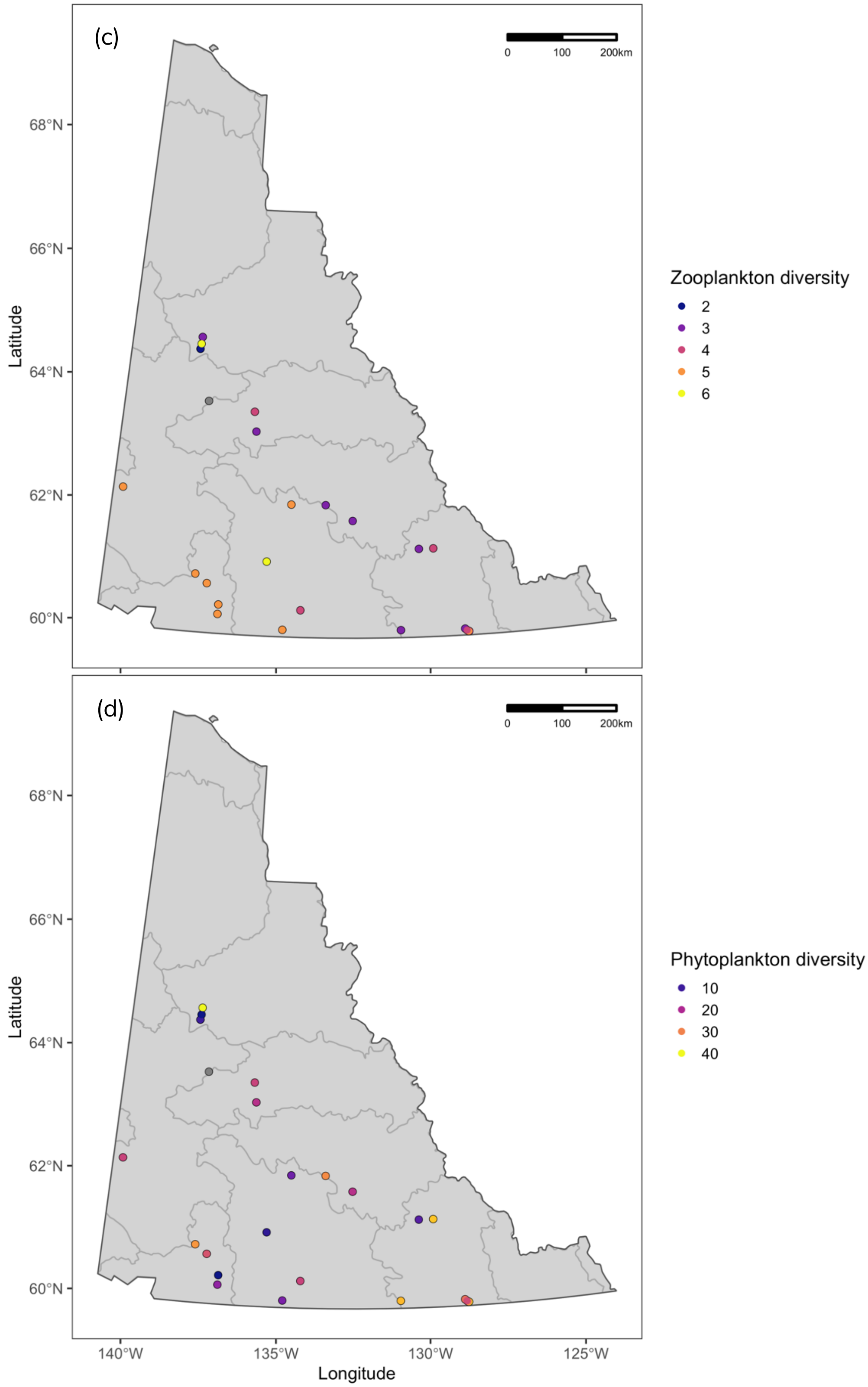
Extremely high values for total nitrogen and phosphorus, chlorophyll a, phytoplankton diversity, cyanobacteria density, water colour and dissolved organic carbon were detected at Gravel Lake (Pond), as well as minimal values for zooplankton diversity. According to these water quality indicators, our results indicate that this lake is the unhealthiest of all 24 lakes sampled across Yukon. However, this lake is very shallow (<1m deep) and small (<1km^2), barely meeting the requirements for lake selection and better defined as a pond than a lake in comparison with most lakes sampled in the Yukon. Small and shallow bodies of water can have higher concentrations of nutrients or contaminants since there is a small dilution effect and often no thermal stratification, which allows the water to better mix. Gravel Lake (Pond) is also located directly next to the north Klondike Highway with potential leaching from a nearby gravel pit and road construction runoff. The poor water quality observed in Gravel Lake (Pond) could be a result of human activities (road construction, outhouses along shoreline, private residence nearby) or its morphology. Because Gravel Lake values were so different from the rest of the sampled Yukon lakes, minor and interesting spatial differences between all sampled lakes were masked in spatial analyses. Gravel Lake (Pond) values were therefore removed from mean calculations in Table 1, in the Figure 3 heat maps, and from the radar plots of the individual lake reports.

Table 1. Minimum, maximum and mean of key variables included in the report. Lake names associated with minimum and maximum values are shown in parenthesis. Note that values exclude data points where the variable was not measured or discarded because of bad data quality

Variable	Min	Max	Mean (n=23)
Total nitrogen (mg/L)	0.03 (Bennett Lake)	0.84 (Lake 13-587)	0.31
Total phosphorus (µg/L)	6.07 (Pine Lake 2)	28.5 (Lake 13-587)	23.27
Zooplankton diversity (number of species)	2 (14-584)	6 (Fox Lake; Two Moose Lake)	4
Phytoplankton diversity (number of species)	7 (Dezadeash Lake; Two Moose Lake)	40 (Chapman Lake)	23
Chlorophyll a (µg/L)	0.42 (Bennett Lake)	10.02 (Lake 13-563)	9.81
Water transparency (meters)	0.95 (Lake 13-563)	14.54 (Fox Lake)	5.58
Cyanobacteria (cells/ml)	0 (Klukshu Lake)	1,595,335 (Lake 13-587)	345,074
Water colour (mg/L Pt)	0.45 (Bennett Lake)	46.63 (Two Moose Lake)	11.03
Dissolved organic carbon (mg/L)	0.62 (Bennett Lake)	19.71 (Lake 13-587)	10.97



(a)
0
100
200km
68°N
66°N
64°N
62°N
60°N
Latitude
Nitrogen (mg|L)
0.2
0.4
0.6
0.8
(b)
0
100
200km
68°N
66°N
64°N
62°N
60°N
Latitude
Phosphorus (ug|L)
10
15
20
25
140°W
135°W
130°W
125°W
Longitude


(c)
0
100
200km
68°N
66°N
64°N
62°N
60°N
Latitude
Zooplankton diversity
2
3
4
5
6
(d)
0
100
200km
68°N
66°N
64°N
62°N
60°N
Latitude
Phytoplankton diversity
10
20
30
40
140°W
135°W
130°W
125°W
Longitude

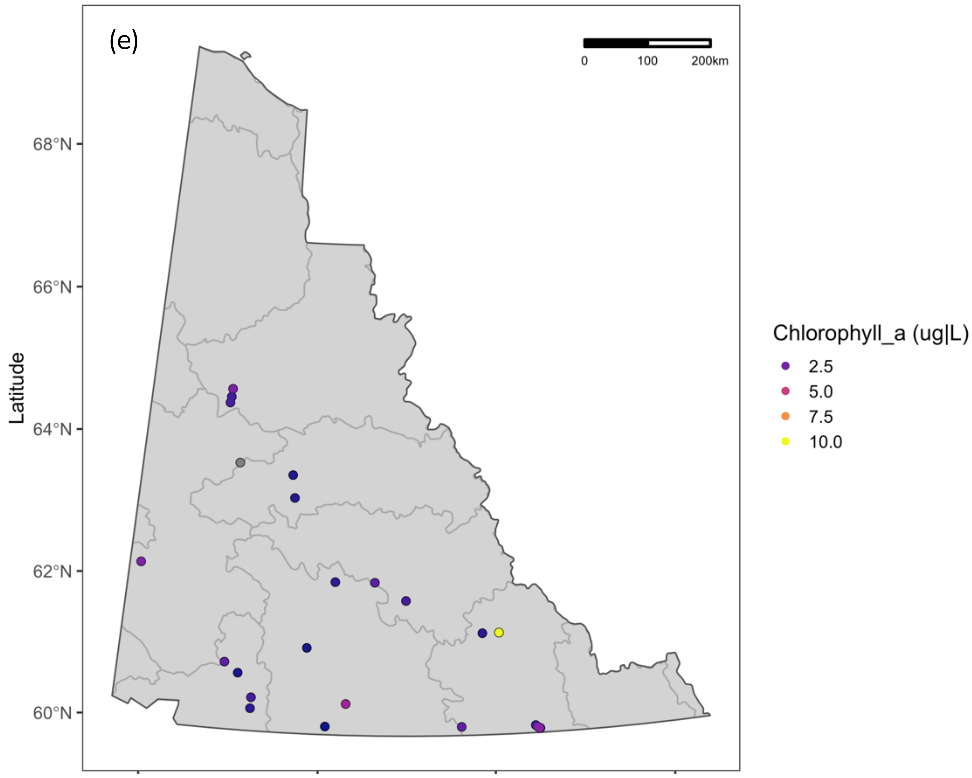


Figure 3. Heat map of total nitrogen (a), total nitrogen (b) total phosphorus (c), zooplankton richness (d), phytoplankton richness, and chlorophyll a (e) by Yukon watersheds. Larger values have a yellow colour, while smaller values have a purple colour. Note that Gravel Lake (Pond), as well as lakes where a variable was not measured or was discarded because of bad data quality, are displayed as grey.

Report limitations

The results in this report should be interpreted with caution since they represent data collected during a single sampling event. This means that all water quality variables were measured only once (on one day) during the summer of 2019, and at a single location, for each lake (with the exception of bacteria which were also sampled from a littoral site). As such, these data do not represent the temporal (seasonal) and spatial variability of conditions within lakes.

Many additional variables were measured in each lake, but were not included in this report since our goal was to provide an overview of lake health. These additional variables include mercury, conductivity, pH, dissolved gasses, isotopic composition, bacterioplankton, soluble reactive phosphorus, nitrous oxides, ammonia, cations, anions, particulate organic matter and microbial DNA (see Huot et al., 2019 for full variable list).

While invasive or exotic species (including plants, molluscs, fish, zooplankton and microorganism) are of concern because they can disrupt trophic interactions between species and replace other vulnerable species, they were not examined as part of LakePulse.

It should also be noted that climate change is another important threat to lake health. For example, shorter winters and therefore shorter periods of ice-on are anticipated to cause shifts in the thermal properties of lakes with a wide range of ecological consequences. Comprehensive lake monitoring (spatial and temporal) is critical to assess the impact of climate change on lake health.

Intent of the report

This report introduces the LakePulse project and provides an overview of lake health for all lakes sampled in Yukon as part of the network. The results have been formatted to enable ease of access to individual lake data in addition to the mean of all sampled lakes.

Data accessibility

The LakePulse database (https://lakepulse.ca/national- lake-pulse-database/) contains data collected over three summers (2017–2018-2019) in 664 lakes across Canada and is anticipated to be publicly available by 2023. If you wish to be contacted when data is made available, please email Catherine Brown (LakePulse Network Manager) at Catherine.A.Brown@USherbrooke.ca.

A web portal to communicate and share LakePulse results with the public is also under construction.

Additional information

For further information regarding the NSERC Canadian Lake Pulse Network, please visit the LakePulse website www.lakepulse.ca

For further information regarding Yukon lake health, please contact the Water Resources Branch by email at waterresources@yukon.ca

For further information regarding the data presented in this report, please email the author, Cindy Paquette at paquette.cindy@courrier.uqam.ca.

Glossary

Bloom: Phytoplankton can agglutinate at the surface of the water and form what we call a bloom, which generally colours at the surface of the water, and can change the water quality of the lake.

Carbon: Lakes receive organic carbon from their watershed. This carbon contributes to lake colour and produces methane or carbon dioxide (CO_2) when decomposed by bacteria.

Chlorophyll a: Photosynthetic pigment shared by all phytoplankton groups. It is used as an estimate for phytoplankton density.

Contaminant: A pollutant or organism that will reduce the water quality.

Cyanobacteria: Bacteria that have the capacity to photosynthesize.

***E. coli*:** Strain of fecal coliform that can case human illness.

Eutrophication: A natural phenomenon of lake aging characterized by the accumulation of nutrients. It is strongly aggravated by human activities.

Fecal coliform: Bacteria naturally found in animal intestines that can reach lakes due to inadequate sewage systems or septic tanks. Ingestion of contaminated water can cause sickness in humans.

Lake health: In this report, lake health is defined as the extent to which ecosystem services can be delivered and the degree of deviation from pristine conditions, using a selection of defined parameters.

Nitrogen: Nutrient essential for plant growth. When found in excess in some lakes, it can cause phytoplankton blooms and accelerate eutrophication.

Nutrients: Chemical elements essential for plants, algae and phytoplankton growth. In lakes, phosphorus and nitrogen are the nutrients limiting the growth of these organisms.

Phosphorus: Nutrient essential for plant growth. When added in lakes, very small quantities can fertilize the ecosystem, cause blooms, and accelerate eutrophication.

Phytoplankton: Microscopic algae in suspension in the water column capable of using sunlight to produce energy.

Thermocline: The water strata that divides the warm water at the surface of a lake (known as the **Epilimnion**) from the cold and dense water at the bottom of a lake (known as the **Hypolimnon**).

Trophic status: Determined by the amount of nutrients (especially phosphorus) in a lake. A lake with low nutrient concentration is considered **oligotrophic**, a lake with moderate concentration is considered **mesotrophic**, and a lake with high concentration is considered **eutrophic**.

Watershed: A watershed is the entire area that drains into a water body. The watershed of a lake is all the upstream part, where when a drop of rain falls on the surrounding land, it will eventually find its way to the lake if it is not evaporated. Many watershed levels can be considered (immediate, minor, major or continental). Immediate watersheds were delineating by measuring the total surface area that flows into a lake.

Zooplankton: Primary consumers in aquatic food webs, they feed on phytoplankton and bacteria and provide food for fish.

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Alsek River Watershed

Dezadeash and Tatshenshini

Alsek River Watershed - Lakes

- Titl’àt Mā̈n (Dezadeash Lake)
- Kloo Lake
- Łu Gha Mā̈n (Klukshu Lake)
- Pine Lake 2

Dezadeash Lake

Titl'àt Mǟn

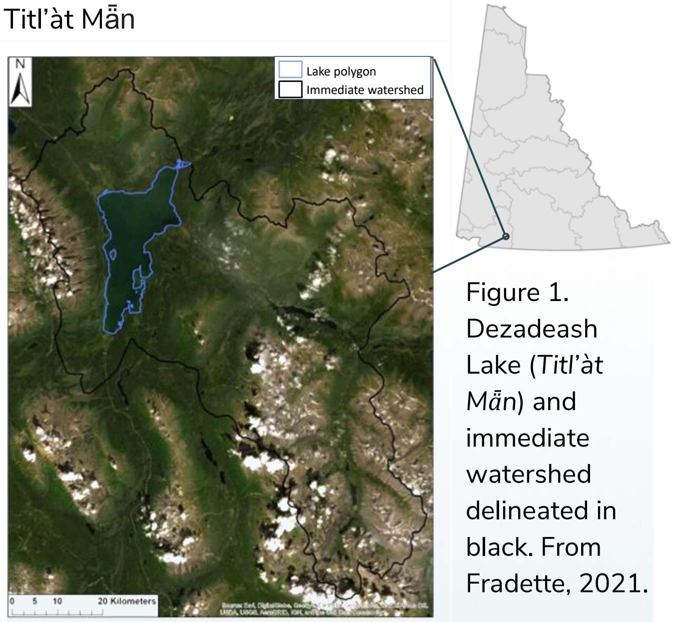

Figure 1. Dezadeash Lake (*Titl'àt Mǟn*) and immediate watershed delineated in black. From Fradette, 2021.

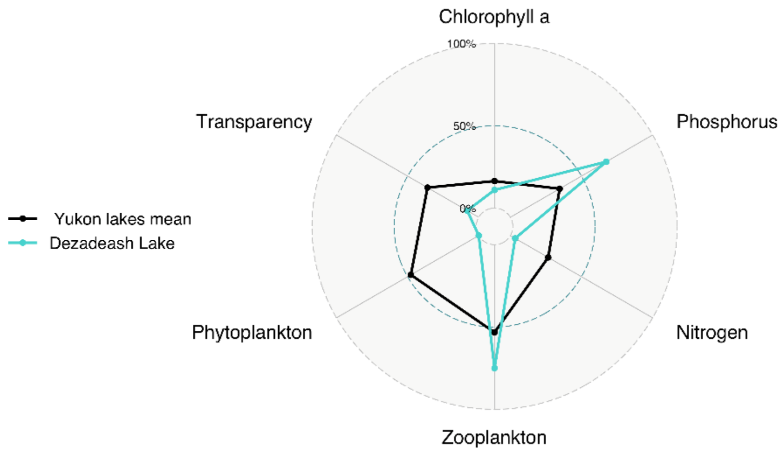

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Dezadeash Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
79.18 km^2	1061.53 km^2
SAMPLING DEPTH	POPULATION
6 m	7
AVERAGE DEPTH	ELEVATION
24.3 m	623 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-26	0 km^2

Location

Dezadeash Lake is located in Southwestern Yukon, approximately 43 km south of Haines Junction, on the Haines Highway.

Land Use

91.7% of Dezadeash Lake's 1061.53 km^2 watershed is natural. 8.2% is composed of water (including the lake itself). The remaining 0.1% of the watershed is comprised of urban and forest loss and mines (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 2.1m the day of the sampling. The color value was of 2.21 mg/L Pt. Dissolved organic carbon had a value of 2.11 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (21.19 µg/L) and total nitrogen (0.05 mg/L) values in Dezadeash Lake were both slightly below the Yukon mean (Figure 2). Chlorophyll a (1.48 µg/L) was also below average. According to the Canadian water quality guidelines for the protection of aquatic life, Dezadeash Lake is meso-eutrotrophic.

Food chain health

Five zooplankton species were identified in Dezadeash Lake, which is above Yukon's average. However, seven phytoplankton species were identified, which is the lowest diversity of all Yukon lakes (Figure 2). Cyanobacteria concentration indicated a low risk exposure to cyanotoxins but one potential bloom former/ toxin producer species of the cyanobacteria group was identified.

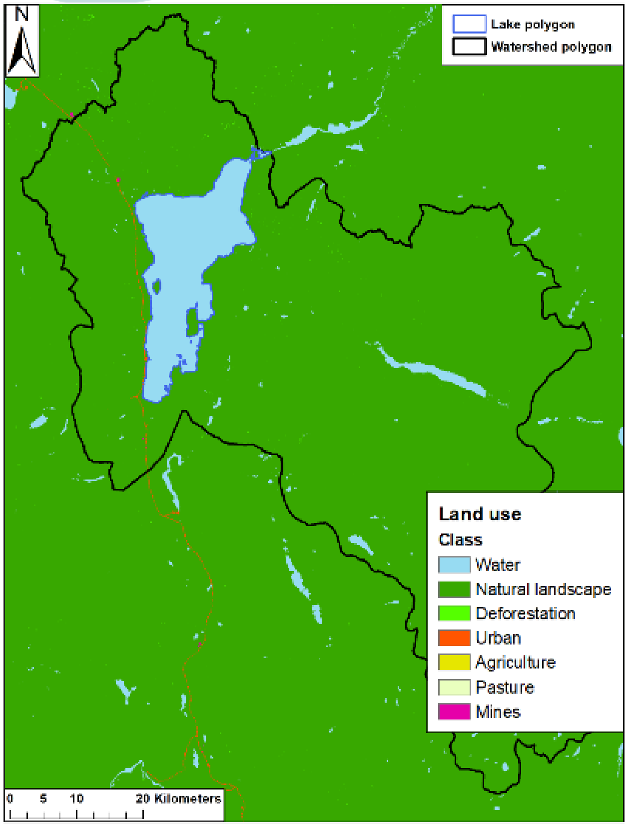

Figure 3. Immediate watershed and land use around Dezadeash Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Dezadeash Lake.

Pharmaceuticals

No pharmaceutical products were reported in Dezadeash Lake.

Industrial chemicals

3 ng/L of Tris(2-chloroethyl) Phosphate(TCEP), a flame retardant were detected in Dezadeash Lake.

Fecal coliforms

No fecal coliforms, including *E. coli* bacteria were detected in Dezadeash Lake, either from the littoral sampling site on the southern point of the lake or from the index site near the deepest point of the lake.

Change over time

Sediment cores were retrieved from Dezadeash Lake, but have not yet been analyzed for total metal, diatoms or zooplankton temporal changes. The longest core was 22 cm and was dated to 1973.

Figure 4. The longest sediment core retrieved from Dezadeash Lake.

Temperature & dissolved oxygen

The temperature profile in Dezadeash Lake stops at 2m depth, so it is not possible to examine lake stratification. The surface temperature was 14.9°C on the day of sampling (Figure 5). Dissolved oxygen data was not available due to instrumentation malfunction.

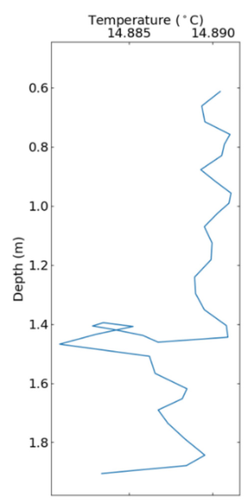

Figure 5. Temperature (°C) profile as measured in Dezadeash Lake. Figures from Fradette, 2021.

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Kloo Lake

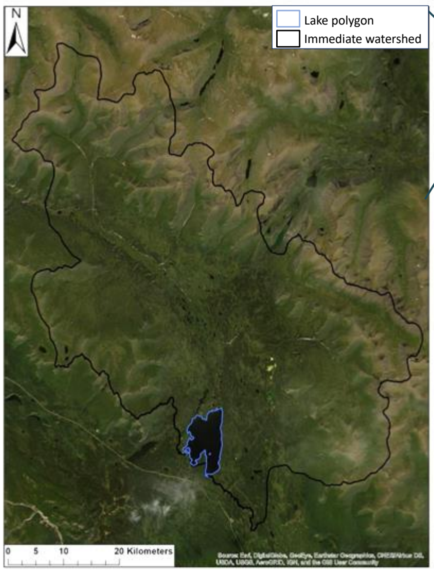


Figure 1. Kloo Lake and immediate watershed delineated in black. Adapted from Fradette, 2021.

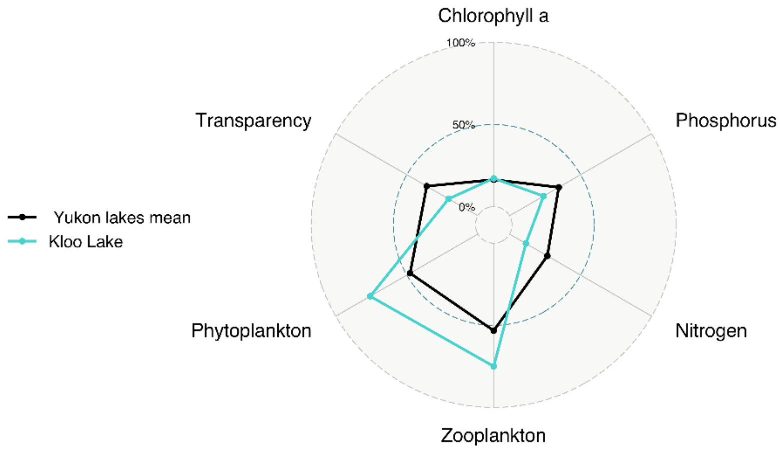


Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Kloo Lake (shown in blue).

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
11.61 km^2	686.64 km^2
SAMPLING DEPTH	POPULATION
10 m	8
AVERAGE DEPTH	ELEVATION
13 m	837 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-24	0 km^2

Location

Kloo Lake is located in Southwestern Yukon, about 30 km northwest of Haines Junction. It lies on the north side of the Alaska Highway.

Land Use

97.29% of Kloo Lake's 0.77 km^2 watershed is natural. 3.70% is composed of water (including the lake itself). The remaining <0.01% of the watershed is composed of urbanized land of forest loss (Figure 3).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 3.8m. The color value was of 15.23 mg/L Pt. Dissolved organic carbon had a value of 5.36 mg/L.

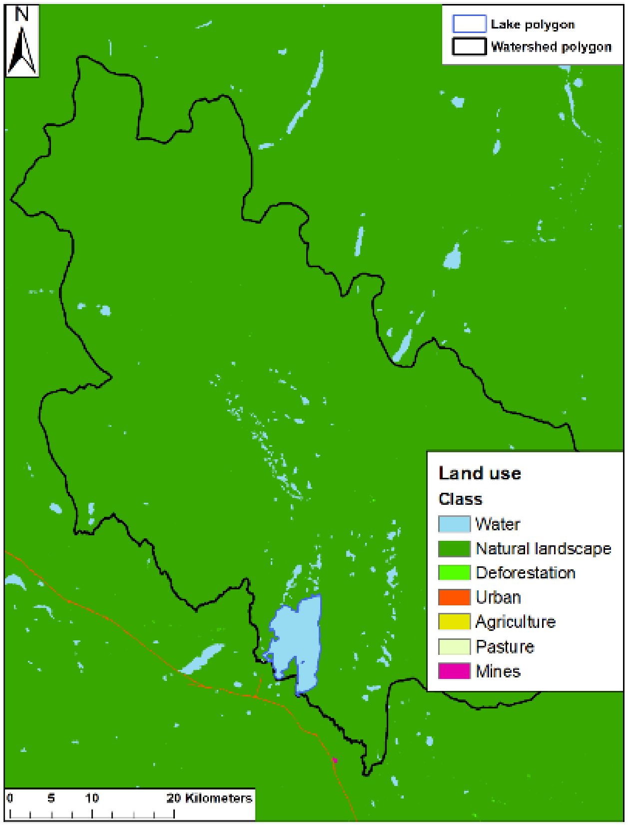
Chlorophyll a, nutrients and trophic status

Total phosphorus (11.44 µg/L) and total nitrogen (0.12 mg/L) values in Kloo Lake were below the Yukon mean (Figure 2). Chlorophyll a (2.07 µg/L) was also below the Yukon average. According to the Canadian water quality guidelines for the protection of aquatic life, Kloo Lake is mesotrophic.

Food chain health

Five zooplankton species and 32 phytoplankton species were identified in Kloo Lake, which is above the average of sampled Yukon lakes (Figure 2). Cyanobacteria concentration indicated a low risk of cyanotoxin exposure. Two potential bloom formers / toxin producer species of the cyanobacteria group were identified.

Figure 3. Immediate watershed and land use around Kloo Lake. Figure from Fradette, 2021.



Did we find contaminants?

Pesticides

Kloo Lake was not analyzed for pesticides.

Pharmaceuticals

Kloo Lake was not analyzed for pharmaceuticals.

Industrial chemicals

Kloo Lake was not analyzed for industrial chemicals.

Fecal coliforms

Fecal coliforms were detected in Kloo Lake, from the littoral sampling site located on the south-western side of the lake. However, the fecal bacteria detected were not of the E. coli species and no fecal coliforms were found from the sampling site near the deepest point of the lake.

Change over time

Sediment cores were retrieved from Kloo Lake, but have not yet been analyzed for total metals, diatoms or zooplankton temporal changes. The longest core was 61 cm.

Figure 4. The longest sediment core from Kloo Lake.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 5.2 m and a hypolimnion at 5.4 m on the sampling day (Figure 5a). Dissolved oxygen was elevated throughout the profile, with minimal values around 90% of oxygen in the hypolimnion (Figure 5b).

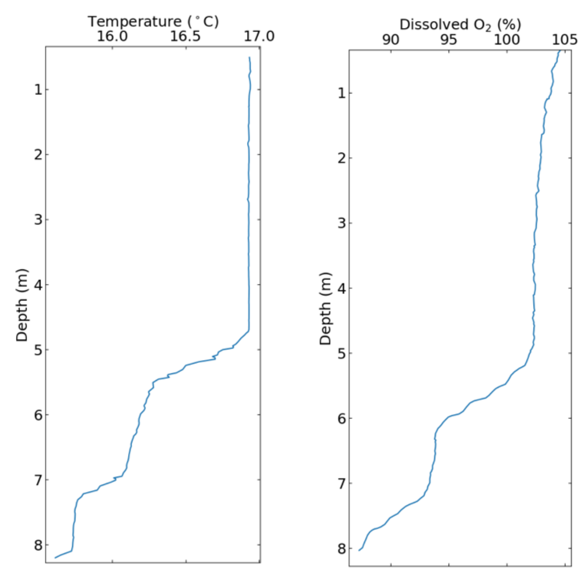


Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Kloo Lake. Figures from Fradette, 2021.

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Klukshu Lake

Łu Gha Mӑ̈n

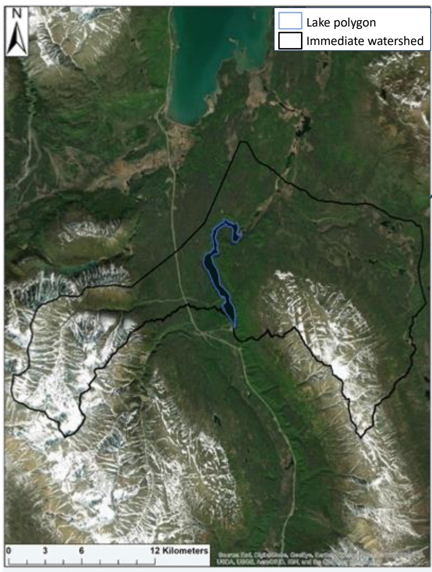

Figure 1. Klukshu Lake (Łu Gha Mӑ̈n) and immediate watershed delineated in black. Adapted from Fradette, 2021.

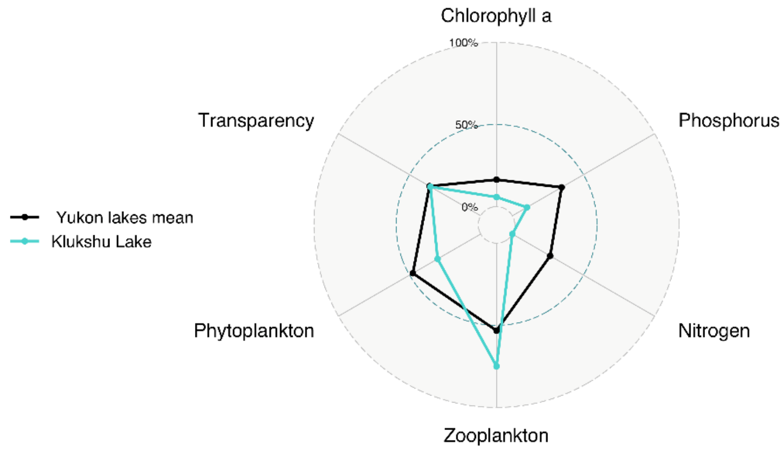

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Klukshu Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
1.29 km^2	79.88 km^2
MAXIMUM DEPTH	POPULATION
31 m	1
AVERAGE DEPTH	ELEVATION
21.5 m	706 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-28	0 km^2

Location

Klukshu Lake is located in Southwestern Yukon, within the Klukshu community, about 63km south of Haines Junction.

Land Use

97.8% of Klukshu Lake's 79.88 km^2 watershed is natural. 2% is composed of water (including the lake itself). The remaining 0.2% of the watershed is comprised of urbanized land or forest losses (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 5.8 m. The color value was of 2.81 mg/L Pt. Dissolved organic carbon had a value of 5.75 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (8.37 µg/L) and total nitrogen (0.03 mg/L) values in Klukshu Lake were below the Yukon mean (Figure 2). Chlorophyll *a* (0.98 µg/L) was also below mean. According to the Canadian water quality guidelines for the protection of aquatic life, Klukshu Lake is oligotrophic.

Food chain health

Five zooplankton species were identified in Klukshu Lake, which is above the Yukon average. However, phytoplankton diversity was below the Yukon average, with 17 species identified (Figure 2). Cyanobacteria concentration indicated a low risk exposure to cyanotoxins and no potential bloom former / toxin producer species of the cyanobacteria group were identified.

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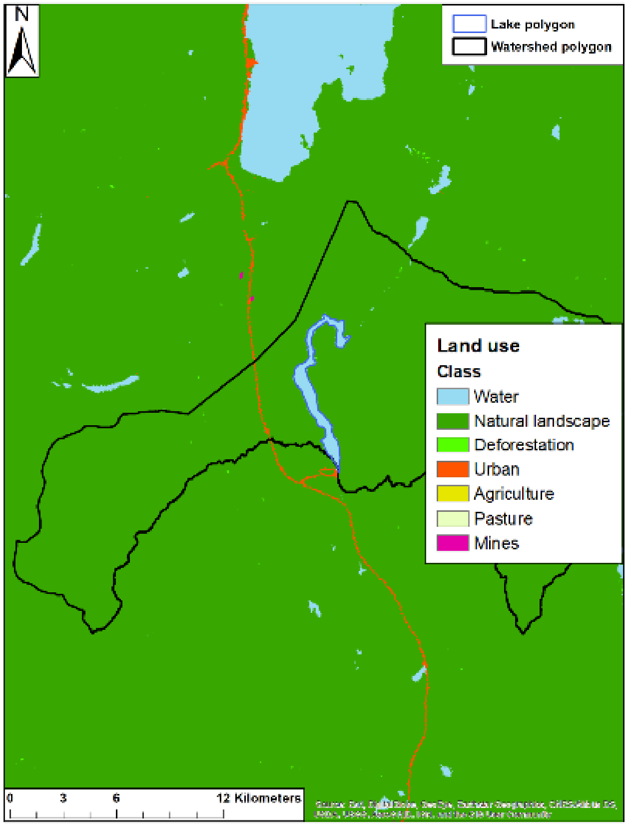

Figure 3. Immediate watershed and land use around Klukshu Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

Klukshu Lake was not analyzed for pesticides.

Pharmaceuticals

Klukshu Lake was not analyzed for pharmaceuticals.

Industrial chemicals

Klukshu Lake was not analyzed for industrial chemicals.

Fecal coliforms

No fecal coliforms, including *E. coli* bacteria were detected in Klukshu Lake, either from the littoral sampling site on the southern point of the lake or from the index site near the deepest point of the lake.

Change over time

Sediment cores were retrieved from Klukshu Lake, but the water-sediment interface of these cores was poorly defined. As such, cores were not analyzed. The longest core was 40 cm.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 10.3m and a hypolimnion at 11.1m on the sampling day (Figure 3). The dissolved oxygen sensor was broken on the day of sampling and thus no oxygen data is available for this lake.

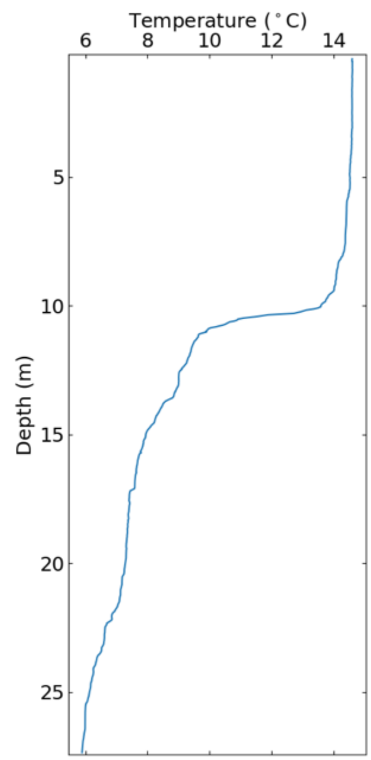

Figure 4. Temperature (°C) profile as measured in Klukshu Lake. Figures from Fradette, 2021.

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Pine Lake 2

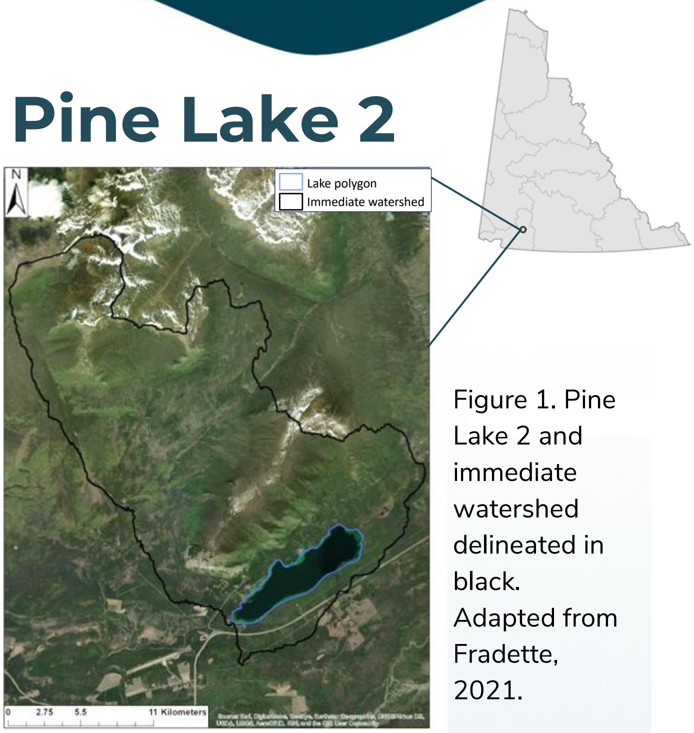

Figure 1. Pine Lake 2 and immediate watershed delineated in black. Adapted from Fradette, 2021.

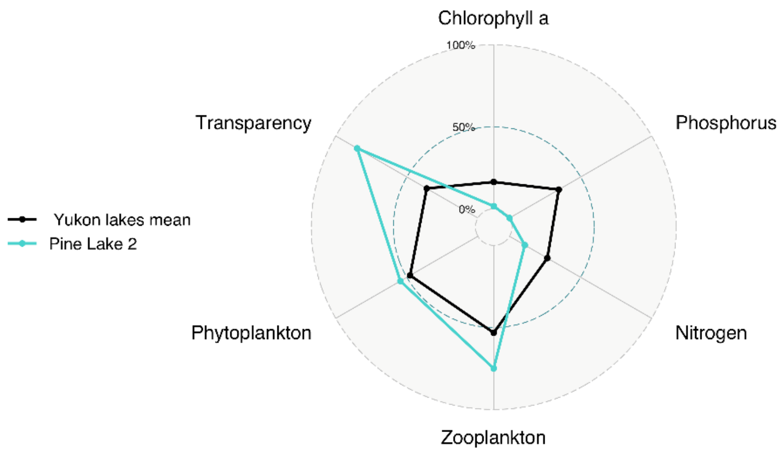

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Pine Lake 2 (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
5.85 km^2	110.52 km^2
MAXIMUM DEPTH	POPULATION
26 m	7
AVERAGE DEPTH	ELEVATION
11.8 m	650 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-25	0.02 km^2

Location

Pine Lake 2 is located in Southwestern Yukon, about 6 km north of Haines Junction, on the north side of the Alaska Highway.

Land Use

94.2% of Pine's Lake 2's 1061.53 km^2 watershed is natural. 5.4% is composed of water (including the lake itself). The remaining 0.4% of the watershed is comprised of urban, forest loss and mines (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 12.5m. The color value was of 2.45 mg/L Pt. Dissolved organic carbon had a value of 3.62 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (6.07 µg/L) and total nitrogen (0.11 mg/L) values in Pine Lake 2 were among the lowest observed across sampled Yukon lakes (Figure 2). Chlorophyll a (0.58 µg/L) was also below the Yukon average. According to the Canadian water quality guidelines for the protection of aquatic life, Pine Lake 2 is oligotrophic.

Food chain health

Five zooplankton species and 25 phytoplankton species were identified in Pine Lake 2, which is above the Yukon average (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins but one potential bloom former / toxin producer species of the cyanobacteria group was identified.

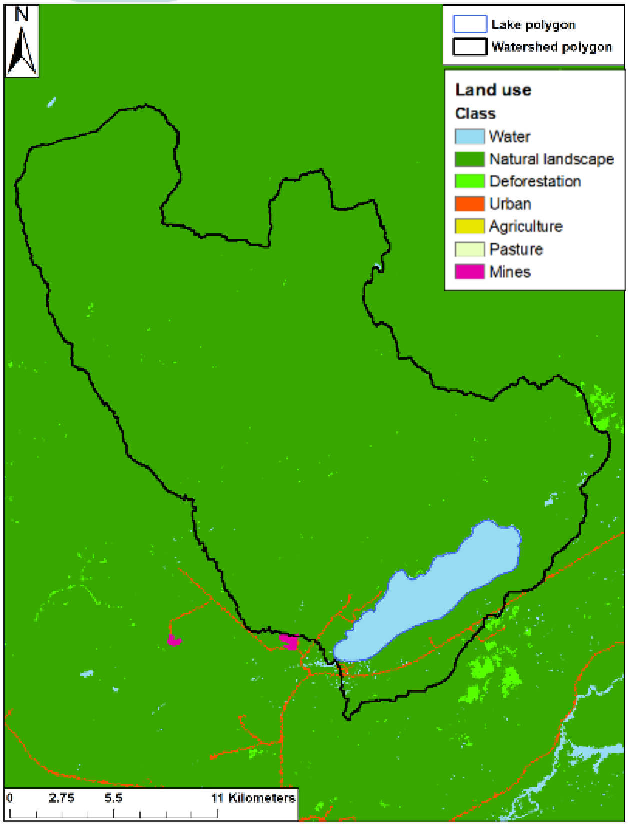

Figure 3. Immediate watershed and land use around Pine Lake 2. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Pine Lake 2.

Pharmaceuticals

No pharmaceutical products were reported in Pine Lake 2.

Industrial chemicals

No industrial chemicals were detected in this Pine Lake 2.

Fecal coliforms

Fecal coliforms were detected in Pine Lake 2, both from the littoral sampling site in Pine Lake Campground and from the index site near the deepest point of the lake. However, the fecal bacteria detected were not of the *E. coli* species.

Change over time

Sediment cores were retrieved from Pine Lake 2, but have not yet been analysed for total metal, diatoms or zooplankton cladoceran temporal changes.

Figure 4. The longest sediment core retrieved from Pine Lake 2 was 21 cm long.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 7.5 m, and a hypolimnion at 13.1 m on the sampling day (Figure 5). Dissolved oxygen data was not available for this lake.

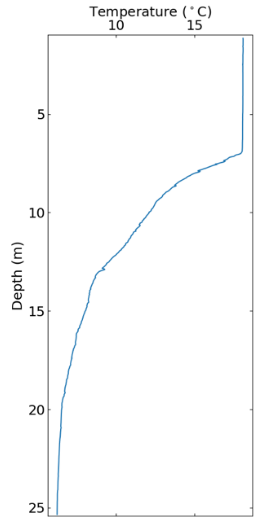

Figure 5. Temperature (°C) profile as measured in Pine Lake 2. Figures from Fradette, 2021

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Mackenzie River Watershed

Peel, Upper Liard and Central Liard

Mackenzie River Watershed - Lakes

- Lake 13-562
- Lake 13-563
- Lake 14-584
- Chapman Lake
- Pine Lake 1
- Second Wye Lake
- Two Moose Lake
- Watson Lake
- Wolverine Lake
- Wye Lake

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Lake 13-562

Unnamed lake next to Watson Lake

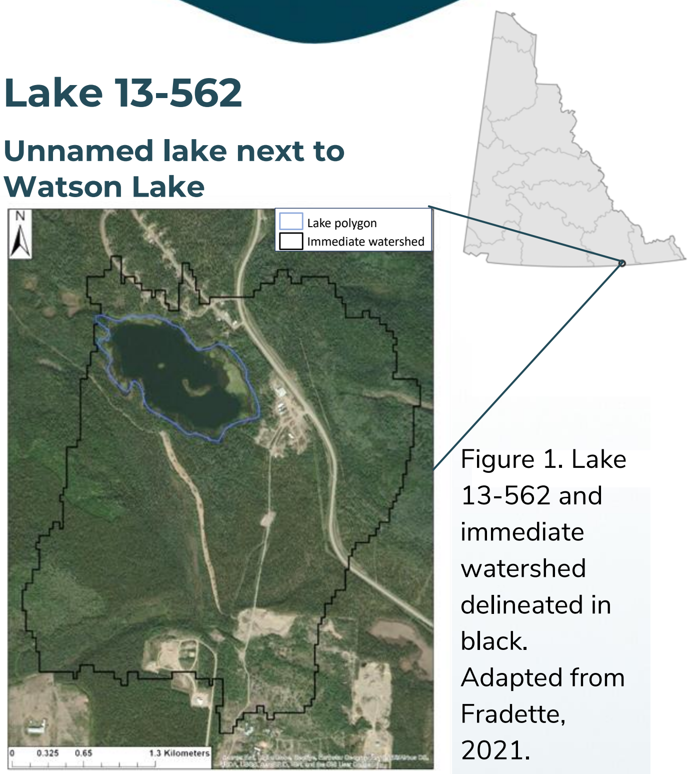

Figure 1. Lake 13-562 and immediate watershed delineated in black. Adapted from Fradette, 2021.

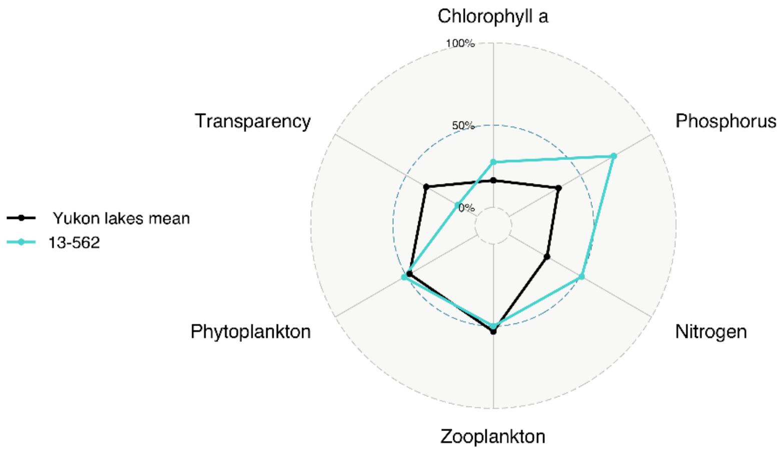

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (black) in comparison with Lake 13-562 (blue).

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
0.23 km^2	2.43 km^2
MAXIMUM DEPTH	POPULATION
7 m	3
AVERAGE DEPTH	ELEVATION
4.5 m	698 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-15	0 km^2

Location

Lake 13-562 is located in Southeastern Yukon, about 3 km North of Watson Lake, on the side of the Robert Campbell Highway. The lake coordinates are 60°04'49.6"N 128°44'44.9"W.

Land Use

Lake "13-562" has a 2.43 km^2 watershed, of which 81.0% is natural. 9.6% is composed of water (including the lake itself). 9.3% of the watershed is urbanized, while the remaining 0.2% is comprised of forest loss (Figure 3).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 2.8 m on the day of sampling. The color value was of 3.28 mg/L Pt. Dissolved organic carbon had a value of 6.10 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (22.55 µg/L) and total nitrogen (0.44 mg/L) values in Lake 13-562 were similar to the Yukon mean (Figure 2). Whereas chlorophyll a (3.07 µg/L) was slightly below the average. According to the Canadian water quality guidelines for the protection of aquatic life, Lake 13-562 is meso-eutrophic.

Food chain health

Four zooplankton species and 24 phytoplankton species were identified in Lake 13-562, which is similar to Yukon average (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins, and two potential bloom former / toxin producer species of the cyanobacteria group were identified.

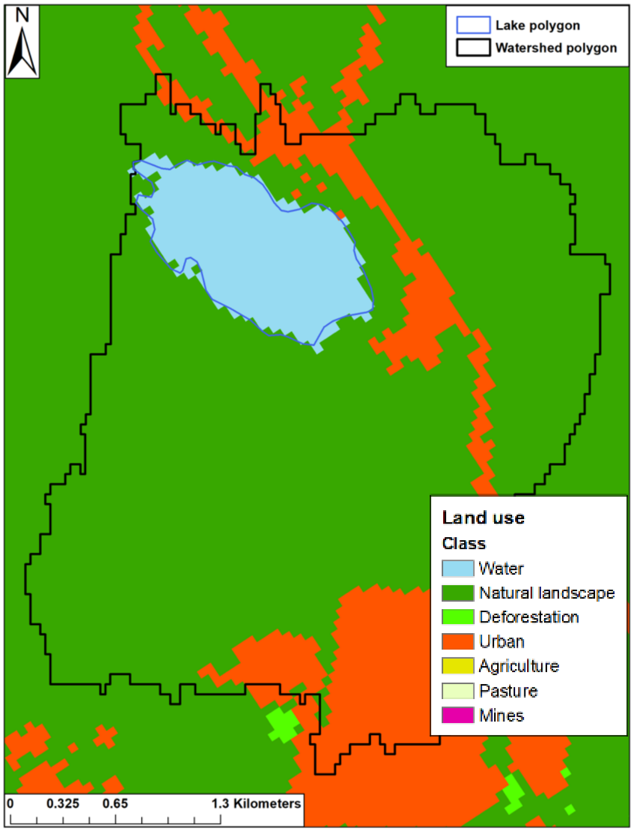

Figure 3. Immediate watershed and land use around Lake 13-562. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides, or herbicides were found in Lake 13-562.

Pharmaceuticals

No pharmaceutical products were reported in Lake 13-562.

Industrial chemicals

No industrial chemicals were reported.

Fecal coliforms

Fecal coliforms were detected in Lake 13-562, both from the littoral sampling site on the South shore of the lake and from the index site near the deepest point of the lake. However, the fecal bacteria detected were not of the *E. coli* species.

Change over time

Sediment cores were retrieved from Lake 13-562, but have not yet been analyzed for total metals, diatoms or zooplankton cladoceran temporal changes yet. The longest core was 37.5 cm, which was dated to 1891.

Figure 4. Longest sediment core collected at Lake 13-562.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 5.6 m depth, and a hypolimnion at 5.8 m depth on the sampling day (Figure 5). Dissolved oxygen had a value of 102% at the surface of the lake, but reduced to 45% of oxygen in the hypolimnion (Figure 5).

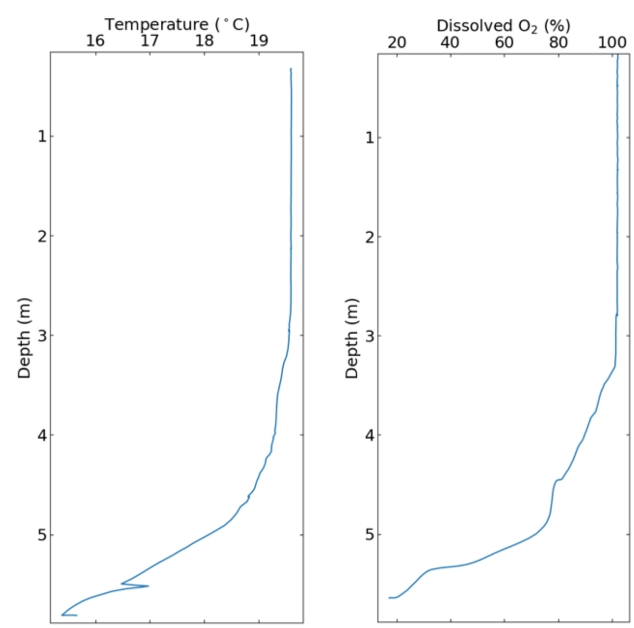

Figure 5. a) Temperature (°C) and b) dissolved oxygen (%) as measured in Lake 13-562. Figures from Fradette, 2021.

Lake 13-563

Unnamed lake adjacent to Frances Lake

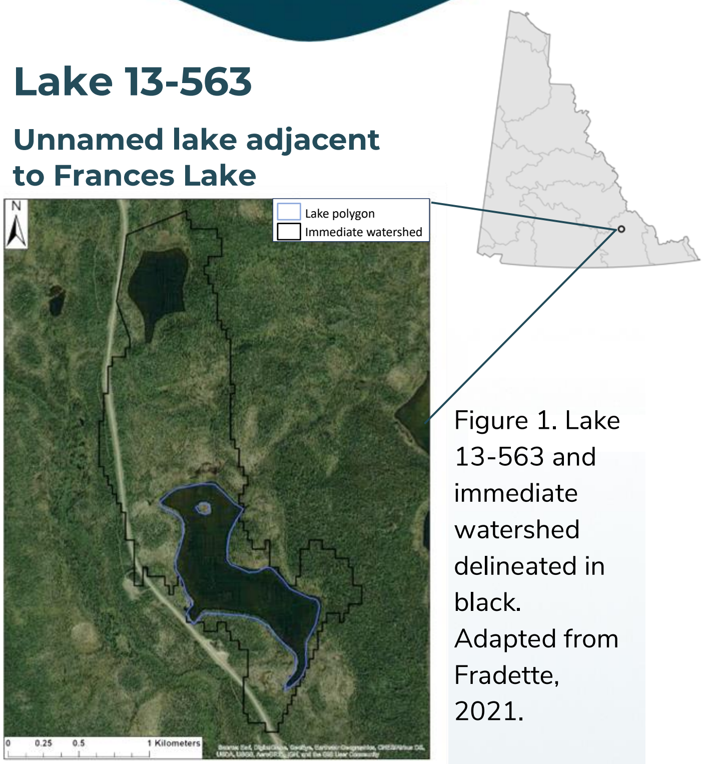

Figure 1. Lake 13-563 and immediate watershed delineated in black. Adapted from Fradette, 2021.

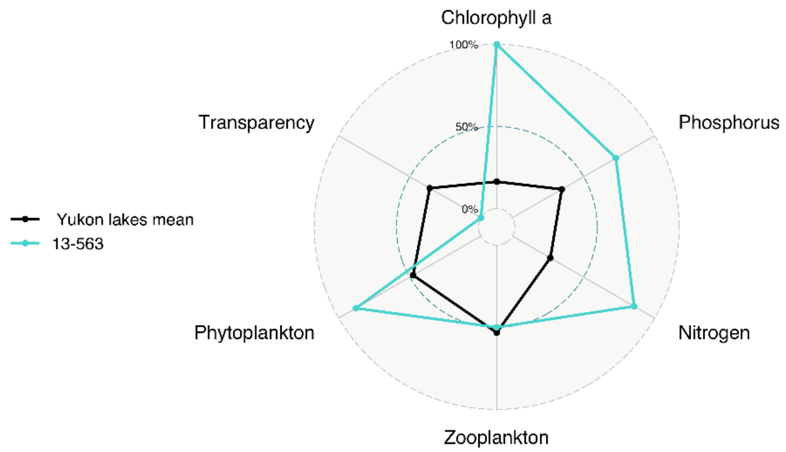

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (black) in comparison with Lake 13-563 (blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
0.12 km^2	0.61 km^2
MAXIMUM DEPTH	POPULATION
3 m	0
AVERAGE DEPTH	ELEVATION
2.5 m	831 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-16	0 km^2

Location

Lake 13-563 is located in Southeastern Yukon, 165 km north of Watson Lake. It is located adjacent to the Robert Campbell Highway. The lake coordinates are 61°27'20.4"N 129°44'42.1"W.

Land Use

66.0% of Lake 13-563's 0.61 km^2 watershed is natural. 27.5% is composed of water (including the lake itself). Urban land composes 4.4% of the watershed, and the remaining 2.1% is characterized by forest loss (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 0.95 m. The color value was 20.86 mg/L Pt. Dissolved organic carbon had a value of 19.60 mg/L Pt.

Chlorophyll a, nutrients and trophic status

Total phosphorus (22.37 µg/L) and Chlorophyll a (10.02 µg/L) concentrations in Lake 13-563 were similar to the Yukon average. (Figure 2). Total nitrogen (0.73 mg/L) was above the Yukon average. According to the Canadian water quality guidelines for the protection of aquatic life, Lake 13-563 is meso-eutrophic.

Food chain health

Four zooplankton species (also the Yukon mean) were identified in Lake 13-563. Phytoplankton diversity was among the highest of all sampled Yukon lakes, with 36 species identified (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins, and 2 potential bloom formers / toxin producer species of the cyanobacteria group were identified.

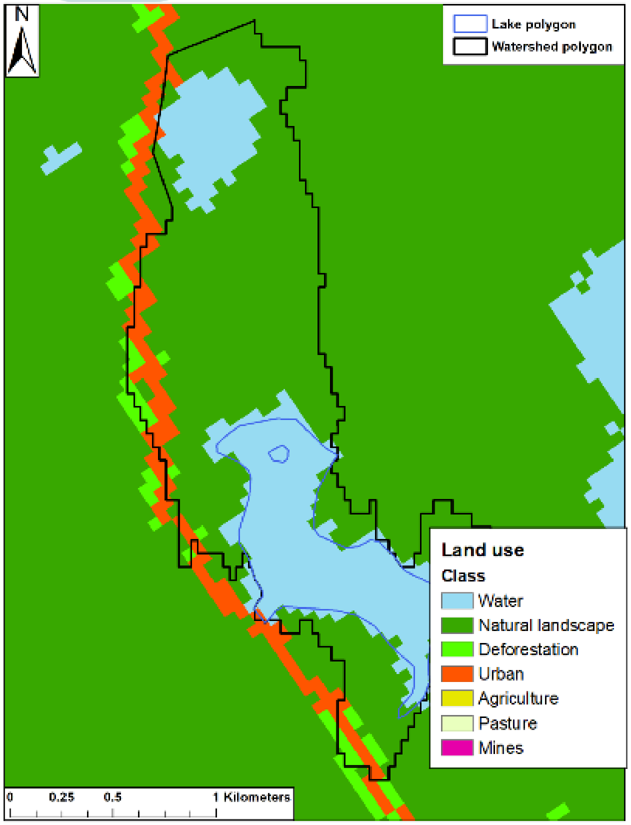

Figure 3. Immediate watershed and land use around Lake 13-563. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Lake 13-563.

Pharmaceuticals

No pharmaceutical products were reported in Lake 13-563.

Industrial chemicals

No industrial chemicals were reported.

Fecal coliforms

Fecal coliforms were detected in Lake 13-563 at both the littoral sampling site located near the Highway and at the index site near the deepest point of the lake. However, the fecal bacteria detected were not of the *E. coli* species.

Change over time

The longest core retrieved from Lake 13-563 was 53 cm long (Figure 4a). The bottom of the core was dated to 1946. The analysis of diatom assemblages from the top and the bottom of the core revealed a temporal dissimilarity of 0.47 (Figure 4b).

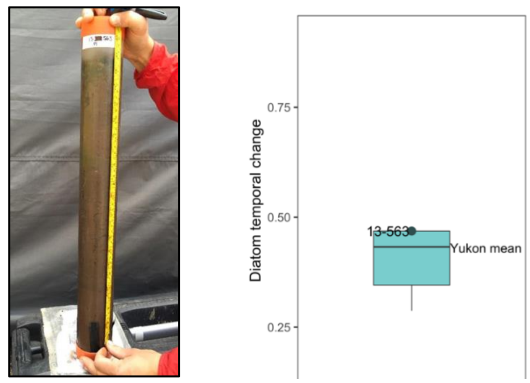

Figure 4. a) The longest sediment core retrieved from Lake 13-563. b) Mean (± Standard error) of Diatom temporal change between the bottom and the top of the core. Lake 13-563 value is indicated with a green point.

Temperature & dissolved oxygen

Lake 13-563 was not stratified in the 2m temperature profile that was collected. The surface temperature was 17.8°C on the day of sampling (Figure 5a). The oxygen remained elevated throughout the profile, with values around 115% at 2m depth (Figure 5b).

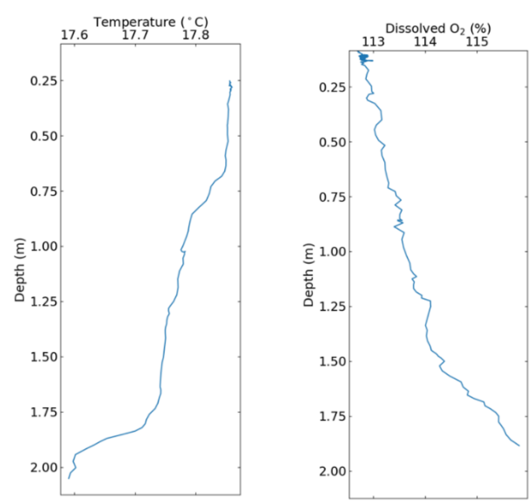

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Lake 13-563. Figures from Fradette, 2021.

Lake 14-584

Unnamed lake in Tombstone Territorial Park

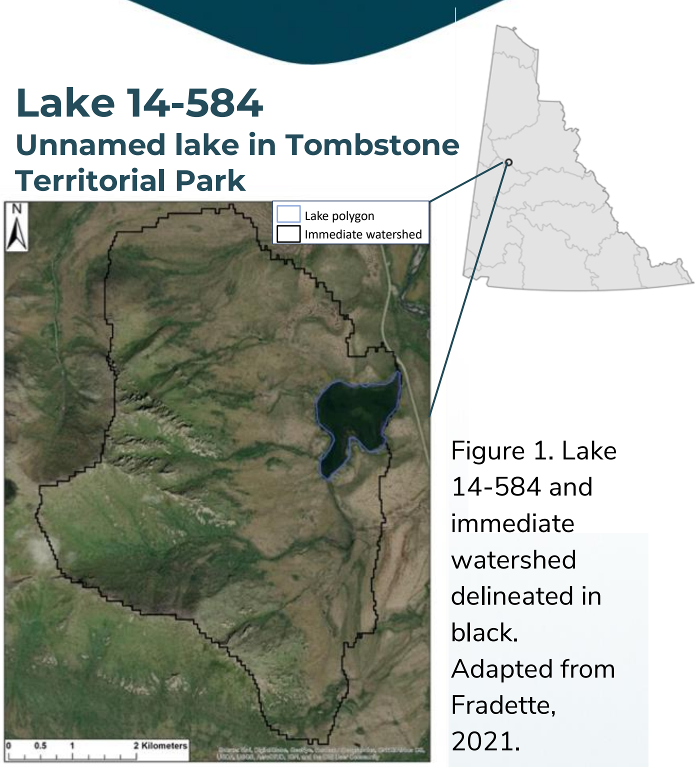

Figure 1. Lake 14-584 and immediate watershed delineated in black. Adapted from Fradette, 2021.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
0.21 km²	5.04 km²
SAMPLING DEPTH	POPULATION
3.3 m	0
AVERAGE DEPTH	ELEVATION
5.3 m	1121 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-26	0 km²

Location

Lake 14-584 is located in central Yukon, within Tombstone Territorial Park. It lies on the west side of the Dempster Highway. The lake coordinates are 64°39'00.6"N 138°23'31.4"W.

Land Use

95.8% of Lake 14-584's 5.04 km² watershed is natural. 4.2% is composed of water (including the lake itself). The remaining <0.1% of the watershed is comprised of urbanized land (Figure 3).

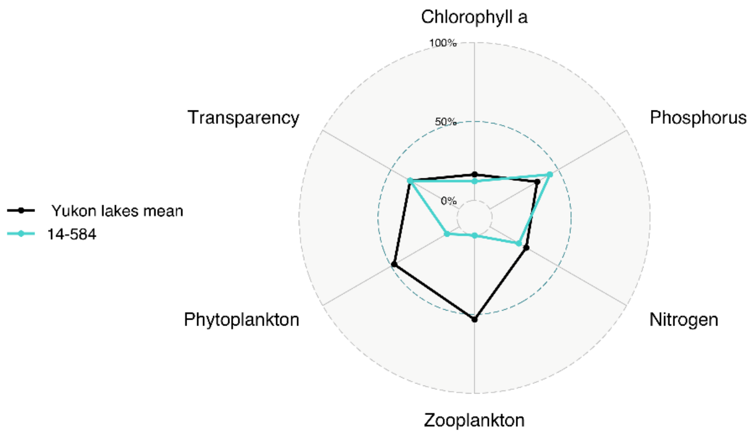

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (black) in comparison with Lake 14-584 (blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Aquatic ecosystem health

Water color and transparency

Secchi depth was equal to lake depth (secchi was visible at the bottom of the lake at 3.3m depth). The color value was of 16.76 mg/L Pt. Dissolved organic carbon had a value of 7.18 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (15.92 µg/L) and total nitrogen (0.20 mg/L) values in Lake 14-584 were both below the Yukon average (Figure 2). Chlorophyll a (1.58 µg/L) was also below the Yukon average. According to the Canadian water quality guidelines for the protection of aquatic life, Lake 14-584 is meso-eutrotrophic.

Food chain health

Two zooplankton species were identified in Lake 14-584, which is the lowest zooplankton diversity found in any of the Yukon sampled lakes. Ten phytoplankton species were identified, which was below the Yukon average (Figure 2). Cyanobacteria concentration indicated a low risk of cyanotoxin exposure. One potential bloom former / toxin producer species of the cyanobacteria group was identified.

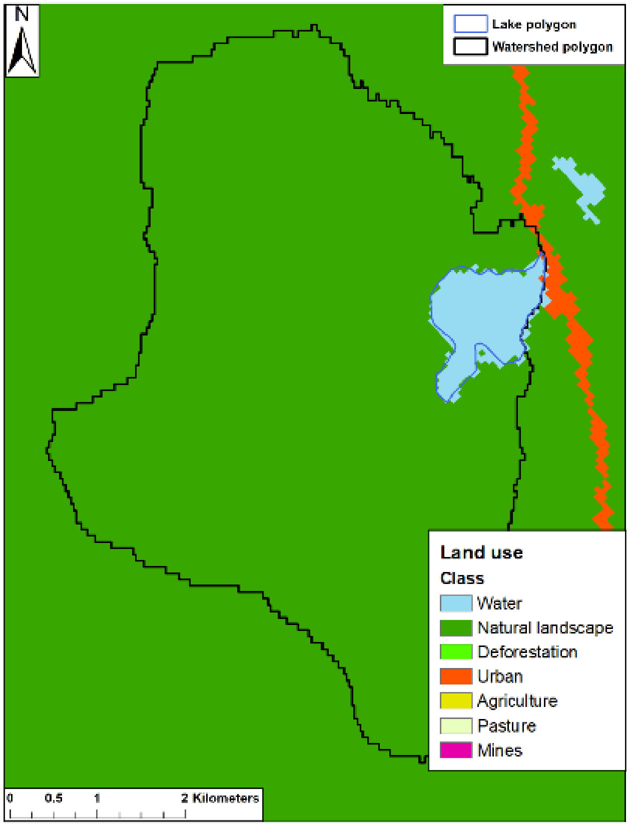

Figure 3. Immediate watershed and land use around Lake 14-584. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

Lake 14-584 was not analyzed for pesticides.

Pharmaceuticals

Lake 14-584 was not analyzed for pharmaceuticals.

Industrial chemicals

Lake 14-584 was not analyzed for industrial chemicals.

Fecal coliforms

No fecal coliforms, including *E. coli* bacteria were detected in Lake 14-584, either from the littoral sampling site near the Dempster Highway from the index site near the deepest point of the lake.

Change over time

The longest core retrieved from Lake 14-584 was 42 cm long (Figure 4a). The bottom of the core was dated to 1948. The analysis of diatom assemblage from the top and the bottom of the core revealed a temporal dissimilarity of 0.29 (Figure 4b).

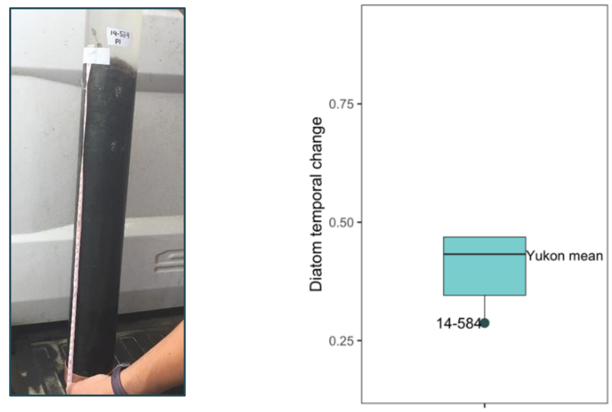

Figure 4. a) The longest sediment core retrieved from Lake 14-584. b) Mean (± Standard error) of diatom temporal change between the bottom and the top of the core. Lake 14-584 value is indicated with a green point.

Temperature & dissolved oxygen

Stratification was not observed in Lake 14-584. The surface temperature was 15.30°C on the day of sampling. Dissolved oxygen had an average value of 110.4%.

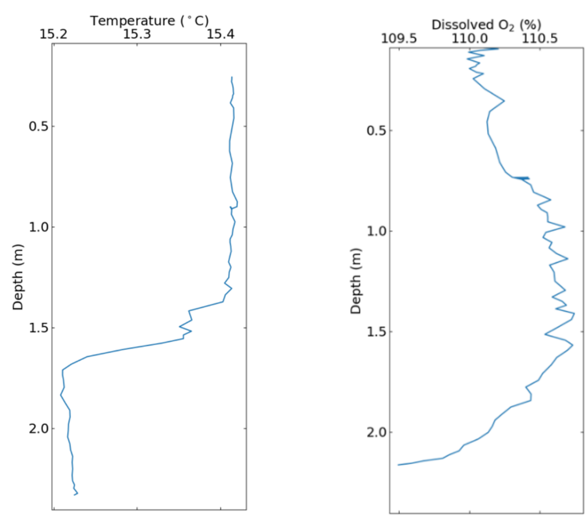

Figure 5a)Temperature (°C) and b) dissolved oxygen (%) as measured in Lake 14-584. Figures from Fradette, 2021.

Chapman Lake

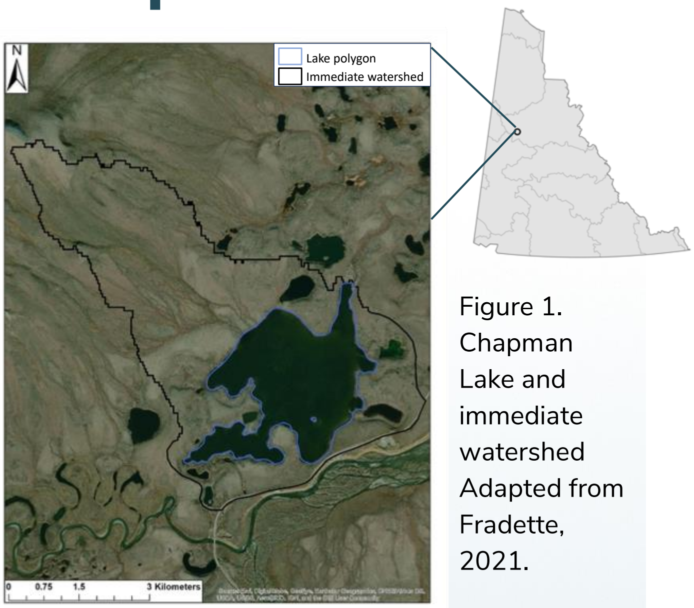

Figure 1. Chapman Lake and immediate watershed Adapted from Fradette, 2021.

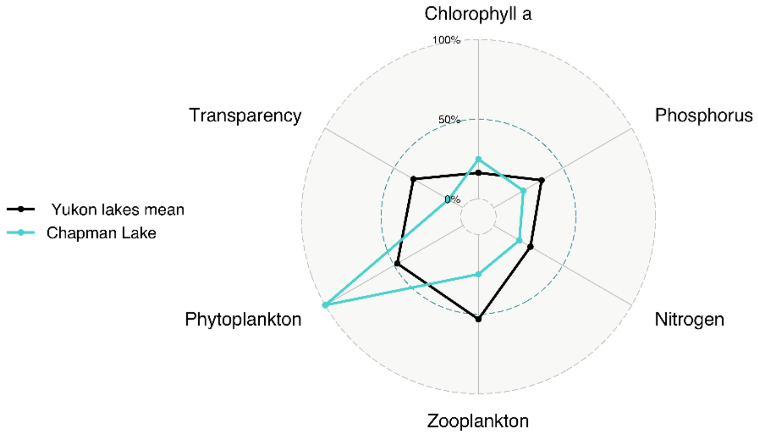

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Chapman Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
1.29 km^2	5.30 km^2
SAMPLING DEPTH	POPULATION
5.2 m	0
AVERAGE DEPTH	ELEVATION
8 m	981 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-27	0 km^2

Location

Chapman Lake is located in central Yukon, about 150 km north of Dawson City, on the northwest side of the Dempster Highway.

Land Use

71.9% of Chapman Lake's 5.30 km^2 watershed is natural. 27.3% is composed of water (including the lake itself). The remaining 0.8% of the watershed comprised of urbanized land including the Dempster Highway (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 2.4 m on the day of sampling. The color value was 19.44 mg/L Pt. Dissolved organic carbon had a value of 10.58 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (10.88 µg/L) and total nitrogen (0.18 mg/L) concentrations in Chapman Lake were below the Yukon mean (Figure 2). Chlorophyll a (2.81 µg/L) was also below the mean. According to the Canadian water quality guidelines for the protection of aquatic life, Chapman Lake is mesotrophic.

Food chain health

Three zooplankton species were identified in Chapman Lake, which is below the Yukon mean. However, 40 phytoplankton species were identified, which is the highest diversity of all Yukon lakes (Figure 2). Cyanobacteria concentration indicated a low risk of cyanotoxin exposure. Three potential bloom formers / toxin producer species of the cyanobacteria group were identified.

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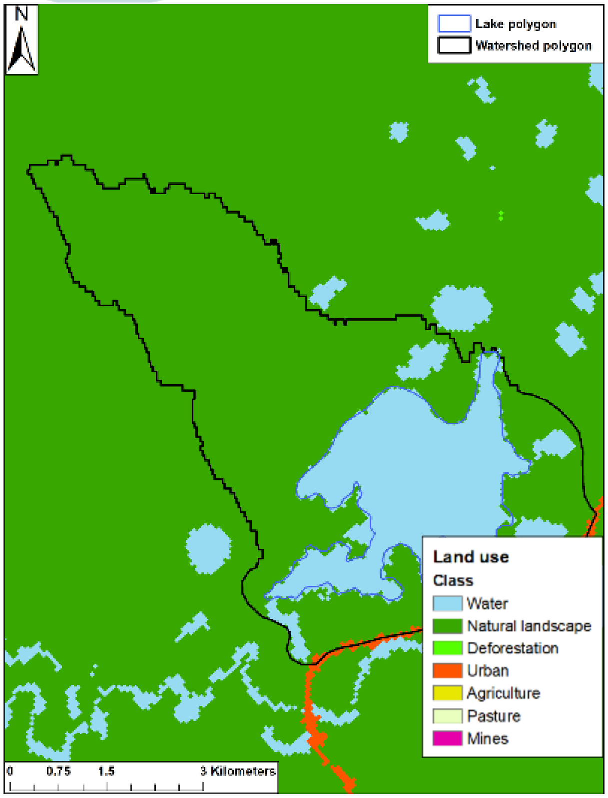

Figure 3. Immediate watershed and land use around Chapman Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

Chapman Lake was not analyzed for pesticides.

Pharmaceuticals

Chapman Lake was not analyzed for pharmaceuticals.

Industrial chemicals

Chapman Lake was not analyzed for industrial chemicals.

Fecal coliforms

Fecal coliforms were detected in Chapman Lake, from the littoral sampling site located on the side of the Dempster Highway. However, the fecal bacteria detected were not of the *E. coli* species and no fecal coliforms were found from the sampling site near the middle of the lake.

Change over time

The longest core retrieved from Chapman Lake was 48 cm long (Figure 4a). The bottom of the core was dated to 1948. The analysis of diatom assemblage from the top and the bottom of the core revealed a temporal dissimilarity of 0.43 (Figure 4b).

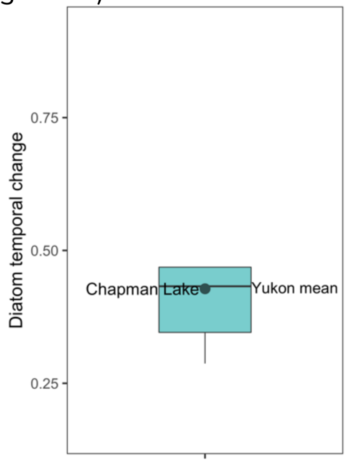

Figure 4. a) The longest sediment core retrieved from Chapman Lake. b) Mean (± Standard error) of diatom temporal change between the bottom and the top of the core. Chapman Lake value is indicated with a green point.

Temperature & dissolved oxygen

No thermal stratification was observed. The surface temperature was 16.0°C on the day of sampling Dissolved oxygen had an average value of 102.8%

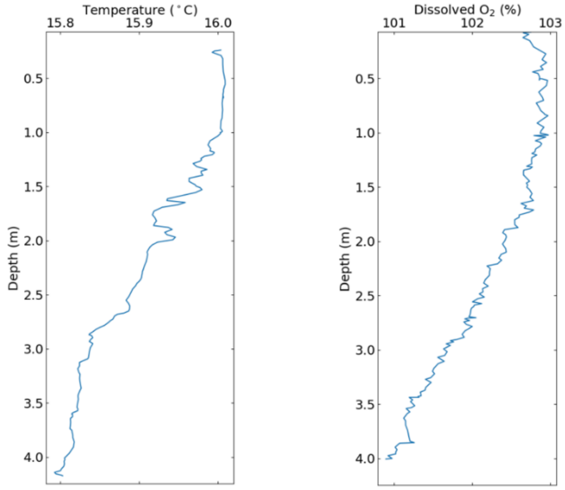

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Chapman Lake. Figures from Fradette, 2021.

Pine Lake 1

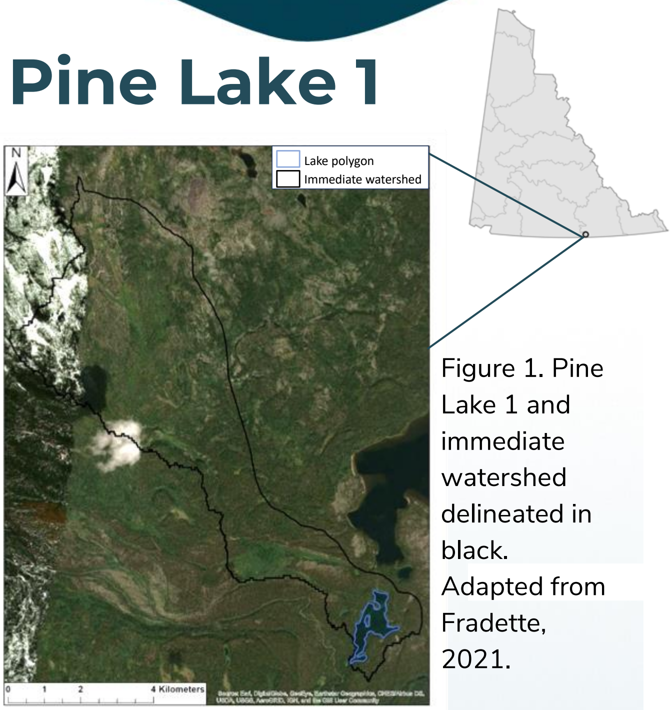

Figure 1. Pine Lake 1 and immediate watershed delineated in black. Adapted from Fradette, 2021.

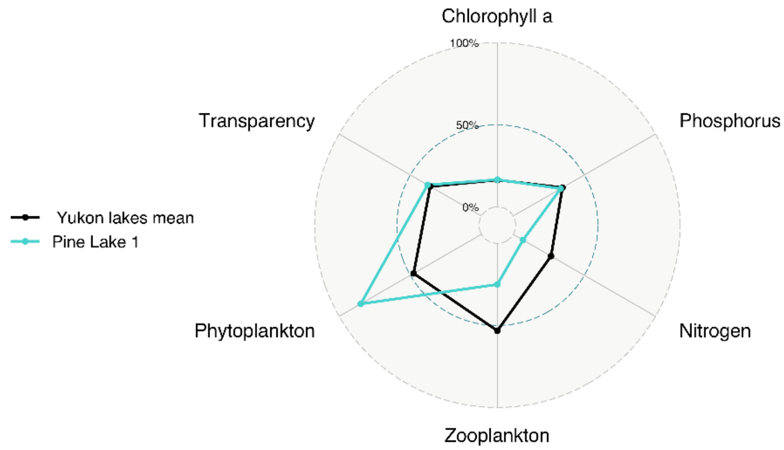

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Pine Lake 1 (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
0.20 km^2	9.79 km^2
MAXIMUM DEPTH	POPULATION
10 m	0
AVERAGE DEPTH	ELEVATION
4.6 m	995 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-18	0 km^2

Location

Pine Lake 1 is located in Southeastern Yukon, about 15 km north of the Highway Camp at Swift River, and just north of the Pine Lake Airstrip.

Land Use

96.8% of Pine's Lake 1's 9.79 km^2 watershed is natural. 2.6% is composed of water (including the lake itself). The remaining 0.7% of the watershed is comprised of urbanized land (Figure 3).

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Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 6.1 m. The color value was of 2.81 mg/L Pt. Dissolved organic carbon had a value of 2.3 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (13.55 µg/L) and total nitrogen (0.08 mg/L) values in Pine Lake 1 were slightly below the Yukon mean (Figure 2). Chlorophyll a (2.02 µg/L) was also below the Yukon mean. According to the Canadian water quality guidelines for the protection of aquatic life, Pine Lake 1 is mesotrophic.

Food chain health

Three zooplankton species were identified in Pine Lake 1, which is below the sampled Yukon lakes average. However, phytoplankton diversity was above average in Yukon lakes, with 35 identified species (Figure 2). Cyanobacteria concentration indicated a low risk exposure to cyanotoxins, and one potential bloom former / toxin producer species of the Cyanobacteria group was identified.

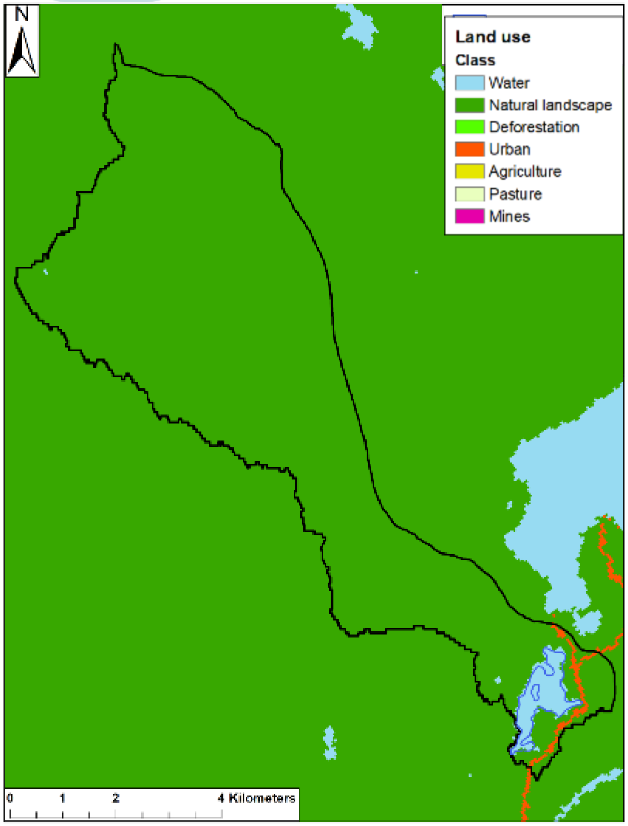

Figure 3. Immediate watershed and land use around Pine Lake 1. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

Pine Lake 1 was not analyzed for pesticides

Pharmaceuticals

Pine Lake 1 was not analyzed for pharmaceuticals

Industrial chemicals

Pine Lake 1 was not analyzed for industrial chemicals

Fecal coliforms

No fecal coliforms, including *E. coli* bacteria were detected in Pine Lake 1, either from the littoral sampling site on the eastern side of the lake or from the index site near the deepest point of the lake.

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Change over time

The longest core retrieved from Pine Lake was 53 cm long. The bottom of the core was dated to 1947 (Figure 4). Sediment cores have not yet been analysed for total metals, diatoms or zooplankton cladoceran temporal changes.

Figure 4. The longest sediment core from Pine Lake 1.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 6.3m, and a hypolimnion at 7.45m on July 18, 2019 (Figure 5a). Dissolved oxygen was around 120% at the surface of the lake, and increased to 149% in the hypolimnion (Figure 5b).

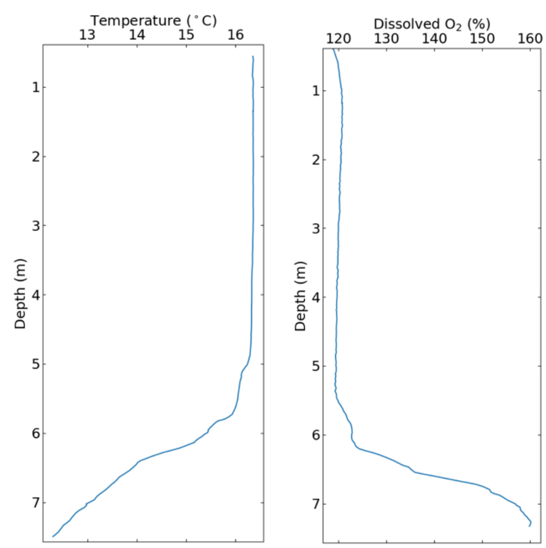

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) profiles as measured in Pine Lake 1. Figures from Fradette, 2021.

Second Wye Lake

Figure 1. Second Wye Lake and immediate watershed delineated in black. Adapted from Fradette, 2021.

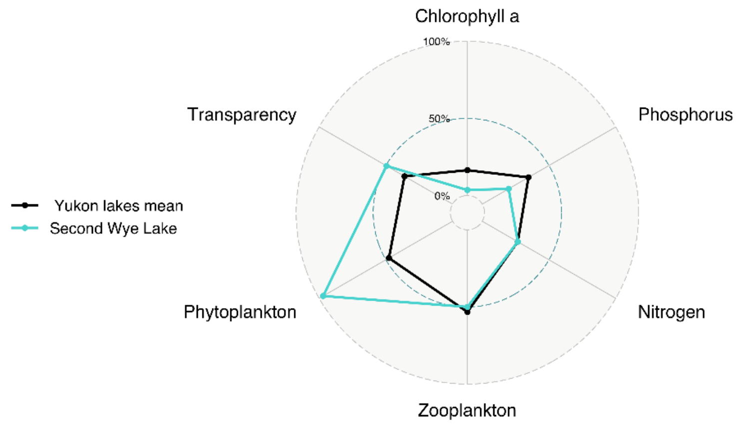

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Second Wye Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
0.30 km^2	22.07 km^2
MAXIMUM DEPTH	POPULATION
28 m	832
AVERAGE DEPTH	ELEVATION
3.5 m	689 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-16	0 km^2

Location

Second Wye Lake is located in Southeastern Yukon, within the community of Watson Lake.

Land Use

84.1% of Second Wye Lake's 22.07 km^2 watershed is natural. 5.2% is composed of water (including the lake itself). 10.1% of the watershed is urbanized and the remaining 0.6% of the watershed is comprised forest loss (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 7.7m the day of the sampling. The color value was of 2.95 mg/L Pt. Dissolved organic carbon had a value of 3.6 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (10.51 µg/L) and chlorophyll a (0.76 µg/L) values in Second Wye Lake were very similar to their respective Yukon mean (Figure 2). According to the Canadian water quality guidelines for the protection of aquatic life, Second Wye Lake is mesotrophic. Total nitrogen value from this lake was discarded because of bad data quality.

Food chain health

Four zooplankton species were identified in Second Wye Lake, which is same as the Yukon average. However, phytoplankton diversity was the second highest across all 24 Yukon lakes, with 39 species identified (Figure 2). Cyanobacteria concentration indicated a low risk exposure to cyanotoxins, and two potential bloom formers / toxin producer species of the cyanobacteria group were identified.

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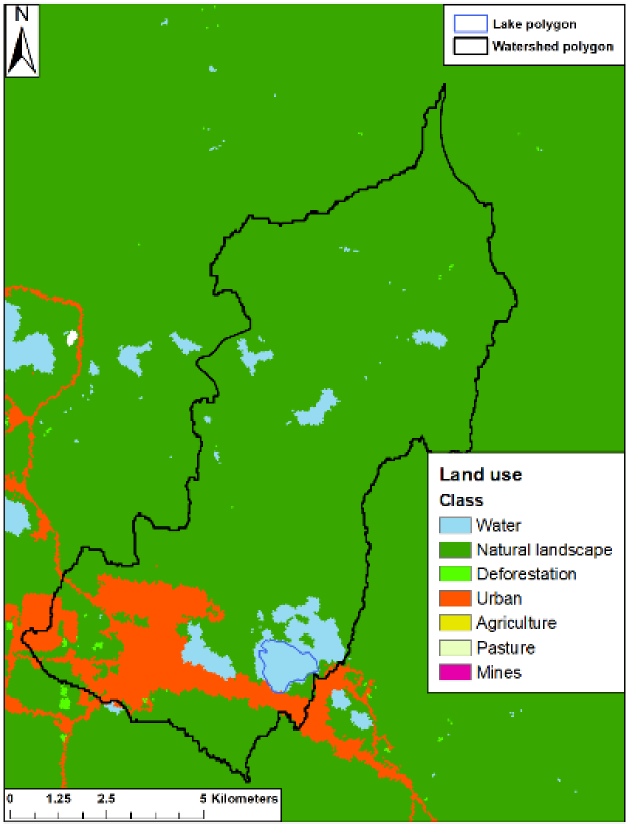

Figure 3. Immediate watershed and land use around Second Wye Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Second Wye Lake.

Pharmaceuticals

No pharmaceutical products were reported in Second Wye Lake.

Industrial chemicals

No industrial chemicals were detected in this Second Wye Lake.

Fecal coliforms

Fecal coliforms were detected in Second Wye Lake, at the littoral sampling site near 3rd St N. The fecal bacteria detected were not of the *E. coli* species.

Change over time

Sediment cores were retrieved from Second Wye Lake, but have not yet been analyzed for total metal, diatoms or zooplankton cladoceran temporal changes yet. The longest core was 54 cm long.

Figure 4. The longest sediment core retrieved from Second Wye Lake was 54cm long.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 5.9m, and a hypolimnion at 9.3m on the sampling day (Figure 5a). Dissolved oxygen had a value of 113% at the surface of the lake, but reduced to 39% of oxygen in the hypolimnion (Figure 5b).

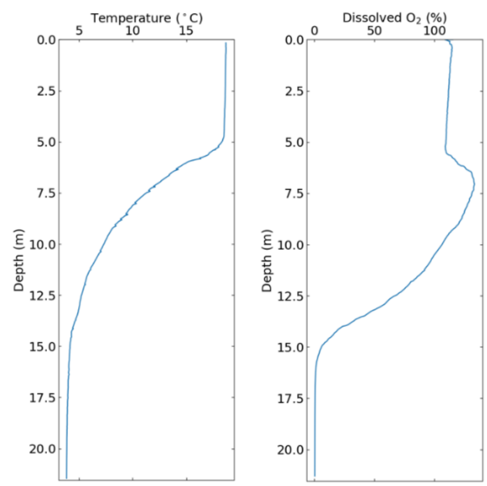

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) profiles as measured in Second Wye Lake. Figures from Fradette, 2021.

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Two Moose Lake

Figure 1. Two Moose Lake and immediate watershed delineated in black. Adapted from Fradette, 2021.

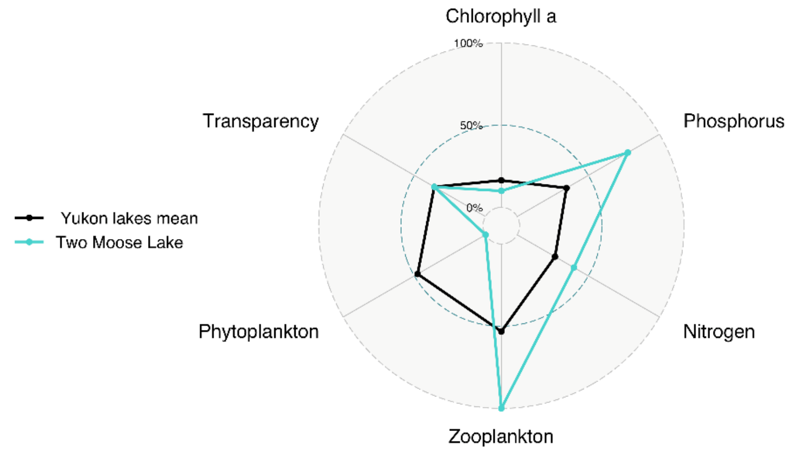

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Two Moose Lake (shown in blue).

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
0.12 km^2	0.92 km^2
SAMPLING DEPTH	POPULATION
1.4 m	0
AVERAGE DEPTH	ELEVATION
5 m	1077 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-08-12	0 km^2

Location

Two Moose Lake is located in central Yukon, about 140 km north of Dawson City in Tombstone Territorial Park. It lies on the west side of the Dempster Highway.

Land Use

83.4% of Two Moose Lake's 0.92 km^2 watershed is natural. 14.2 % is composed of water (including the lake itself). The remaining 2.5 % of the watershed, including the Dempster Hwy, comprised of urbanized land (Figure 3).

Aquatic ecosystem health

Water color and transparency

The Secchi disk depth was equivalent to lake depth (i.e. secchi depth was visible to lake bottom). The color value was 46.63 mg/L Pt. Dissolved organic carbon had a value of 11.51 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (23.50 µg/L) and total nitrogen (0.35 mg/L) values in Two Moose Lake were both above their respective mean values (Figure 2). Whereas, chlorophyll a (1.38 µg/L) was slightly below the Yukon mean. According to the Canadian water quality guidelines for the protection of aquatic life, Two Moose Lake is meso-eutrophic.

Food chain health

Six zooplankton species were identified in Two Moose Lake, which is the highest diversity of all Yukon lakes. However, seven phytoplankton species were identified, which is the lowest diversity of all Yukon lakes (Figure 2). Cyanobacteria concentration indicated a low risk of cyanotoxin exposure. One potential bloom formers / toxin producer species of the cyanobacteria group was identified.

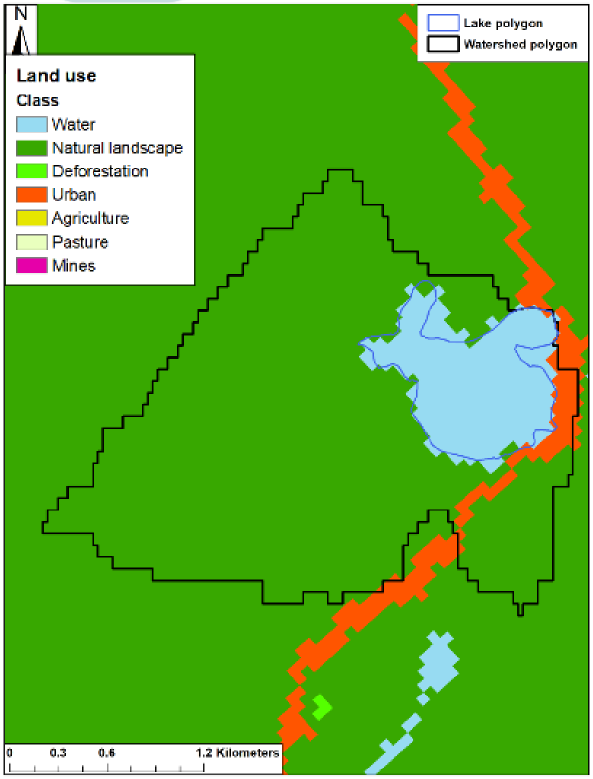

Figure 3. Watershed and land use around Two Moose Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Two Moose Lake.

Pharmaceuticals

102 µg/L of carbamazepine, an anticonvulsant drug was detected in Two Moose Lake. This concentration is 10 times over the guideline established by the Canadian Council of Ministers of the Environment.

Industrial chemicals

No industrial chemicals were detected in Two Moose Lake.

Fecal coliforms

Fecal coliforms were detected in Two Moose Lake, from the littoral sampling site located on the side of the Dempster Hwy. However, the fecal bacteria detected were not of the E. coli species and no fecal coliforms were found from the sampling site near the middle of the lake.

Change over time

The longest core retrieved from Two Moose Lake was 48 cm long. The bottom of the core was dated to 1968 (Figure 4a). The analysis of diatom assemblage from the top and the bottom of the core revealed a temporal dissimilarity of 0.34 (Figure 4b).

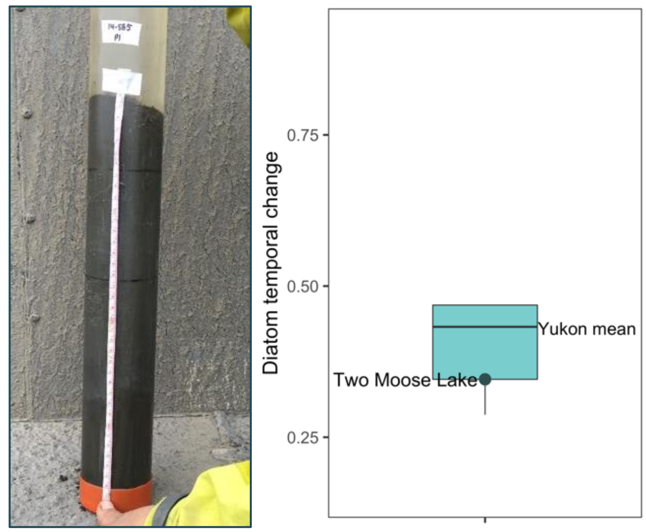

Figure 4. a) The longest sediment core retrieved from Two Moose Lake. b) Mean (± Standard error) of diatom temporal change between the bottom and the top of the core. Two Moose Lake value is indicated with a green dot.

Temperature & dissolved oxygen

A shallow basin (1.4 m depth) prevented stratification from occurring in Two Moose Lake. The average surface temperature was 11.8°C on the day of sampling. Dissolved oxygen had an average value of 112.6% (Figure 5b). Since only surface measurements were collected, no temperature or oxygen profiles are shown.

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Watson Lake

Figure 1. Watson Lake and immediate watershed delineated in black. Adapted from Fradette, 2021.

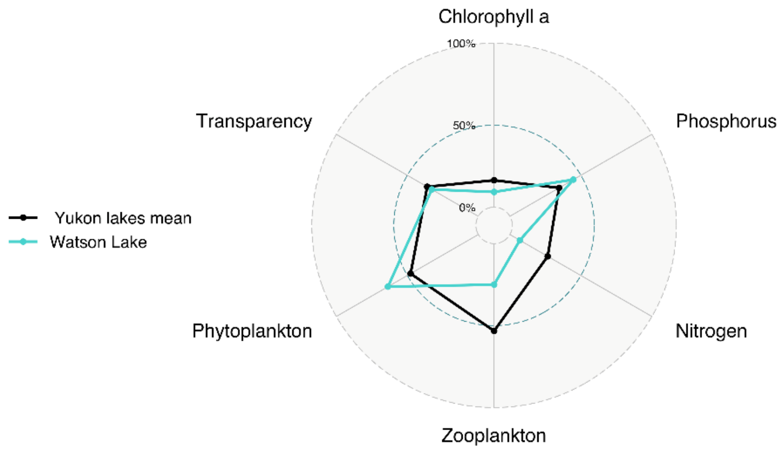

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Watson Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
13.44 km²	161.29 km²
MAXIMUM DEPTH	POPULATION
36 m	28
AVERAGE DEPTH	ELEVATION
12 m	677 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-15	0 km²

Location

Watson Lake is located approximately 4 km north of the community of Watson Lake, in Southeastern Yukon, along the Robert Campbell Highway.

Land Use

89.1% of Watson Lake's 161.29 km² watershed is natural. 9.5% is composed of water (including the lake itself). 1.4% of the watershed is urbanized. The remaining of the watershed comprised of <1% of forest loss and mines (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 5.4 m. The color value was of 2.66 mg/L Pt. Dissolved organic carbon had a value of 3.85 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (16.10 µg/L) and total nitrogen (0.08 mg/L) values in Watson Lake were below the Yukon average (Figure 2). Chlorophyll a (1.31 µg/L) was also below the Yukon average. According to the Canadian water quality guidelines for the protection of aquatic life, Watson Lake is mesotrophic.

Food chain health

Three zooplankton species were identified in Watson Lake, which is below Yukon's mean. However, 28 phytoplankton species were identified, which is above the Yukon mean (Figure 2). The cyanobacteria concentration indicated a low risk exposure to cyanotoxins, and one potential bloom former / toxin producer species of the cyanobacteria group was identified.

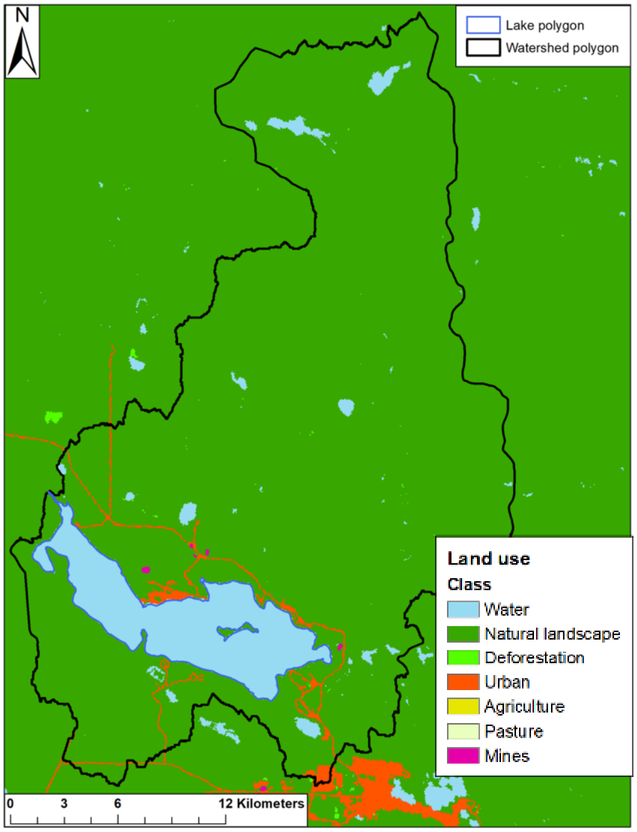

Figure 3. Immediate watershed and land use around Watson Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Watson Lake.

Pharmaceuticals

No pharmaceutical products were reported in Watson Lake.

Industrial chemicals

2 ng/L of Tris(2-chloroethyl) Phosphate (TCEP), a flame retardant was found in Watson Lake.

Fecal coliforms

No fecal coliforms, including *E. coli* bacteria were detected in Watson Lake, either from the littoral sampling site along the Robert Campbell Highway or from the index site near the deepest point of the lake.

Change over time

The longest core retrieved from Watson Lake was 47 cm long (Figure 4a). The analysis of diatom assemblage from the top and the bottom of the core revealed a temporal dissimilarity of 0.16, which is was to lowest of all sampled Yukon Lakes (Figure 4b).

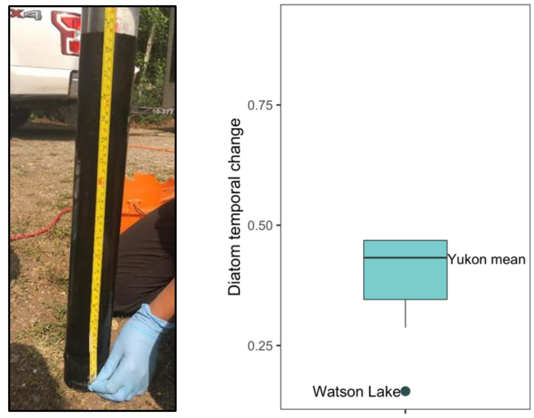

Figure 4. a) The longest sediment core retrieved from Watson Lake. b) Mean (± Standard error) of diatom temporal change between the bottom and the top of the core. Watson Lake value is indicated with a green point.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 7.6m and a hypolimnion at 10.9m on July 15, 2019. Dissolved oxygen had a value of 112% at the lake surface but fell to 45% oxygen in the hypolimnion.

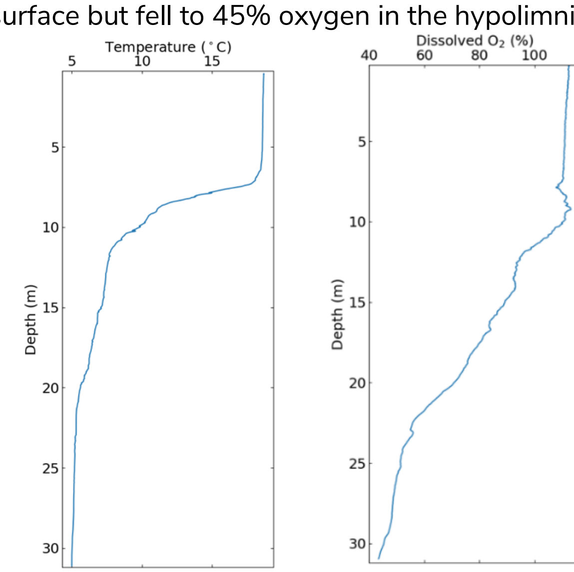

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Watson Lake. Figures from Fradette, 2021.

Wolverine Lake

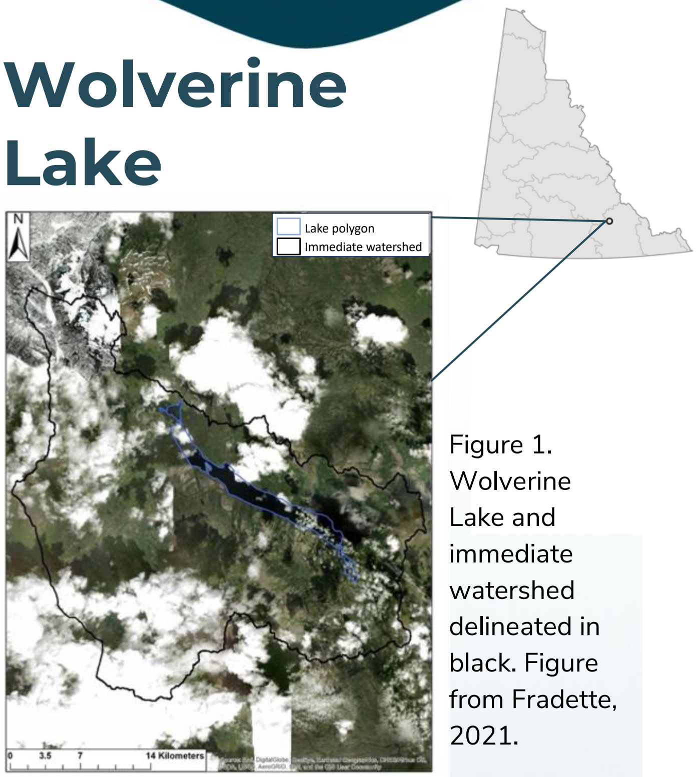

Figure 1. Wolverine Lake and immediate watershed delineated in black. Figure from Fradette, 2021.

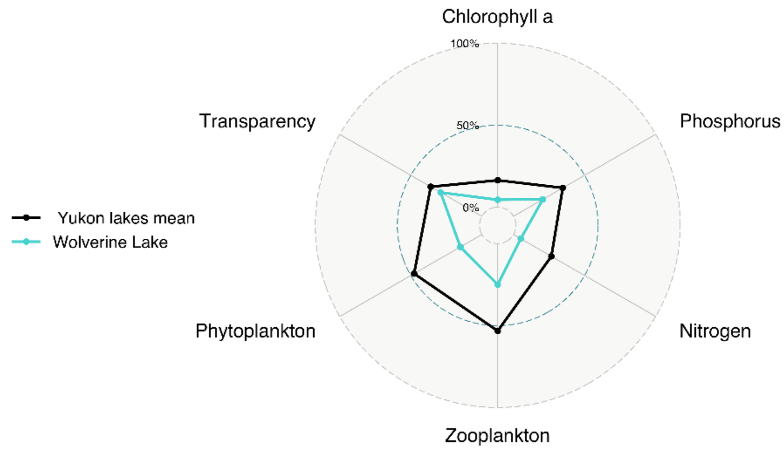

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Wolverine Lake (shown in blue).

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
7.64 km^2	195.23 km^2
MAXIMUM DEPTH	POPULATION
73 m	3
AVERAGE DEPTH	ELEVATION
21.2 m	1115 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-17	0 km^2

Location

Wolverine Lake is located in Southeastern Yukon, about 190 km North of Watson Lake. It can be reached using forestry roads from the Robert Campbell Highway.

Land Use

94.1% of Wolverine Lake's 195.23 km^2 watershed is natural. 5.6% is composed of water (including the lake itself). The remaining 0.3% of the watershed is comprised of forest loss, urban land and mines (Figure 3).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 4.9m the day of the sampling. The color value was of 10.89 mg/L Pt. Dissolved organic carbon had a value of 3.87 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (10.69 µg/L) and total nitrogen (0.07 mg/L) values in Wolverine Lake were below their respective Yukon mean (Figure 2). Chlorophyll a (0.86 µg/L) was also below the mean. According to the Canadian water quality guidelines for the protection of aquatic life, Wolverine Lake is mesotrophic.

Food chain health

Three zooplankton species and 12 phytoplankton species were identified in Wolverine Lake, which is below the Yukon average (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins, but no potential bloom former / toxin producer species of the cyanobacteria group were identified.

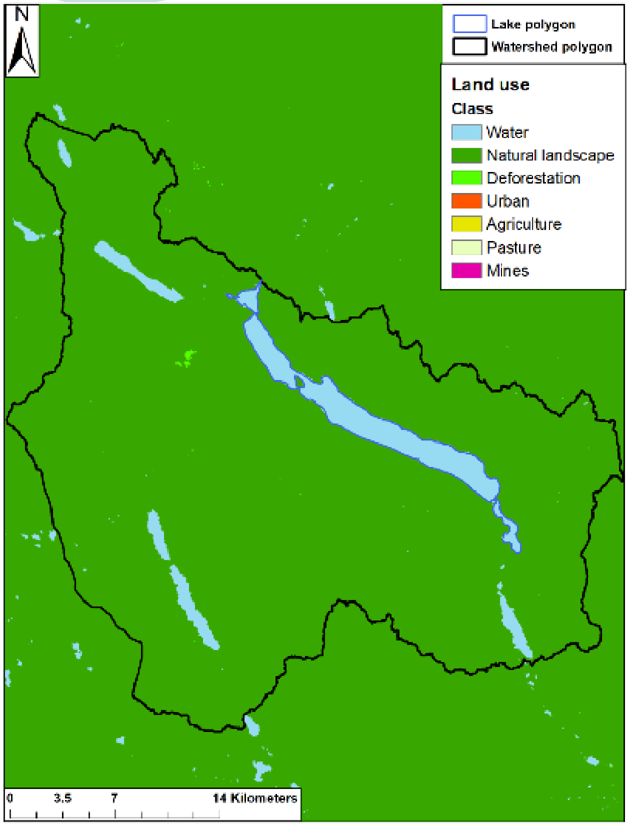

Figure 3. Watershed and land use around Wolverine Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

Wolverine Lake was not analyzed for pesticides.

Pharmaceuticals

Wolverine Lake was not analyzed for pharmaceuticals.

Industrial chemicals

Wolverine Lake was not analyzed for industrial chemicals.

Fecal coliforms

Fecal coliforms were detected in Wolverine Lake, both from the littoral sampling site on the south shore of the lake and from the index site near the deepest point of the lake. However, the fecal bacteria detected were not of the *E. coli* species.

Change over time

Sediment cores were retrieved from Wolverine Lake, but have not yet been analyzed for total metals, diatoms or zooplankton cladoceran temporal changes. The longest core was 39 cm long.

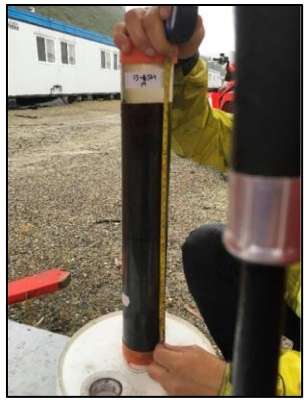

Figure 4. The longest sediment core retrieved from Wolverine Lake.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 9.2 m and a hypolimnion at 9.9 m on the sampling day (Figure 5a). Dissolved oxygen had a value of 110% at the lake surface, and minimal values around 85% oxygen at the lake bottom (Figure 5b).

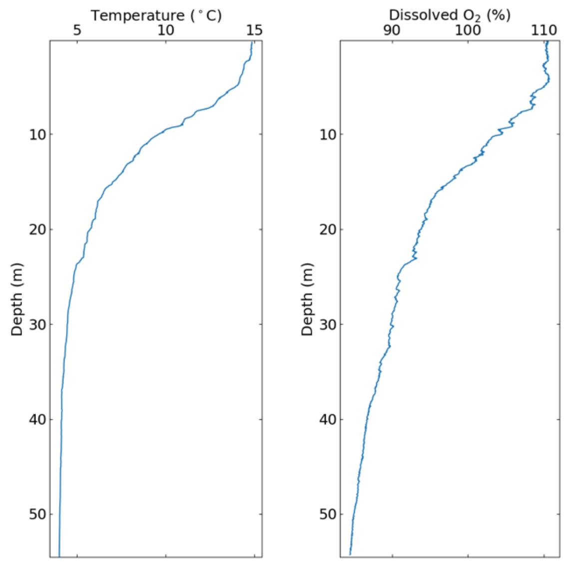

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Wolverine Lake. Figures from Fradette, 2021.

Wye Lake

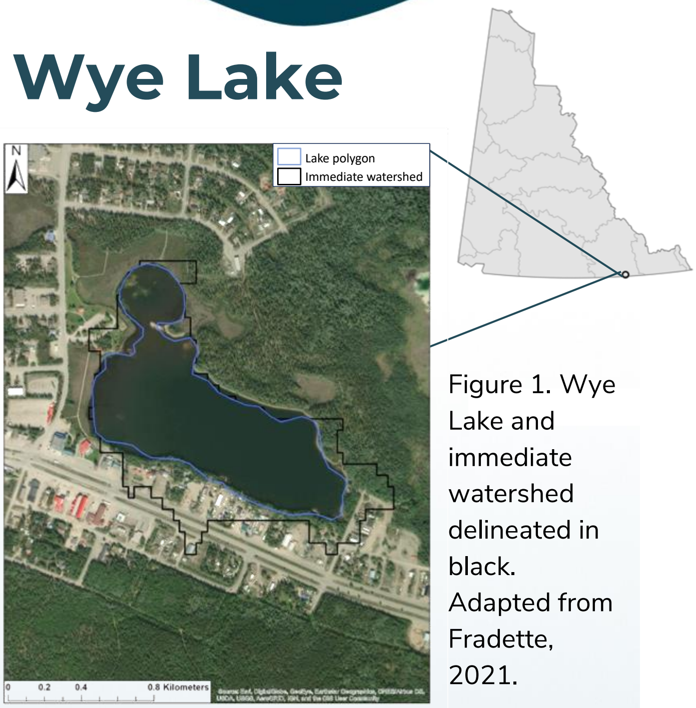

Figure 1. Wye Lake and immediate watershed delineated in black. Adapted from Fradette, 2021.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
0.19 km²	0.29 km²
MAXIMUM DEPTH	**POPULATION**
5.6 m	13
AVERAGE DEPTH	**ELEVATION**
2.7 m	692 m
SAMPLING DATE	**FOREST FIRES 2014-2019**
2019-07-17	0 km²

Location

Wye Lake is located in southern Yukon, within the limits of Watson Lake. It lies on the north side of the Alaska Highway.

Land Use

Wye's Lake watershed is very small relative to the lake. 10.8% of the 0.29 km² watershed is natural. The largest part (64.5%) is composed of water, including the lake itself. The remaining 24.7% of the watershed comprised urban land (Figure 3).

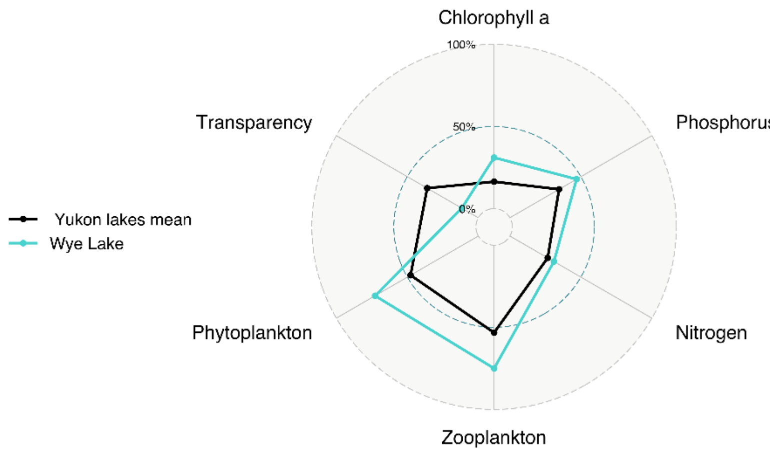

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Wye Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 2.53 m the day of the sampling. The color value was of 3.39 mg/L Pt. Dissolved organic carbon had a value of 6.95 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (16.60 µg/L) and total nitrogen (0.28 mg/L) values in Wye Lake were very similar to their respective Yukon mean (Figure 2). Chlorophyll a (3.40 µg/L) was slightly below the mean. According to the Canadian water quality guidelines for the protection of aquatic life, Wye Lake is mesotrophic.

Food chain health

Five zooplankton species were identified in Wye Lake, which is above Yukon's average. Phytoplankton diversity was slightly above average, with 31 species identified (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins, and 2 potential bloom formers / toxin producer species of the cyanobacteria group were identified.

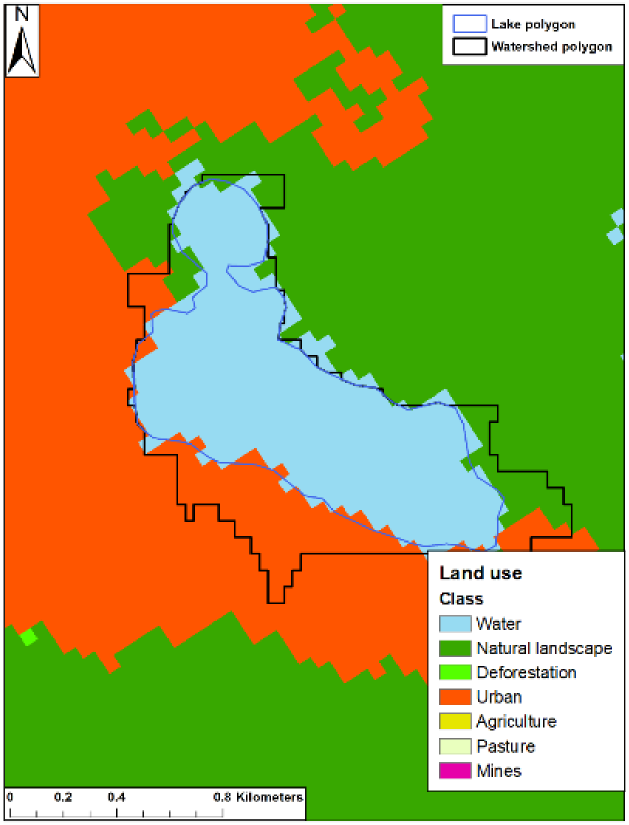

Figure 3. Immediate watershed and land use around Wye Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

Wye Lake was not analyzed for pesticides.

Pharmaceuticals

Wye Lake was not analyzed for pharmaceuticals.

Industrial chemicals

Wye Lake was not analyzed for industrial chemicals.

Fecal coliforms

Fecal coliforms were detected in Wye Lake, from the littoral sampling site located on the shore of Wye Lake park. However, the fecal bacteria detected were not of the *E. coli* species.

Change over time

The longest core retrieved from Wye Lake was 60 cm long. The bottom of the core was dated to 1830 (Figure 4a). The analysis of diatom assemblage from the top and the bottom of the core revealed a temporal dissimilarity of 0.69. This was the oldest core sample collected across all Yukon lakes.

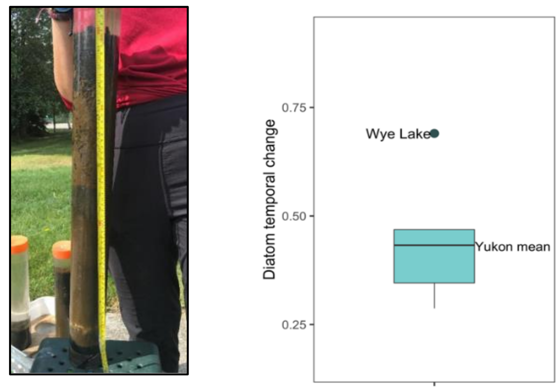

Figure 4. a) The longest sediment core retrieved from Wye Lake. b) Mean (± Standard error) of diatom temporal change between the bottom and the top of the core. Watson Lake value is indicated with a green point.

Temperature & dissolved oxygen

Wye Lake was not stratified in the 3.5m depth profile. The surface temperature was 19.8°C on July 17, 2019 (Figure 5a). Dissolved oxygen remained elevated throughout the profile, with minimal values around 100% of oxygen at the bottom of the lake (Figure 5b).

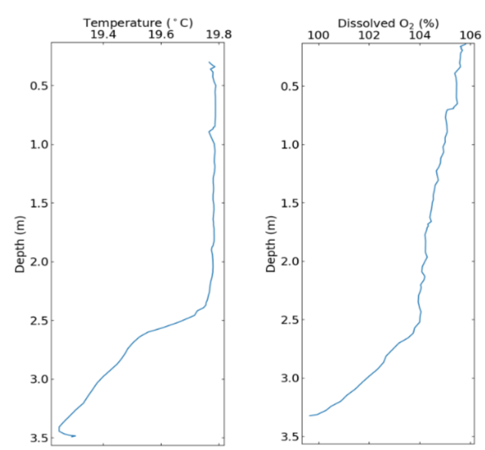

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Wye Lake. Figures from Fradette, 2021.

Yukon River Watershed

Headwaters Yukon, Upper Yukon, Pelly and Stewart

Yukon River Watershed - Lakes

- Lake 13-587
- Bennett Lake
- Enger Lake
- Ethel Lake
- Fish Eye Lake
- Fox Lake
- Gravel Lake (pond)
- Jackfish Lake
- Chu Cho (Little Salmon Lake)
- Minto Lake

Lake 13-587

Unnamed lake adjacent to Marsh Lake

Figure 1. Lake 13-587 and immediate watershed delineated in black. Adapted from Fradette, 2021.

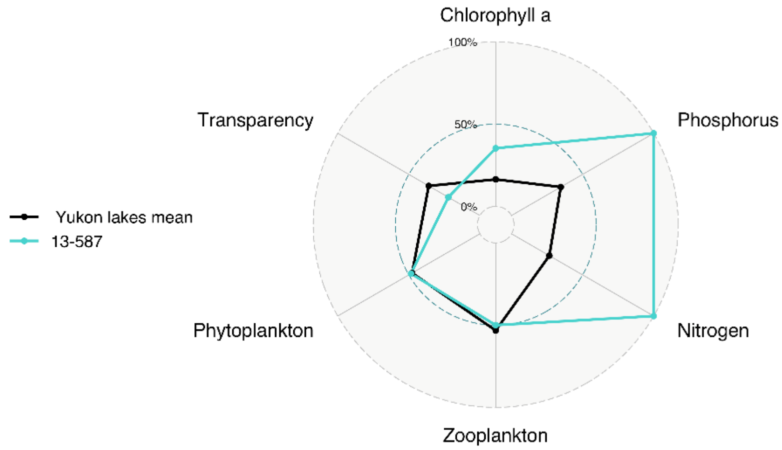

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (black) in comparison with Lake 13-587 (blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
0.11 km^2	0.77 km^2
MAXIMUM DEPTH	POPULATION
6 m	12
AVERAGE DEPTH	ELEVATION
4 m	664 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-08-17	0 km^2

Location

Lake 13-587 is located in southcentral Yukon, within the Marsh Lake community and on the east side Judas Creek Drive. The lake coordinates are 60°27'01.1"N 134°15'55.2"W.

Land Use

81.83% of Lake 13-587's 0.77 km^2 watershed is natural. 15.04% is composed of water (including the lake itself). The remaining 3.13% of the watershed is urbanized land (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 4.0 m. The color value was 14.38 mg/L Pt, while the dissolved organic carbon was 19.71 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (28.50 µg/L) and total nitrogen (0.84 mg/L) values in Lake 13-587 were above the Yukon average, while chlorophyll a (3.81 µg/L) was below the Yukon average (Figure 2). According to the Canadian water quality guidelines for the protection of aquatic life, Lake 13-587 is meso-eutrotrophic.

Food chain health

Four zooplankton species and 23 phytoplankton species were identified in Lake 13-587, which is the same as the Yukon average (Figure 2). Cyanobacteria concentration indicated a low risk of cyanotoxin exposure. One potential bloom formers / toxin producer species of the cyanobacteria group was identified.

waterresources@yukon.ca

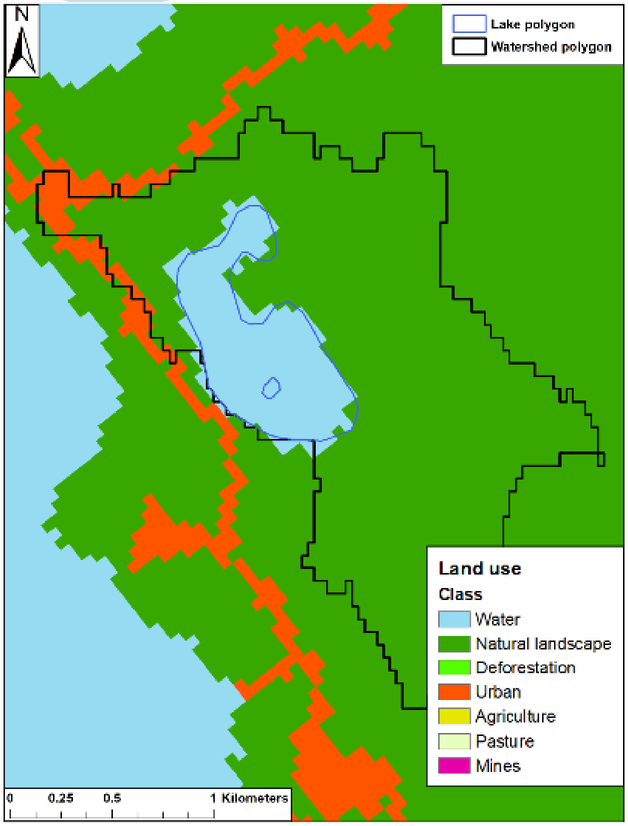

Figure 3. Immediate watershed and land use around Lake 13-587. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Lake 13-587.

Pharmaceuticals

No pharmaceutical products were reported in Lake 13-587.

Industrial chemicals

No industrial chemicals were reported.

Fecal coliforms

Fecal coliforms, including *E. coli* bacteria were detected in Lake 13-587 from the littoral sampling site on the northern side of the lake. Fecal coliforms that were not of *E. coli species* were also detected at the index site near the deepest point of the lake.

Change over time

Sediment cores were retrieved from Lake 13-587, but have not yet been analyzed for total metals, diatoms or zooplankton cladoceran temporal changes. The longest core was 48 cm.

Figure 4. The longest sediment core retrieved from Lake 13-587.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 4.6 m and a hypolimnion at 4.8 m on the sampling day (Figure 5a). Dissolved oxygen was elevated throughout the profile, but reduced to 50% of oxygen in the hypolimnion (Figure 5b).

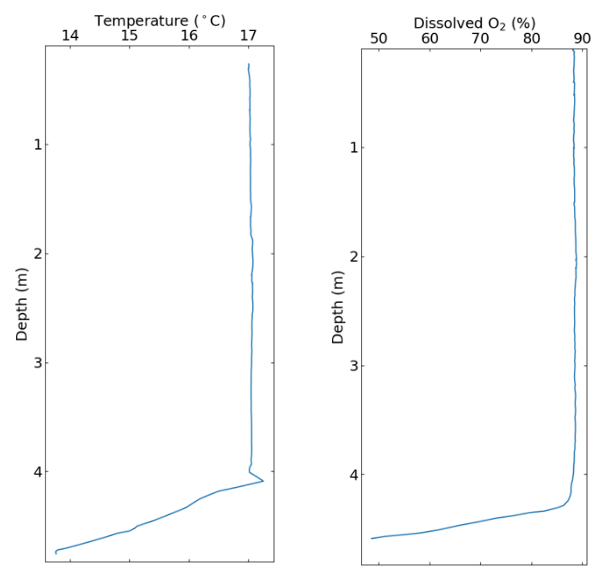

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Lake 13-587. Figures from Fradette, 2021.

waterresources@yukon.ca

Bennett Lake

Figure 1. Bennett Lake and immediate watershed delineated in black. Adapted from Fradette, 2021

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
91.12 km^2	3341.37 km^2
MAXIMUM DEPTH	POPULATION
127 m	468
AVERAGE DEPTH	ELEVATION
68.6 m	640 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-23	0 km^2

Location

Bennett Lake is located in Southwestern Yukon. It is located near Carcross along the South Klondike Highway.

Land Use

95.6% of Bennett Lake's 3341.37 km^2 watershed is natural. 4.2% is composed of water (including the lake itself). The remaining 0.2% of the watershed is comprised of 0.1% urbanization, 0.01% forest loss and <0.01% mines (Figure 3).

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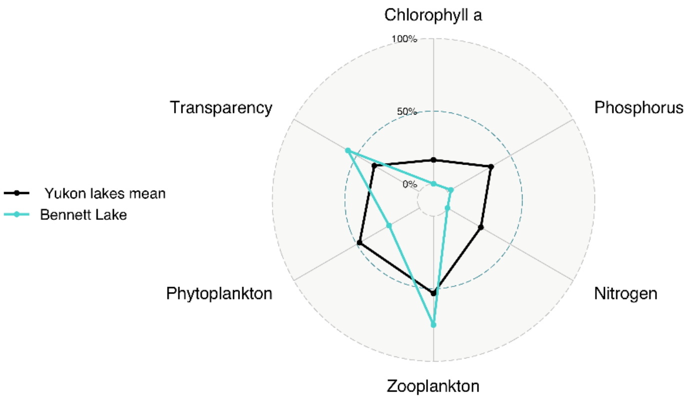

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Bennett Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 8.7m on the day of sampling. The color value was 0.5 mg/L Pt, which was the lowest value of all Yukon lakes sampled. Dissolved organic carbon had a value of 0.6 mg/L, which was also the lowest of all lakes sampled in Yukon.

Chlorophyll a, nutrients and trophic status

Total phosphorus (6.68 µg/L) and total nitrogen (0.03 mg/L) concentrations in Bennett Lake were low compared to the Yukon mean (Figure 2). Chlorophyll a (0.42 µg/L) was also below the mean. According to the Canadian water quality guidelines for the protection of aquatic life, Bennett Lake is oligotrophic.

Food chain health

Five zooplankton species were identified in Bennett Lake, which is more than the Yukon mean. However, only 15 phytoplankton species were identified which is below the Yukon mean (Figure 2). Cyanobacteria concentration indicated a low risk of cyanotoxin exposure, but 2 potential bloom formers / toxin producer species of the cyanobacteria group were identified.

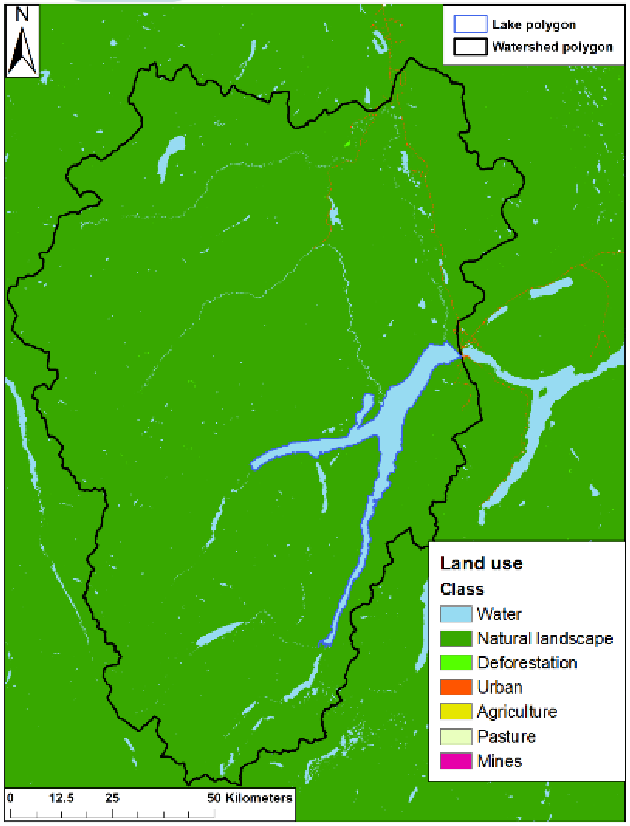

Figure 3. Immediate watershed and land use around Bennett Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Bennett Lake.

Pharmaceuticals

No pharmaceutical products were reported in Bennett Lake.

Industrial chemicals

No industrial chemicals were reported.

Fecal coliforms

No fecal coliforms, including *E. coli* bacteria were detected in Bennett Lake, either from the littoral sampling site near the train station or from the index site near the deepest point of the lake.

Change over time

Sediment cores were retrieved from Bennett Lake, but core length was not long enough for analysis.

Figure 4. The longest sediment core retrieved from Bennett Lake was 11cm long.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 0.3 m and a hypolimnion at 8.8 m to 25m on the sampling day (Figure 4a). Dissolved oxygen remained elevated throughout the profile, with the lowest values of 100% saturation found at lake bottom (Figure 4b).

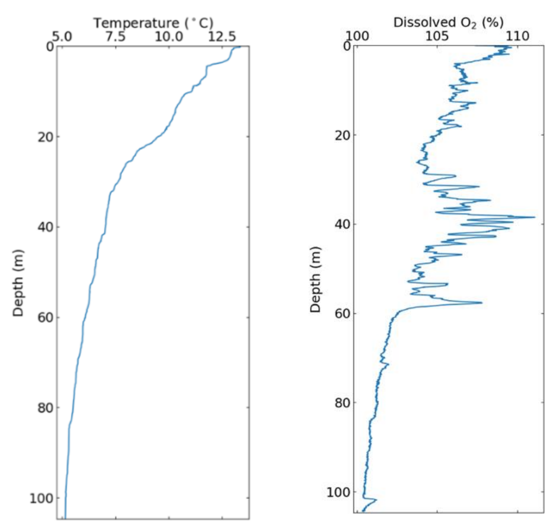

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Bennett Lake. Figure from Fradette, 2021.

Enger Lake

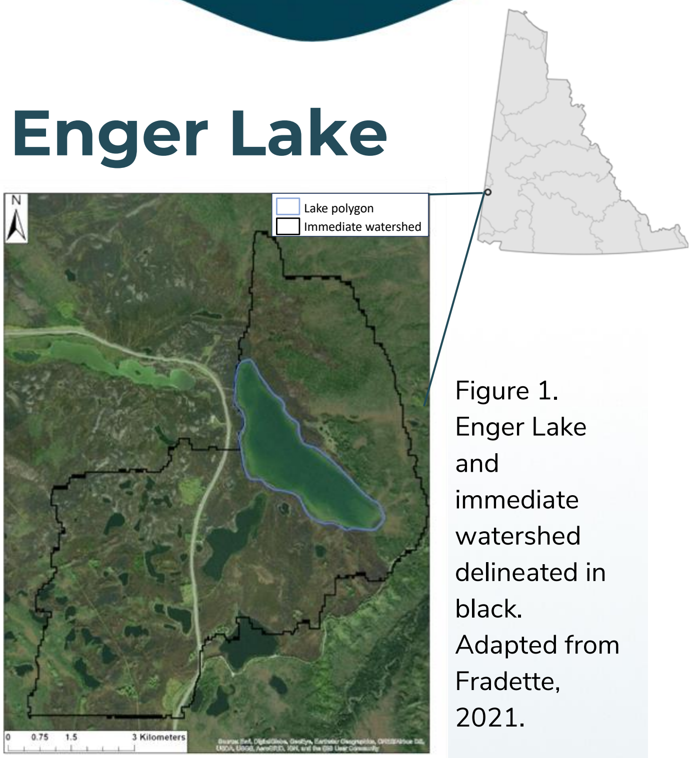

Figure 1. Enger Lake and immediate watershed delineated in black. Adapted from Fradette, 2021.

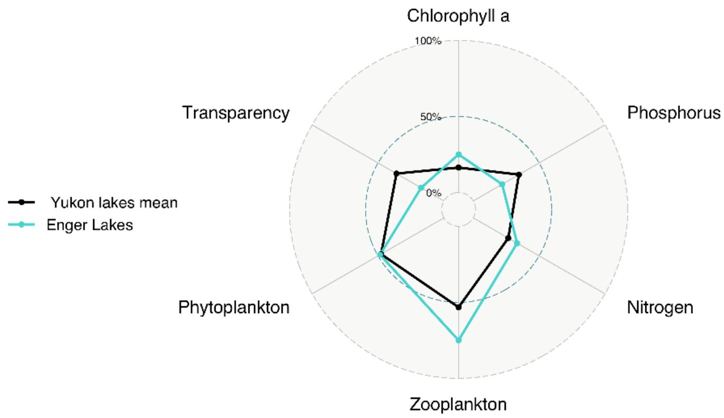

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (black) in comparison with Enger Lake (blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
1.17 km^2	11.31 km^2
MAXIMUM DEPTH	POPULATION
16 m	0
AVERAGE DEPTH	ELEVATION
6.3m	741 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-27	8.17 km^2

Location

Enger Lake is located in Southwestern Yukon, about 2 km north of Snag Junction, on the east side of the Alaska Highway.

Land Use

80.5% of Enger Lake's 11.31 km^2 watershed is natural. 17.7% is composed of water (including the lake itself). 1.4% of the watershed is urbanized, while the remaining 1.4% is comprised of forest loss and mines (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 3.3m on the day of the sampling. The color value was of 7.12 mg/L Pt. Dissolved organic carbon had a value of 12.50 mg/L. These values could be partially influenced by the forest fires that occurred in the watershed 2-3 weeks prior to sampling.

Chlorophyll a, nutrients and trophic status

Total phosphorus (10.99 µg/L) and total nitrogen (0.30 mg/L) values in Enger Lake were slightly below the Yukon mean (Figure 2). Chlorophyll a (2.82 µg/L) was also below average. According to the Canadian water quality guidelines for the protection of aquatic life, Enger Lake is mesotrophic.

Food chain health

Five zooplankton species were identified in Enger Lake, which is above Yukon average. Phytoplankton diversity was equivalent to Yukon average, with 23 species identified (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins, and no potentially bloom former / toxin producer species of the cyanobacteria group were identified.

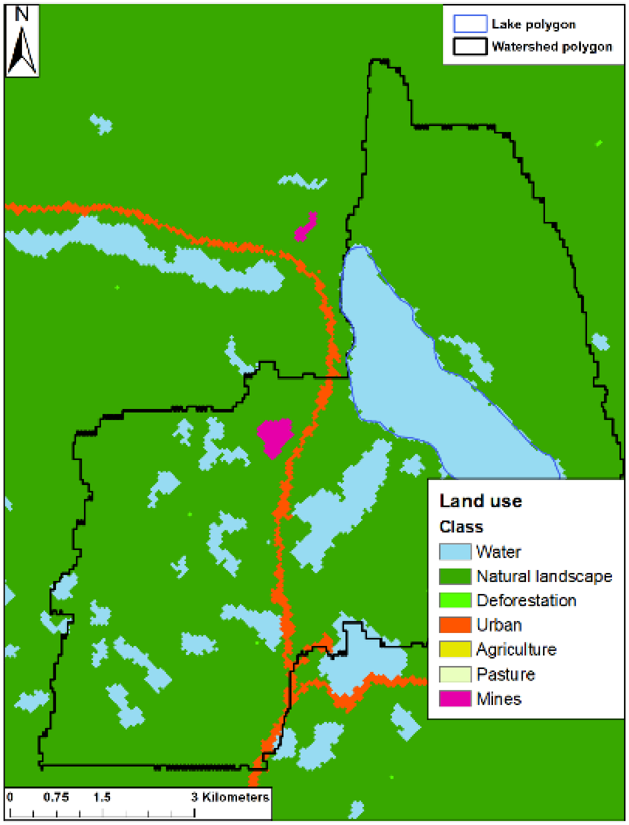

Figure 3. Immediate watershed and land use around Enger Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

Enger Lake was not analyzed for pesticides.

Pharmaceuticals

Enger Lake was not analyzed for pharmaceuticals.

Industrial chemicals

Enger Lake was not analyzed for industrial chemicals.

Fecal coliforms

Fecal coliforms were detected in Enger Lake, both from the littoral sampling site on the North side of the lake and index site near the deepest point of the lake. However, the fecal bacteria detected were not of the *E. coli* species.

Change over time

Sediment cores were retrieved from Enger Lake, but have not yet been analyzed for total metal, diatoms or zooplankton cladoceran temporal changes. The longest core was 56 cm. A black layer was observed on top of the core that might have been caused by forest fire that occurred 2-3 weeks prior to sampling.

Figure 4. The second-longest sediment core retrieved from Enger Lake was 43 cm. Picture from the longest core was lost.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 7.8m and a hypolimnion at 9.5m on the sampling day (Figure 5). Dissolved oxygen data was unavailable due to instrumentation malfunction.

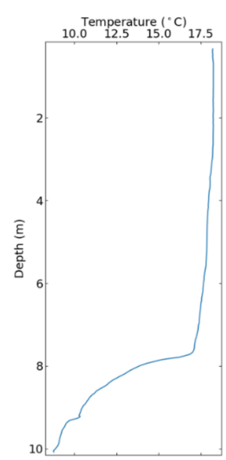

Figure 5. Temperature (°C) profile as measured in Enger Lake. Figures from Fradette, 2021.

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Ethel Lake

Takwą̄nt'ye

Figure 1. Ethel Lake, (*Takwą̄nt'ye*) and immediate watershed delineated in black. Adapted from Fradette, 2021.

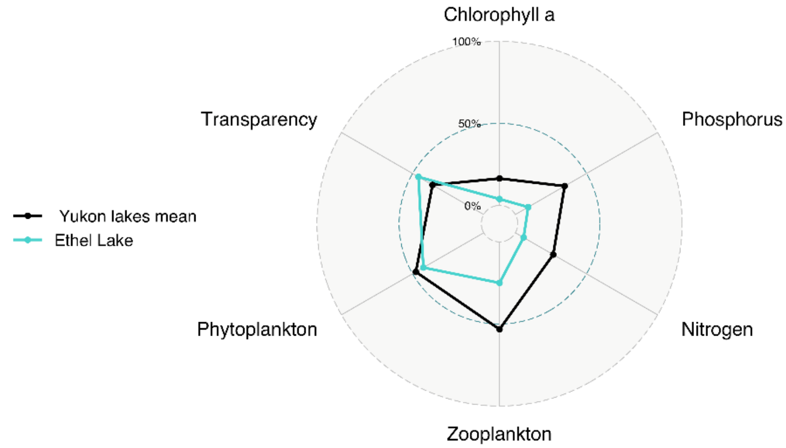

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Ethel Lake (shown in blue).

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
43.31 km^2	289.35 km^2
MAXIMUM DEPTH	POPULATION
60 m	0
AVERAGE DEPTH	ELEVATION
37 m	675 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-23	69.65 km^2

Location

Ethel Lake is located in central Yukon, about 15 km east of Stewart Crossing. It is located at 63°21'41.9"N 136°03'44.7"W.

Land Use

84.7% of Ethel Lake's 2449.32 km^2 watershed is natural. 15.2% is composed of water (including the lake itself). The remaining 0.2% of the watershed is comprised of forest loss or urbanized land (Figure 3).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 7.2 m the day of the sampling. The color value was of 6.62 mg/L Pt. Dissolved organic carbon had a value of 4.35 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (8.10 µg/L) and total nitrogen (0.07 mg/L) values in Ethel Lake were both lower than the Yukon mean (Figure 2). Chlorophyll a (0.80 µg/L) was also below average. According to the Canadian water quality guidelines for the protection of aquatic life, Ethel Lake is oligotrophic.

Food chain health

Three zooplankton and 21 phytoplankton species were identified in Ethel Lake, which is below Yukon's diversity average (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins. No potential bloom former / toxin producer species of the cyanobacteria group were identified.

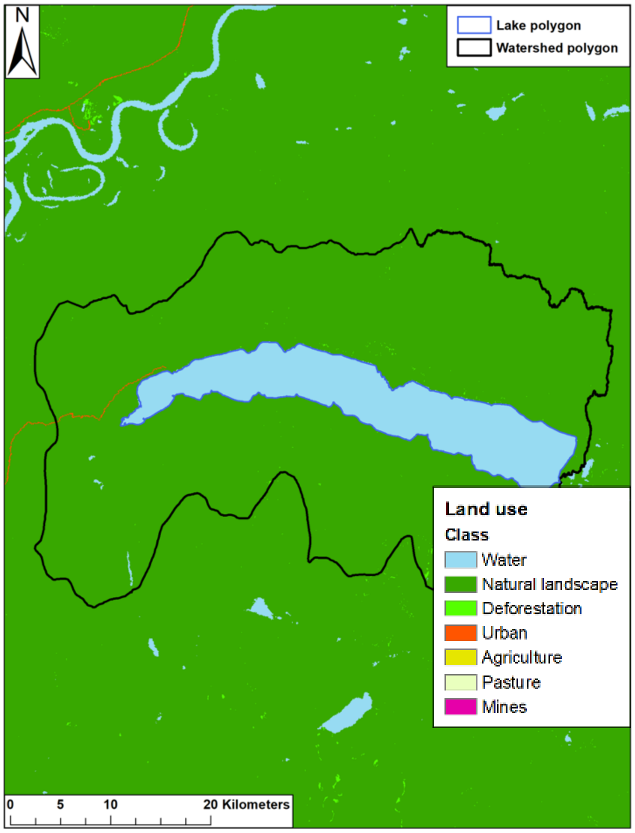

Figure 3. Immediate watershed and land use around Ethel Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Ethel Lake.

Pharmaceuticals

No pharmaceutical products were reported in Ethel Lake.

Industrial chemicals

6 ng/L of Tris(2-chloroethyl) Phosphate(TCEP), a flame retardant was detected in Ethel Lake.

Fecal coliforms

No fecal coliforms, including *E. coli* bacteria were detected in Ethel Lake, from either the littoral sampling site near the campground, or from the index site near the deepest point of the lake.

waterresources@yukon.ca

Change over time

Sediment cores were retrieved from Ethel Lake, but have not yet been analyzed for total metals, diatoms or zooplankton cladoceran temporal changes yet. The longest core was 46 cm.

Figure 4. The longest sediment core from Ethel Lake.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 7.7 m and a hypolimnion at 14.1 m on the day of sampling (Figure 5a). Dissolved oxygen had a value of 106% at the surface and reduced to 85% in the hypolimnion (Figure 5b).

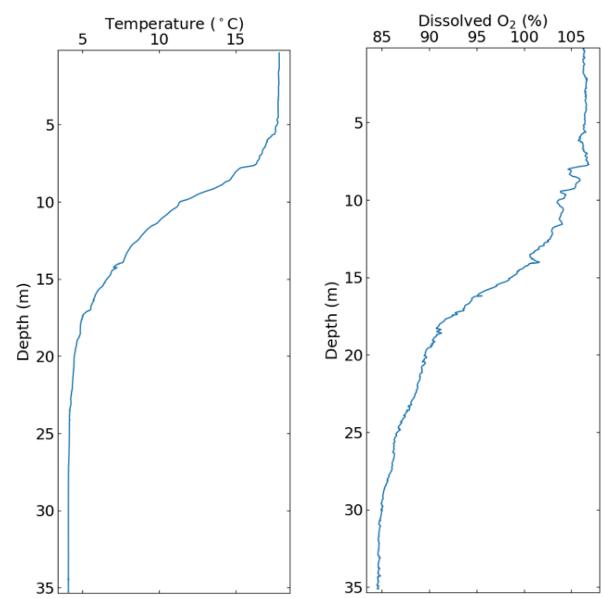

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Ethel Lake. Figures from Fradette, 2021.

Fish Eye Lake

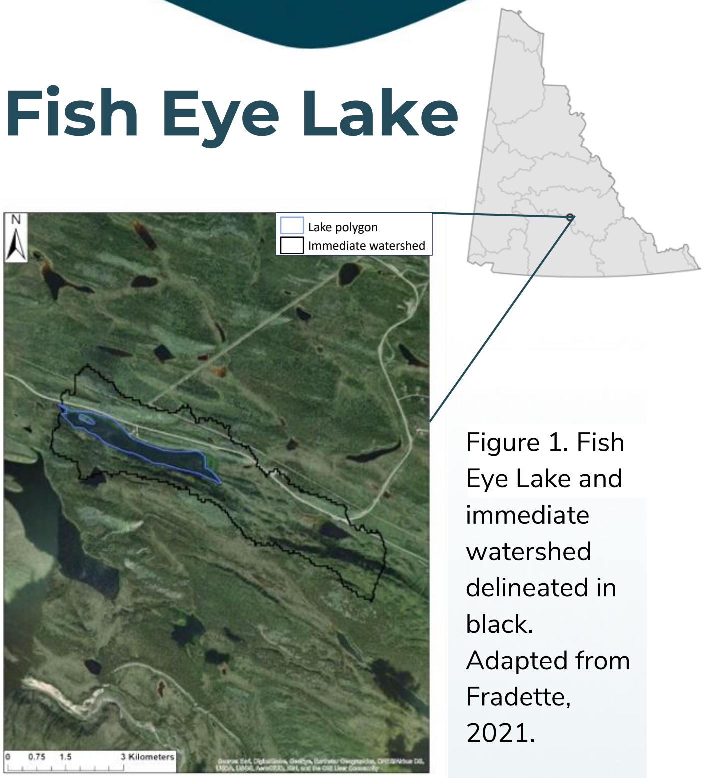

Figure 1. Fish Eye Lake and immediate watershed delineated in black. Adapted from Fradette, 2021.

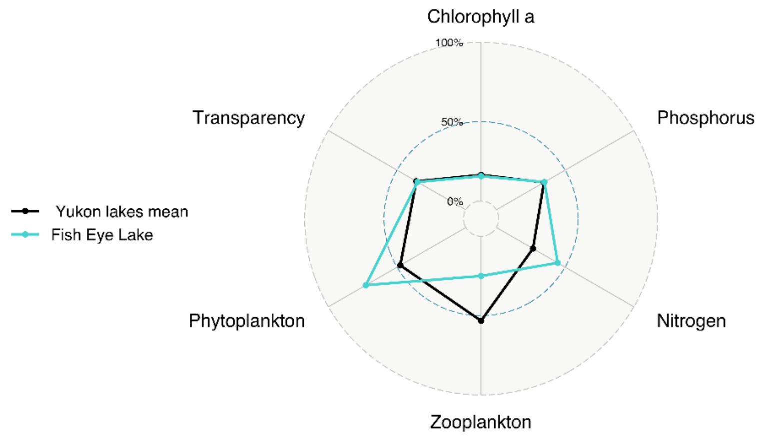

Figure 1. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Fish Eye Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
0.36 km^2	3.47 km^2
MAXIMUM DEPTH	POPULATION
21 m	0
AVERAGE DEPTH	ELEVATION
7.6 m	773 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-20	0 km^2

Location

Fish Eye Lake is located in central Yukon, 13 km southeast of Faro. It lies on the south side of Robert Campbell Highway.

Land Use

80.3% of Fish Eye Lake's 3.47 km^2 watershed is natural. 14.5% is composed of water (including the lake itself). Urban land composes the remaining 5.2% of the watershed (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 5.7 m the day of the sampling. The color value was of 10.89 mg/L Pt. Dissolved organic carbon had a value of 15.90 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (13.92 µg/L) and total nitrogen (0.39 mg/L) values in Fish Eye Lake were similar to the Yukon mean. Chlorophyll a (1.92 µg/L) was slightly below the mean (Figure 2). According to the Canadian water quality guidelines for the protection of aquatic life, Fish Eye Lake is mesotrophic.

Food chain health

Three zooplankton species were identified in Fish Eye Lake, which is below the average of sampled Yukon lakes. However, phytoplankton diversity was above the Yukon average, with 31 species identified (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins, and one potential bloom formers / toxin producer species of the cyanobacteria group was identified.

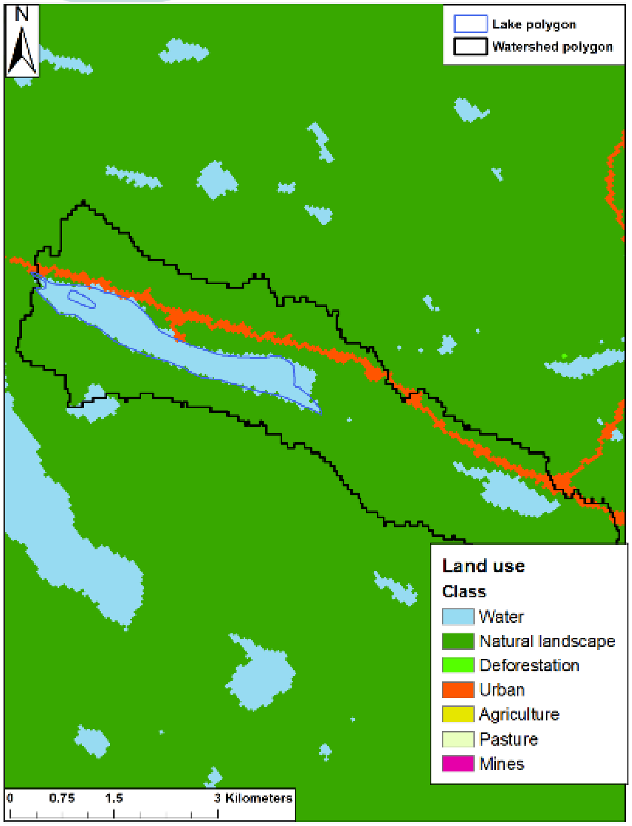

Figure 3. Immediate watershed and land use around Fish Eye Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Fish Eye Lake.

Pharmaceuticals

No pharmaceutical products were reported in Fish Eye Lake.

Industrial chemicals

No industrial chemicals were detected in Fish Eye Lake.

Fecal coliforms

Fecal coliforms were detected in Fish Eye Lake, from the littoral sampling site located on the north shore of the lake, near the highway. However, the fecal bacteria detected were not of the *E. coli* species.

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Change over time

The longest core retrieved from Fish Eye Lake was 49 cm long. The bottom of the core was dated to 1864 (Figure 4a). The analysis of diatom assemblage from top and bottom of the core revealed a temporal dissimilarity of 0.43 (Figure 4b).

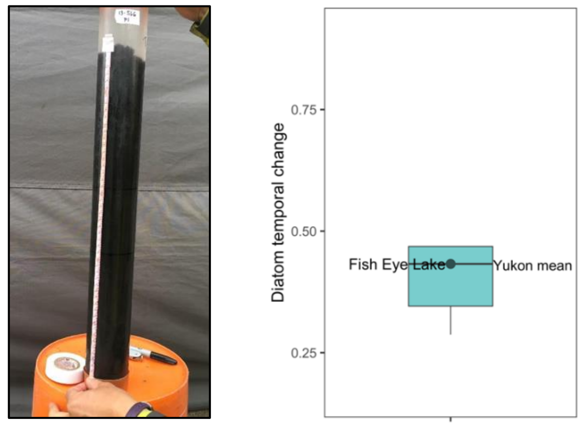

Figure 4. a) The longest sediment core retrieved from Fish Eye Lake. b) Mean (± Standard error) of diatom temporal change between the bottom and the top of the core. Fish Eye Lake value is indicated with a green point.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 6.6 m and a hypolimnion at 8.5 m on the sampling day (Figure 5a). Dissolved oxygen had a value of 105% at the surface of the lake, but reduced to 16.7% of oxygen in the hypolimnion (Figure 5b).

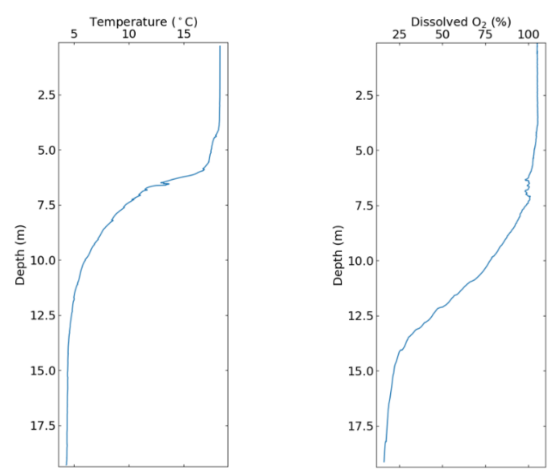

Figure 5. a) Temperature (°C) and Dissolved oxygen (%) as measured in Fish Eye Lake. Figures from Fradette, 2021.

Fox Lake

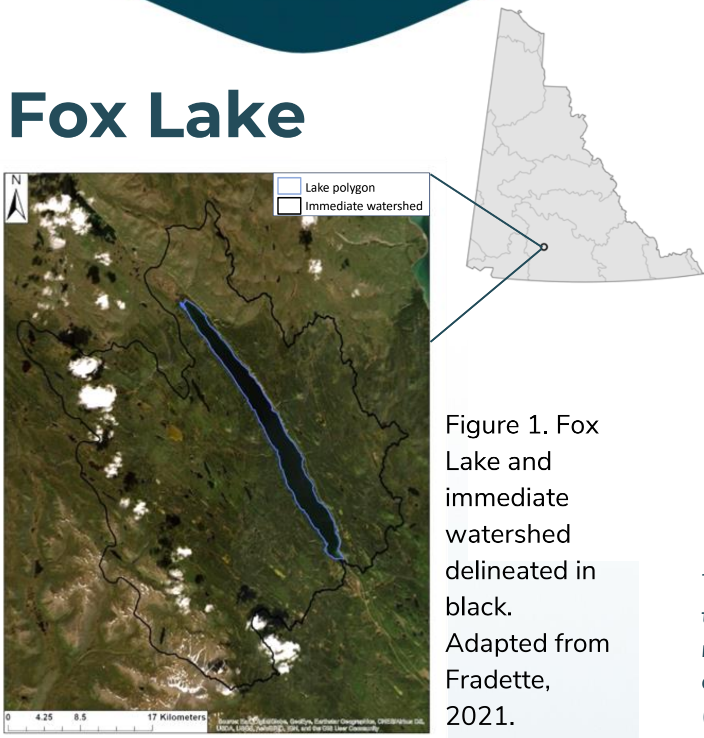

Figure 1. Fox Lake and immediate watershed delineated in black. Adapted from Fradette, 2021.

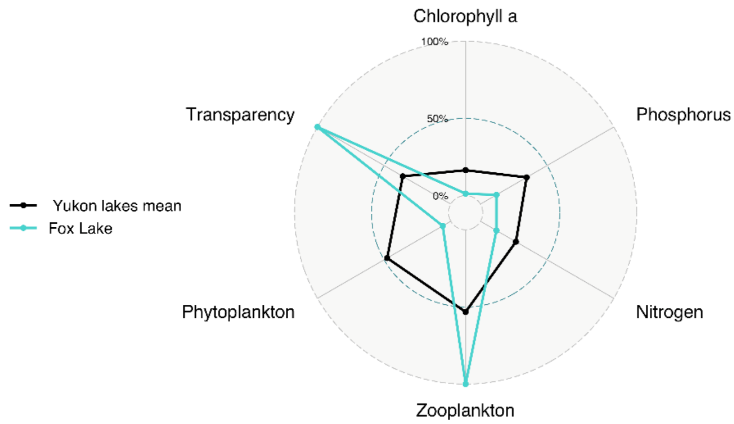

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Fox Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
15.15 km²	282.79 km²
MAXIMUM DEPTH	POPULATION
45 m	51
AVERAGE DEPTH	ELEVATION
39.5 m	746 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-08-16	0 km²

Location

Fox Lake is located in southcentral Yukon, about 70 km north of Whitehorse. It lies on the west side of the Klondike Highway.

Land Use

91.5% of Fox Lake's 282.79 km^2 watershed is natural. 8.2% is composed of water (including the lake itself). The remaining 0.3% of the watershed is comprised of forest loss or urbanized land (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 14.5 m. This transparency is the highest of all 24 sampled lakes in Yukon. The color value was of 2.80 mg/L Pt, while the dissolved organic carbon had a value of 5.19 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (8.76 µg/L) and total nitrogen (0.12 mg/L) values in Fox Lake were below the Yukon mean (Figure 2). Chlorophyll a (0.54 µg/L) was also below average. According to the Canadian water quality guidelines for the protection of aquatic life, Fox Lake is oligotrophic.

Food chain health

Six zooplankton species were identified in Fox Lake, which is the highest zooplankton diversity found in any of the Yukon sampled lakes. However, nine phytoplankton species were identified, which is the lowest diversity of all Yukon lakes (Figure 2). Cyanobacteria concentration indicated a low risk of cyanotoxin exposure. One potential bloom formers / toxin producer species of the cyanobacteria group was identified.

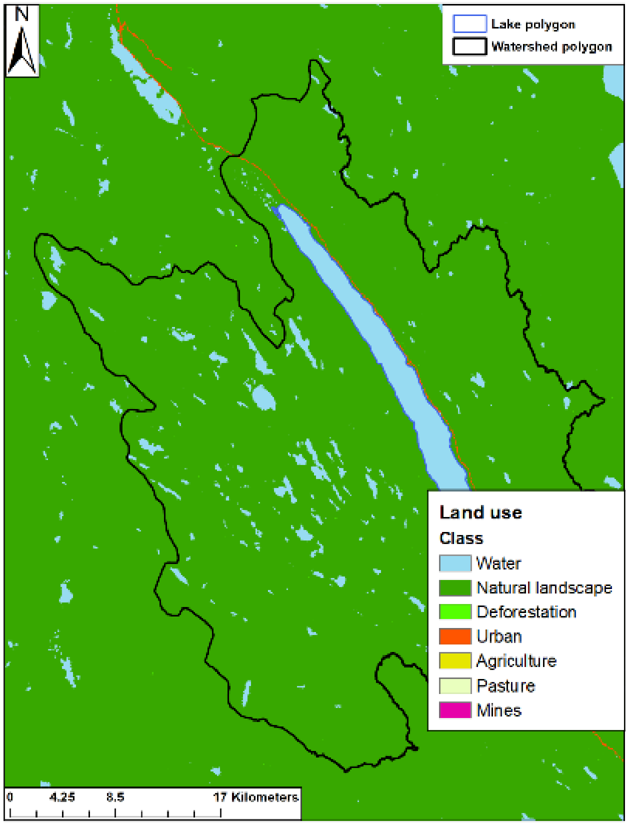

Figure 3. Immediate watershed and land use around Fox Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Fox Lake.

Pharmaceuticals

No pharmaceutical products were reported in Fox Lake.

Industrial chemicals

No industrial chemicals were reported.

Fecal coliforms

No fecal coliforms, including *E. coli* bacteria were detected in Fox Lake, either from the littoral sampling site near Fox lake campground or from the index site near the deepest point of the lake.

Change over time

Sediment cores were retrieved from Fox Lake, but have not yet been analyzed for total metals, diatoms or zooplankton cladoceran temporal changes. The longest core was 22 cm.

Figure 4. The longest sediment core from Fox Lake.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 9.8m and a hypolimnion at 14.7m on the sampling day (Figure 5a). Dissolved oxygen was elevated throughout the profile, with minimal values around 83% of oxygen in the hypolimnion (Figure 5b).

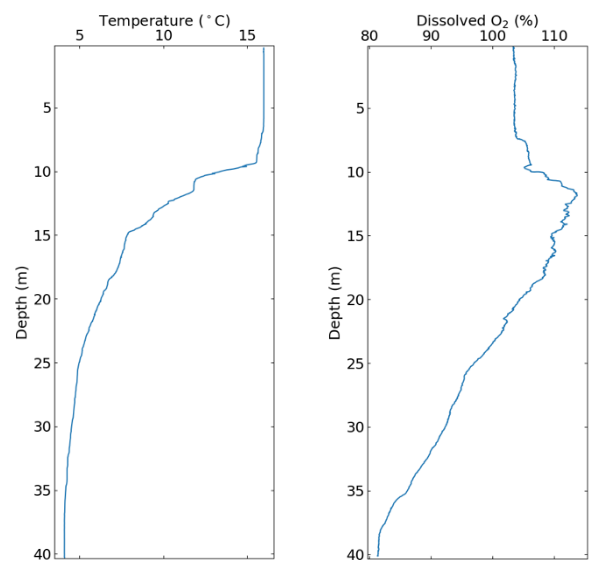

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Fox Lake. Figures from Fradette, 2021.

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Gravel Lake (pond)

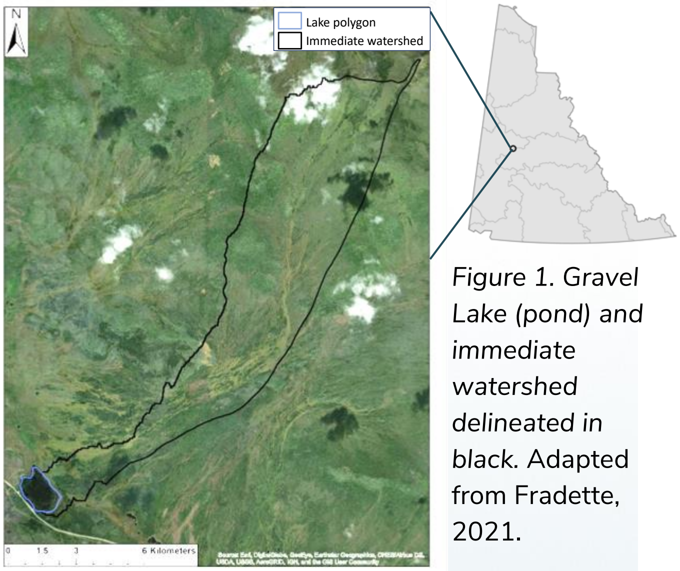

Figure 1. Gravel Lake (pond) and immediate watershed delineated in black. Adapted from Fradette, 2021.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
0.38 km^2	14.61 km^2
MAXIMUM DEPTH	POPULATION
0.9 m	0
AVERAGE DEPTH	ELEVATION
NA	628 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-08-14	0 km^2

Location

Gravel Lake (pond) is located in central Yukon. It is located on the north side of the North Klondike Highway, 92 km from Dawson City.

Land Use

97.3% of Gravel Lake (pond)'s 14.61 km^2 watershed is natural. 2.6% is composed of water (including the lake itself). The remaining 0.1% of the watershed comprised of 0.08% of forest loss and <0.01% of urbanization (Figure 3).

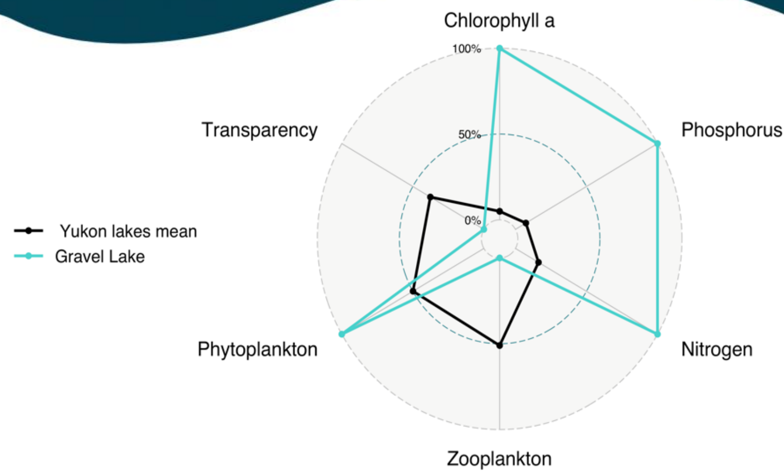

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes sampled (black) in comparison with Gravel Lake (blue).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 0.18 m. This transparency was the lowest of all 24 Yukon sampled lakes. The color value was of 48.23 mg/L Pt, while the dissolved organic carbon had a value of 101.54 mg/L, both of which were the highest values of all lakes sampled in Yukon.

Chlorophyll a, nutrients and trophic status

Total phosphorus (240.10 µg/L) and total nitrogen (1.80 mg/L) values in Gravel Lake were the highest values observed in sampled Yukon Lakes (Figure 2). Chlorophyll a (189.49 µg/L) was also the highest value observed across Yukon lakes. According to the Canadian water quality guidelines for the protection of aquatic life, Gravel Lake is hyper-eutrophic. These high values might be partially explained by the very shallow depth and small size of the lake and the proximity of the Highway.

Food chain health

Two zooplankton species were identified in Gravel Lake, which is the lowest zooplankton diversity found in any of the Yukon sampled lakes. However, phytoplankton diversity was the highest in all Yukon Lakes sampled Cyanobacteria concentration was also the highest across Yukon lakes, but the risk of cyanotoxin exposure was low. Two potential bloom formers/toxin producer species of the cyanobacteria group were identified.

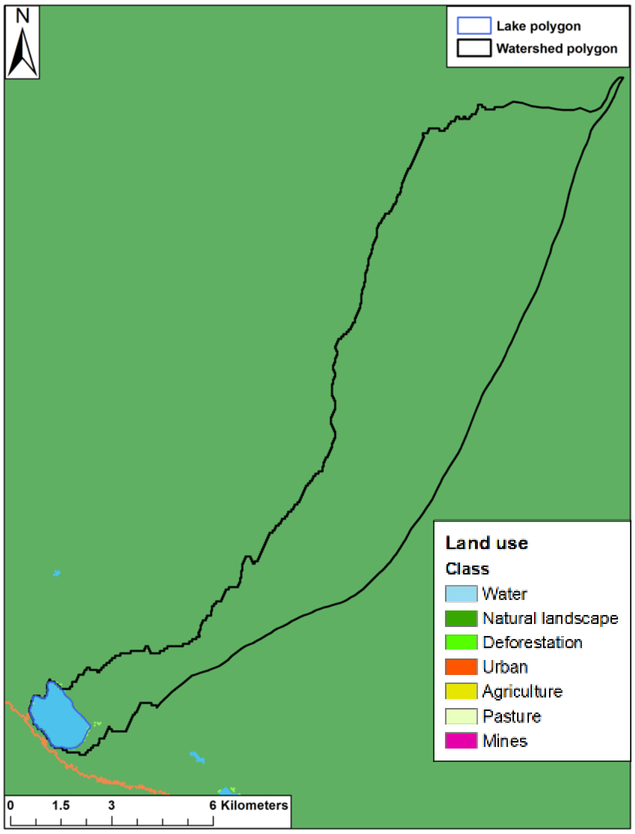

Figure 3. Watershed and land use around Gravel Lake (pond). Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

Gravel Lake (pond) was not analyzed for pesticides.

Pharmaceuticals

Gravel Lake (pond) was not analyzed for pharmaceuticals.

Industrial chemicals

Gravel Lake (pond) was not analyzed for industrial chemicals.

Fecal coliforms

Fecal coliforms were detected in Gravel Lake (pond), both from the littoral sampling site near Klondike highway and from the middle of the lake.

Change over time

The longest core retrieved from Gravel Lake (pond) was 41 cm long (Figure 4a). The analysis of diatom assemblage from the top and the bottom of the core revealed a temporal dissimilarity of 0.47 (Figure 4b).

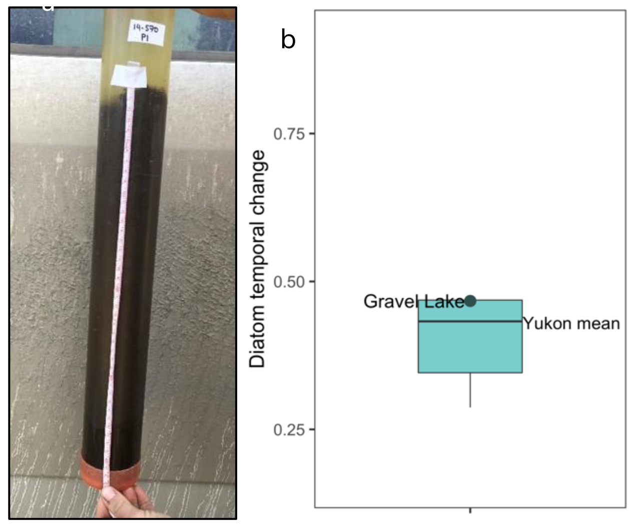

Figure 4. a) The longest sediment core retrieved from Gravel Lake. b) Mean (± Standard error) of diatom temporal change between the bottom and the top of the core. Gravel Lake (pond) value is indicated with a green point.

Temperature & dissolved oxygen

A shallow basin (0.9 m depth) prevented stratification from occurring in Gravel Lake (pond). The average temperature was 15.3°C on the day of sampling. Dissolved oxygen had an average value of 121.73%, indicating the lake is well oxygenated despite its high trophic status (Figure 5b). Since only surface measurements were taken, temperature and oxygen profiles are not available.

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Jackfish Lake

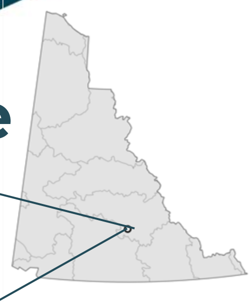

Figure 1. Jackfish Lake and immediate watershed delineated in black. Adapted from Fradette, 2021.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
1.14 km^2	76.78 km^2
MAXIMUM DEPTH	POPULATION
21 m	7
AVERAGE DEPTH	ELEVATION
5.3 m	797 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-18	0 km^2

Location

Jackfish Lake is located in central Yukon, 10 km south of Ross River. It lies on the south side of the Robert Campbell Highway. The lake coordinates are 61°56'06.0"N 132°31'18.7"W.

Land Use

88.5% of Jackfish Lake's 76.78 km^2 watershed is natural. 10.4% is composed of water (including the lake itself). Urban land composes 1.0% of the watershed, and the remaining <0.1% is comprised of mines (Figure 3).

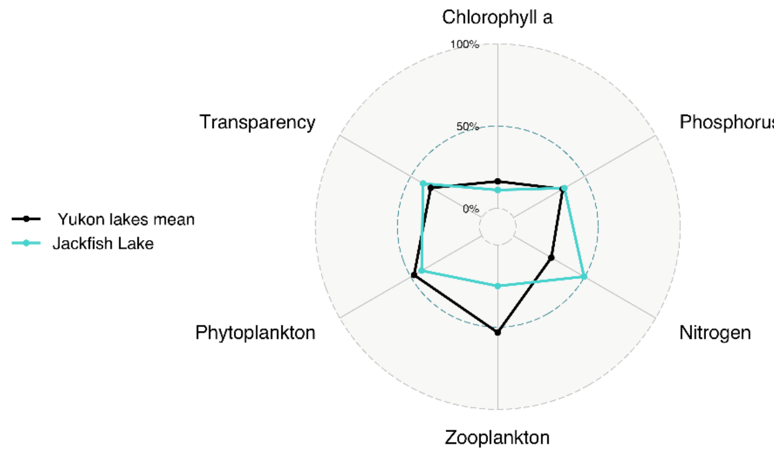

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Jackfish Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 6.6 m. The color value was of 4.03 mg/L Pt. Dissolved organic carbon had a value of 9.17 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (14.10 µg/L) and total nitrogen (0.43 mg/L) values in Jackfish Lake were similar to the Yukon mean. Chlorophyll a (1.49 µg/L) was also below the Yukon mean (Figure 2). According to the Canadian water quality guidelines for the protection of aquatic life, Jackfish Lake is mesotrophic.

Food chain health

Three zooplankton species and 21 phytoplankton species were identified in Jackfish Lake, which is below Yukon's average (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins, but no potential bloom formers / toxin producer species of the cyanobacteria group were identified.

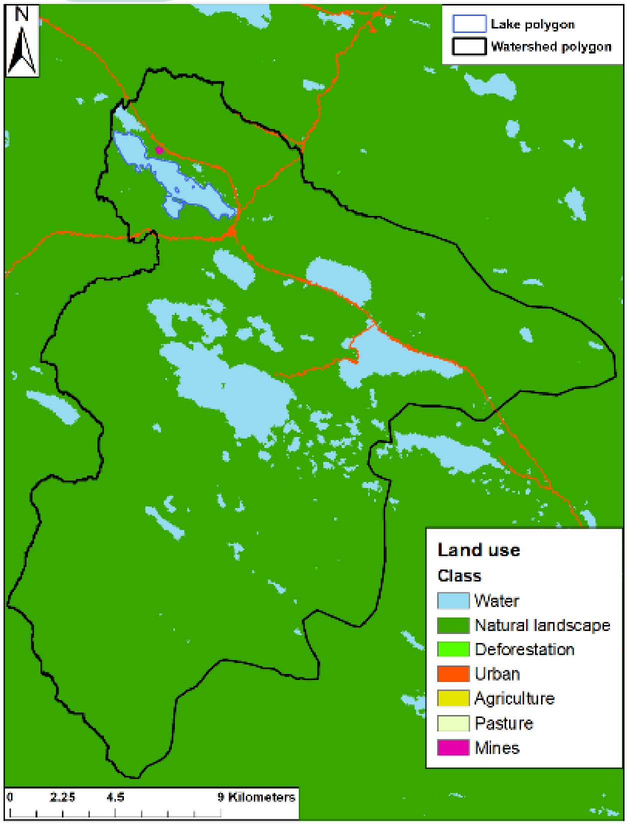

Figure 3. Immediate watershed and land use around Jackfish Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Jackfish Lake.

Pharmaceuticals

44 ng/L of Azithromycin, a pharmaceutical antibiotic was found from the sampling site near the lake deepest point.

Industrial chemicals

No industrial chemicals were detected.

Fecal coliforms

Fecal coliforms were detected in Jackfish Lake, from the littoral sampling site located on the south shore of the lake. However, the fecal bacteria detected were not of the E. coli species and no fecal coliforms were found from the sampling site near the deepest point of the lake.

Change over time

The longest core retrieved from Jackfish Lake was 55 cm long. The bottom of the core was dated to 1868 (Figure 4a). The analysis of diatom assemblage from the top and the bottom of the core revealed a temporal dissimilarity of 0.92, which is the highest across all Yukon sampled lakes (Figure 4b).

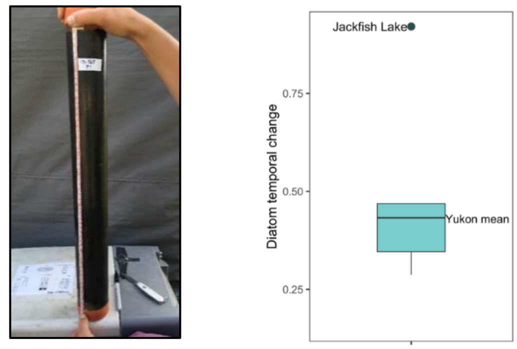

Figure 4. a) The longest sediment core retrieved from Jackfish Lake. b) Mean (± Standard error) of diatom temporal change between the bottom and the top of the core. Jackfish Lake value is indicated with a green point.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 5.9m and a hypolimnion at 8.6m on July 18, 2019. The dissolved oxygen was 110% at the surface of the lake, but reduced to 0.4% in the hypolimnion after reaching a peak (~225%) near the thermocline.

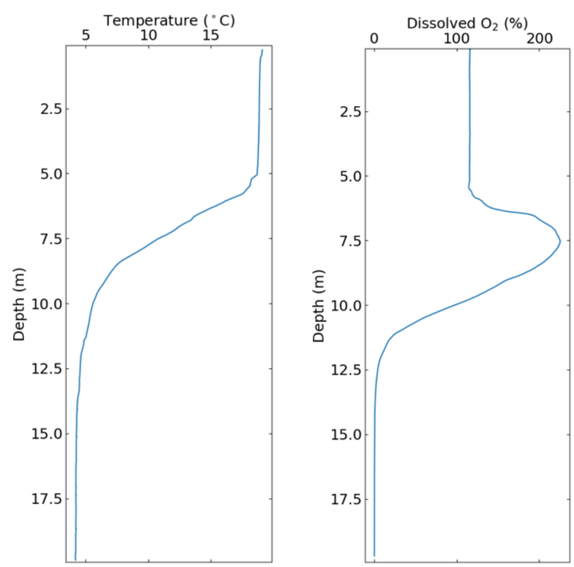

Figure 4. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Jackfish Lake. Figures from Fradette, 2021.

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Little Salmon Lake

Chu Cho

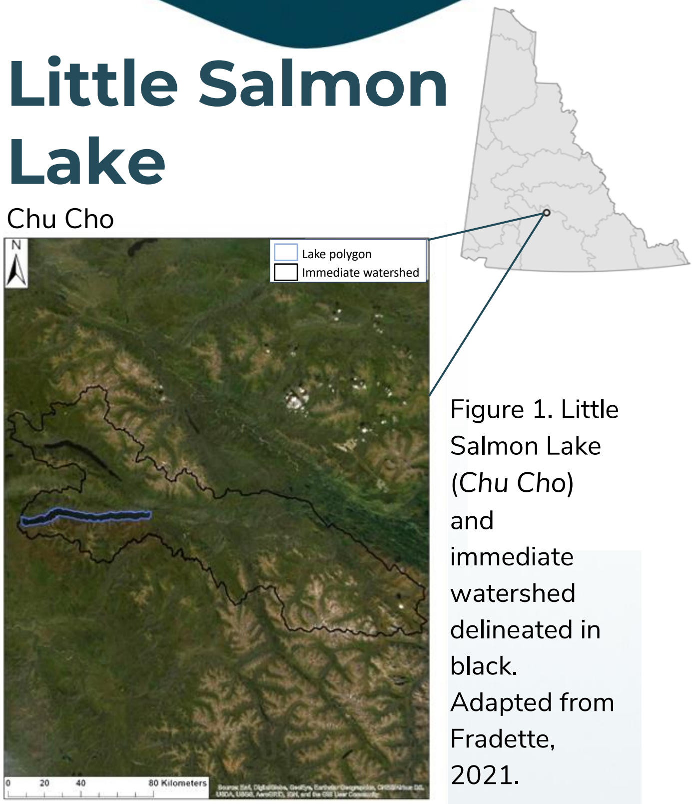

Figure 1. Little Salmon Lake (Chu Cho) and immediate watershed delineated in black. Adapted from Fradette, 2021.

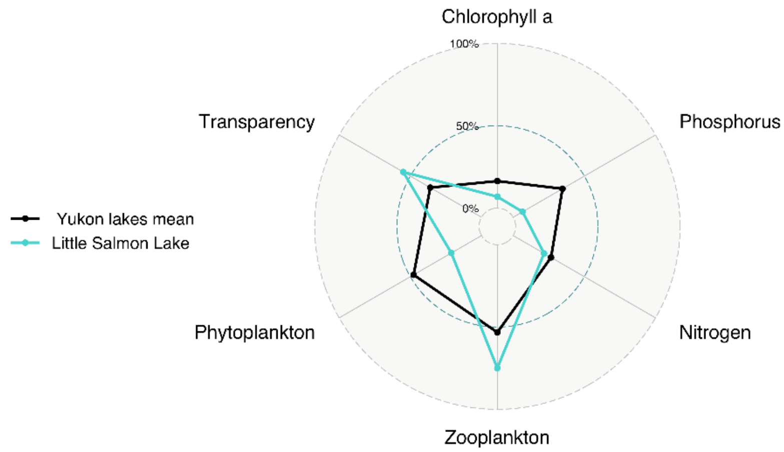

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Little Salmon Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
59.31 km^2	2449.32 km^2
MAXIMUM DEPTH	POPULATION
150 m	4
AVERAGE DEPTH	ELEVATION
61.6 m	518 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-21	0 km^2

Location

Little Salmon Lake is located in central Yukon, about 101 km east of Carmacks, on the south side of the Robert Campbell Highway.

Land Use

95.7% of Little Salmon Lake's 2449.32 km^2 watershed is natural. 4.1% is composed of water (including the lake itself). The remaining 0.2% of the watershed is comprised of forest loss, urbanized land or mines (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 8.4m the day of the sampling. The color value was of 5.63 mg/L Pt. Dissolved organic carbon had a value of 2.30 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (7.55 µg/L) and total nitrogen (0.20 mg/L) values in Little Salmon Lake were lower than the Yukon mean (Figure 2). Chlorophyll a (1.09 µg/L) was also below average. According to the Canadian water quality guidelines for the protection of aquatic life, Little Salmon Lake is oligotrophic.

Food chain health

Five zooplankton species were identified in Little Salmon Lake, which is above the Yukon average. However, phytoplankton diversity was below the Yukon average, with 13 species identified (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins, and two potentially bloom former / toxin producer species of the cyanobacteria group were identified.

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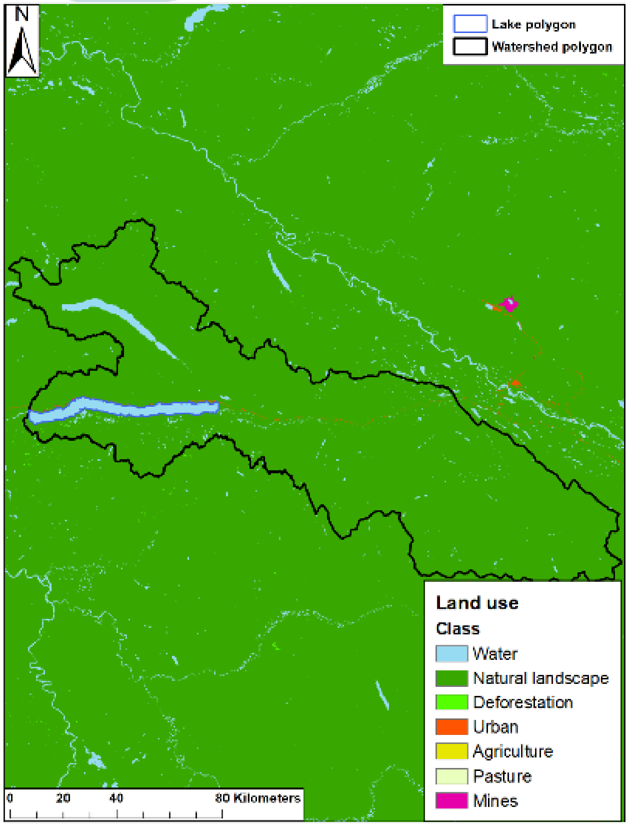

Figure 3. Immediate watershed and land use around Little Salmon Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

Little Salmon Lake was not analyzed for pesticides.

Pharmaceuticals

Little Salmon Lake was not analyzed for pharmaceuticals.

Industrial chemicals

Little Salmon Lake was not analyzed for industrial chemicals.

Fecal coliforms

Fecal coliforms, including bacteria from the *E.coli* species were detected from the littoral sampling site on the north-west shore of Little Salmon Lake, but were not detected from the index site near the deepest point of the lake.

Change over time

Sediment cores were retrieved from Little Salmon Lake, but were not analyzed due to their short length.

Figure 4. The longest sediment core retrieved from Little Salmon Lake was 12 cm long.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 9.2 m and a hypolimnion at 11.4 m on the sampling day (Figure 5a). The oxygen remained elevated throughout the profile, with minimal values around 96% of oxygen at the bottom of the lake (Figure 5b).

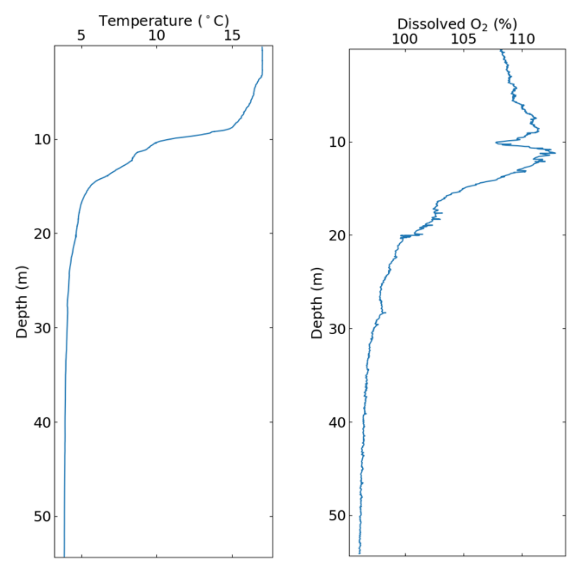

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Little Salmon Lake. Figures from Fradette, 2021.

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Minto Lake

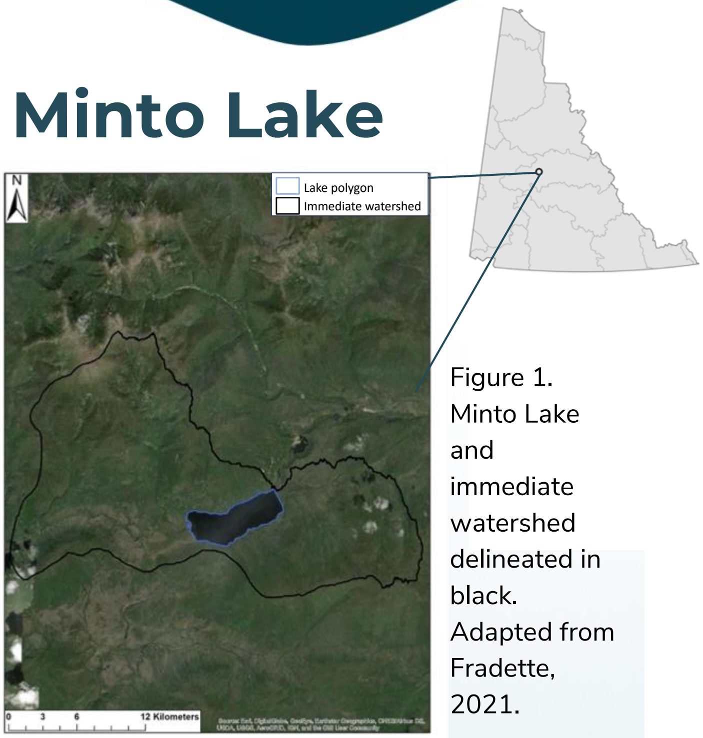

Figure 1. Minto Lake and immediate watershed delineated in black. Adapted from Fradette, 2021.

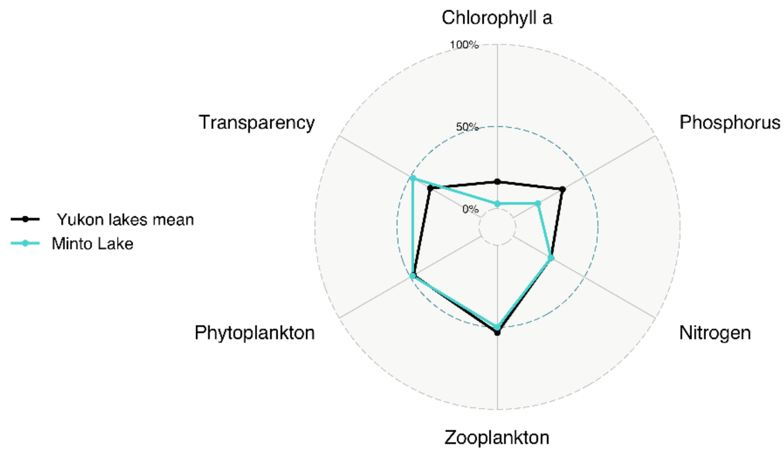

Figure 2. Relative values (rescaled from 0% to 100%) of water quality variables from the mean of all Yukon lakes that were sampled (shown in black) in comparison with Minto Lake (shown in blue).

The results in this report should be interpreted with caution as they represent data collected during a single sampling event. This means that all water quality variables were measured only once during the summer of 2019, and at a single location, for each lake (with the exception of bacteria). For more information on methods please refer to the summary report.

Lake and watershed information

LAKE SURFACE AREA	WATERSHED AREA
3.99 km^2	82.48 km^2
MAXIMUM DEPTH	POPULATION
34 m	0
AVERAGE DEPTH	ELEVATION
17.8 m	680 m
SAMPLING DATE	AREA FOREST FIRES 2014-2019
2019-07-24	0 km^2

Location

Minto Lake is located in central Yukon, about 10 km northwest of the community of Mayo. It is accessible via mining roads and located at 63°41'08.3"N 136°09'42.1"W.

Land Use

95.05% of Minto Lake's 82.48 km^2 watershed is natural. 4.9% is composed of water (including the lake itself). The remaining 0.05% of the watershed is comprised of forest loss or urbanized land (Figure 3).

Aquatic ecosystem health

Water color and transparency

Secchi disk depth was measured at 7.5 m. The color value was of 10.60 mg/L Pt. Dissolved organic carbon had a value of 4.32 mg/L.

Chlorophyll a, nutrients and trophic status

Total phosphorus (9.97 µg/L) value in Minto Lake was lower than the Yukon mean (Figure 2). Whereas chlorophyll a (0.71 µg/L) was also below average. According to the Canadian water quality guidelines for the protection of aquatic life Minto Lake is oligotrophic. Total nitrogen value from this lake was discarded due to poor data quality.

Food chain health

Four zooplankton and 23 phytoplankton species were identified in Minto Lake, which is the same as Yukon's average (Figure 2). Cyanobacteria concentration indicated a low risk of exposure to cyanotoxins and no potential bloom former / toxin producer species of the

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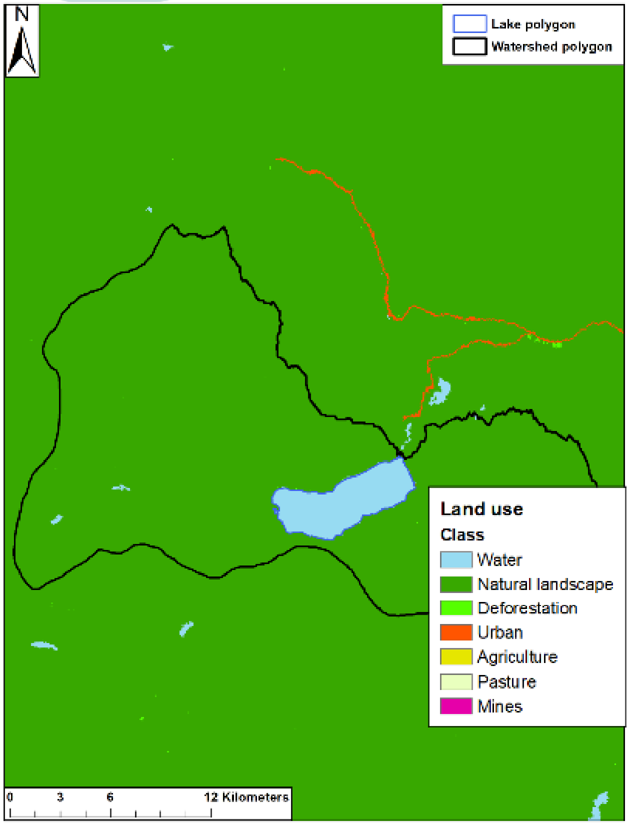

Figure 3. Immediate watershed and land use around Minto Lake. Figure from Fradette, 2021.

Did we find contaminants?

Pesticides

No pesticides, insecticides or herbicides were found in Minto Lake.

Pharmaceuticals

No pharmaceutical products were reported in Minto Lake.

Industrial chemicals

6 ng/L of Tris(2-chloroethyl) Phosphate (TCEP), a flame retardant was found in the Minto lake.

Fecal coliforms

Fecal coliforms were detected in Minto Lake, both from the littoral sampling site located at the northeast corner of the lake and at the index site near the deepest point of the lake. However, the fecal bacteria detected were not of the *E. coli* species.

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Change over time

Sediment cores were retrieved from Minto Lake, but have not yet been analysed for total metals, diatoms or zooplankton cladoceran temporal changes. The longest core was 40 cm.

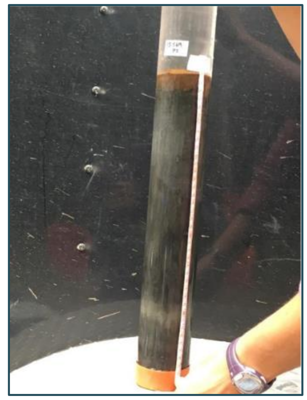

Figure 4. The second-longest sediment core from Minto Lake was 37.5 cm. The longest core picture was lost.

Temperature & dissolved oxygen

The temperature profile shows a thermocline at 7.3 m and a hypolimnion at 9.8 m on the sampling day (Figure 5a). Dissolved oxygen had a value of 104% at the surface, but reduced to 63% in the hypolimnion (Figure 5b).

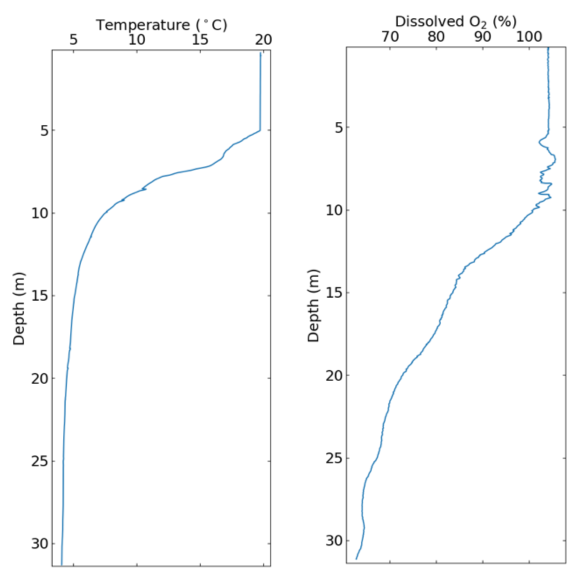

Figure 5. a) Temperature (°C) and b) Dissolved oxygen (%) as measured in Minto Lake. Figures from Fradette, 2021.