BC Lake Stewardship and Monitoring Program

Spider Lake 2016 - 2018

A partnership between the BC Lake Stewardship Society and the BC Ministry of Environment and Climate Change Strategy

BCLSS

BRITISH COLUMBIA
Ministry of Environment and Climate Change Strategy

The Importance of Spider Lake & its Watershed

British Columbians want lakes to provide good water quality, aesthetics, and recreational opportunities. When these features are not apparent in our local lakes, people begin to wonder why. Concerns often include whether the water quality is getting worse, if the lake has been impacted by land development or other human activities, and what conditions will result from more development within the watershed.

The BC Lake Stewardship Society (BCLSS), in collaboration with the Ministry of Environment and Climate Change Strategy (ENV), has designed a program, entitled *The BC Lake Stewardship and Monitoring Program*, to address these concerns. Through regular water sample collections, we can come to understand a lake's current water quality, identify the preferred uses for a given lake, and monitor water quality changes resulting from land development within the lake's watershed. There are different levels of lake monitoring and assessment. The level appropriate for a particular lake depends on the funding and human resources available. In some cases, data collected as part of a Level I or II program can point to the need for a more in-depth Level III program. This report gives the 2016-18 results of a Level I program for Spider Lake. Data was collected by the Mount Arrowsmith Biosphere Region Research Institute (MABRRI).

The BCLSS can provide communities with both lake-specific monitoring results and educational materials on general lake protection issues. This useful information can help communities play a more active role in the protection of the lake resource. Finally, this program allows government to use its limited resources efficiently with the help of local volunteers and the BCLSS.

A **watershed** is defined as the entire area of land that moves the water it receives into a common waterbody. The term watershed is misused when describing only the land immediately around a waterbody or the waterbody itself. The true definition represents a much larger area than most people normally consider.

Watersheds are where much of the hydrologic cycle occurs and play a crucial role in the purification of water. Although no "new" water is ever made, it is continuously recycled as it moves through watersheds and other hydrologic compartments. The quality of the water resource is largely determined by a watershed's capacity to buffer impacts and absorb pollution.

Every component of a watershed (vegetation, soil, wildlife, etc.) has an important function in maintaining good water quality and a healthy aquatic environment. It is a common misconception that detrimental land use practices will not impact water quality if they are kept away from the area immediately surrounding a waterbody. Poor land use practices in a watershed can eventually impact the water quality of the downstream environment.

Human activities that impact water bodies range from small, widespread and numerous *non-point* sources throughout the watershed to large *point* sources of concentrated pollution (e.g. outfalls, spills, etc.). Undisturbed watersheds have the ability to purify water and repair small amounts of damage from pollution and alteration. However, modifications to the landscape and increased levels of pollution impair this ability.

Spider Lake is located 20 km east of Qualicum Beach on Central Vancouver Island. It lies at an elevation of 133 m, has a surface area of 0.44 km^2 (44.3 ha), and a perimeter of 7.2 km. The lake has a volume of 1.8 Mm^3, a mean depth of 4.1 m, and a maximum depth of 12.7 m. Spider Lake has many arms, which creates a number of secluded coves. There is also a number of small islands in the lake, with their perimeter totaling 0.5 km. A portion of the lake has been separated from the main lake by a road (Pirani and Bryden, 1996). The inflow to Spider Lake is unidentified and the main outflow is Kinkade Creek, which flows into the Little Qualicum River.

Spider Lake Provincial Park encompasses much of the southern and western areas of the lake. The park has two day-use areas, one open seasonally and a smaller one that is open year-round. The lake has a sandy beach and provides recreational uses such as canoeing, kayaking, paddle boarding, fishing, swimming, and hiking. Powerboats are prohibited on the lake.

Fish species in Spider Lake include smallmouth bass, steelhead, sculpin, bass/sunfish, and rainbow trout. The lake has been stocked with rainbow trout since 1986 (FIDQ, 2019).

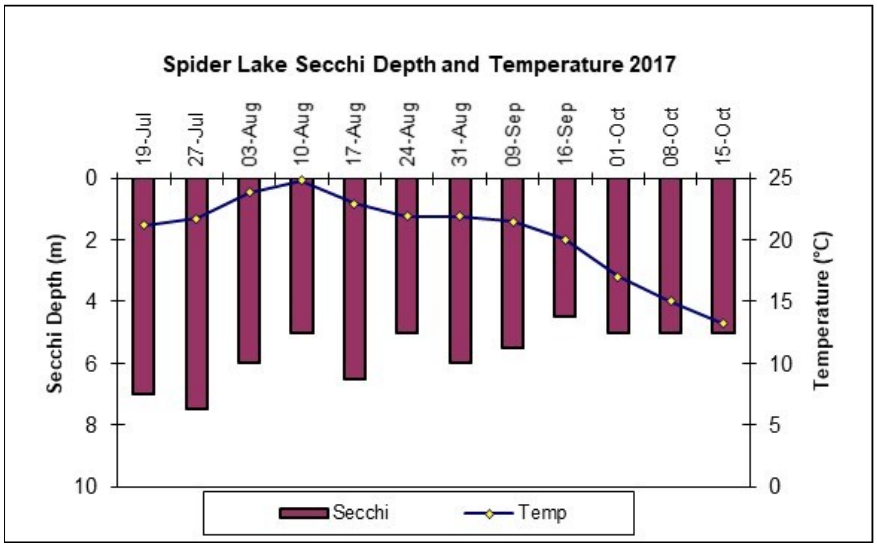
What's Going on Inside Spider Lake?

Temperature

Lakes show a variety of annual temperature patterns based on their location and depth. Most interior lakes form layers (stratify), with the coldest water at the bottom. Because colder water is denser, it resists mixing into the warmer upper layer for much of the summer. In spring and fall, these lakes usually mix from top to bottom (overturn) as wind energy overcomes the reduced temperature and density differences between surface and bottom waters. In the winter, lakes re-stratify under ice with the densest water (4 °C) near the bottom. These lakes are called dimictic lakes because they turn over twice per year. They are the most common type of lake in British Columbia.

Coastal lakes in BC are more often termed warm monomictic lakes because they turn over once per year. These lakes have temperatures that do not fall below 4°C. Warm monomictic lakes generally do not freeze and circulate freely in the winter at or above 4°C, and stratify only in the summer. Spider Lake is classified as a monomictic lake.

Ice-on and ice-off dates for BC lakes are important data for climate change research. By comparing these dates to climate change trends, we can examine how global warming is affecting our lakes. Spider Lake does not freeze over.



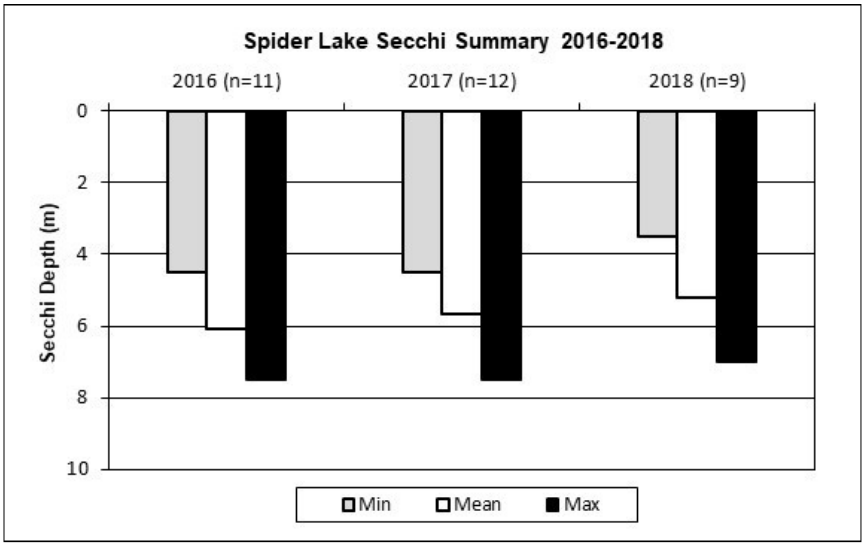
Surface temperature readings serve as an important ecological indicator. By measuring surface temperature, we can record and compare readings from season to season and year to year. Surface temperature helps to determine much of the seasonal oxygen, phosphorus, and algal conditions.

Surface temperature (T) and Secchi depth (water clarity) were measured at the monitoring site on Spider Lake from 2016-18 (site marked on map on p. 3). Minimum data requirements of 12 samples were not met for all years. The adjacent graph illustrates the 2017 Secchi and surface temperature data. In 2017 the maximum temperature measured was 24.8°C (Aug 10) and the minimum was 13.2°C (Oct 15). The maximum surface temperatures measured in 2016 and 2018 were 23.8 °C (Aug 17) and 24.5 °C (Aug 9), respectively. Minimum surface temperatures were 12.2 °C (Oct 16) and 12.8 °C (Oct 11) in 2016 and 2018, respectively.

Trophic Status and Water Clarity

The term *trophic status* is used to describe a lake's level of productivity and depends on the amount of nutrients available for plant growth, including tiny floating algae called phytoplankton. Algae are important to the overall ecology of the lake because they are food for zooplankton, which in turn are food for other organisms, including fish. In most lakes, phosphorus is the nutrient in shortest supply and thus acts to limit the production of aquatic life. When in excess, phosphorus accelerates growth and may artificially age a lake. Total phosphorus (TP) in a lake can be greatly influenced by human activities.

One measure of productivity is water clarity. The more productive a lake, the higher the algal growth and, therefore, the less clear the water becomes. The clarity of the water can be evaluated by using a Secchi disc, a 20 cm diameter black and white disc that measures the depth of light penetration.



Natural variation and trends in Secchi depth and temperature not only occur between years, but also throughout one season. In general, as temperatures increase during the summer months, Secchi depth decreases. As the temperature of the lake increases, so do some species of algae. Due to the increase in algae, the water clarity can decrease.

The adjacent graph shows the minimum, average, and maximum Secchi readings at the monitoring site from 2016-18 and the number of readings for each year (n). The maximum readings during these years were 7.5 m (Aug 17, 2016), 7.5 m (Jul 27, 2017), and 7 m (Jul 2, 2018). The minimum readings were 4.5 m (Sep 18, 2016), 4.5 (Sep 16, 2017) and 3.5 m (Aug 31, 2018). The average Secchi readings were 6.1 m, 5.7 m, and 5.2 m for 2016-18 respectively. The overall water clarity remained fairly consistent over the sampling years. Based on these summer average Secchi values, Spider Lake was exhibiting mesotrophic conditions (3-6 m Secchi depth) with one slightly oligotrophic (> 6m) value (Nordin, 1985). This oligotrophic value may be due to fewer readings being taken that year (2018).

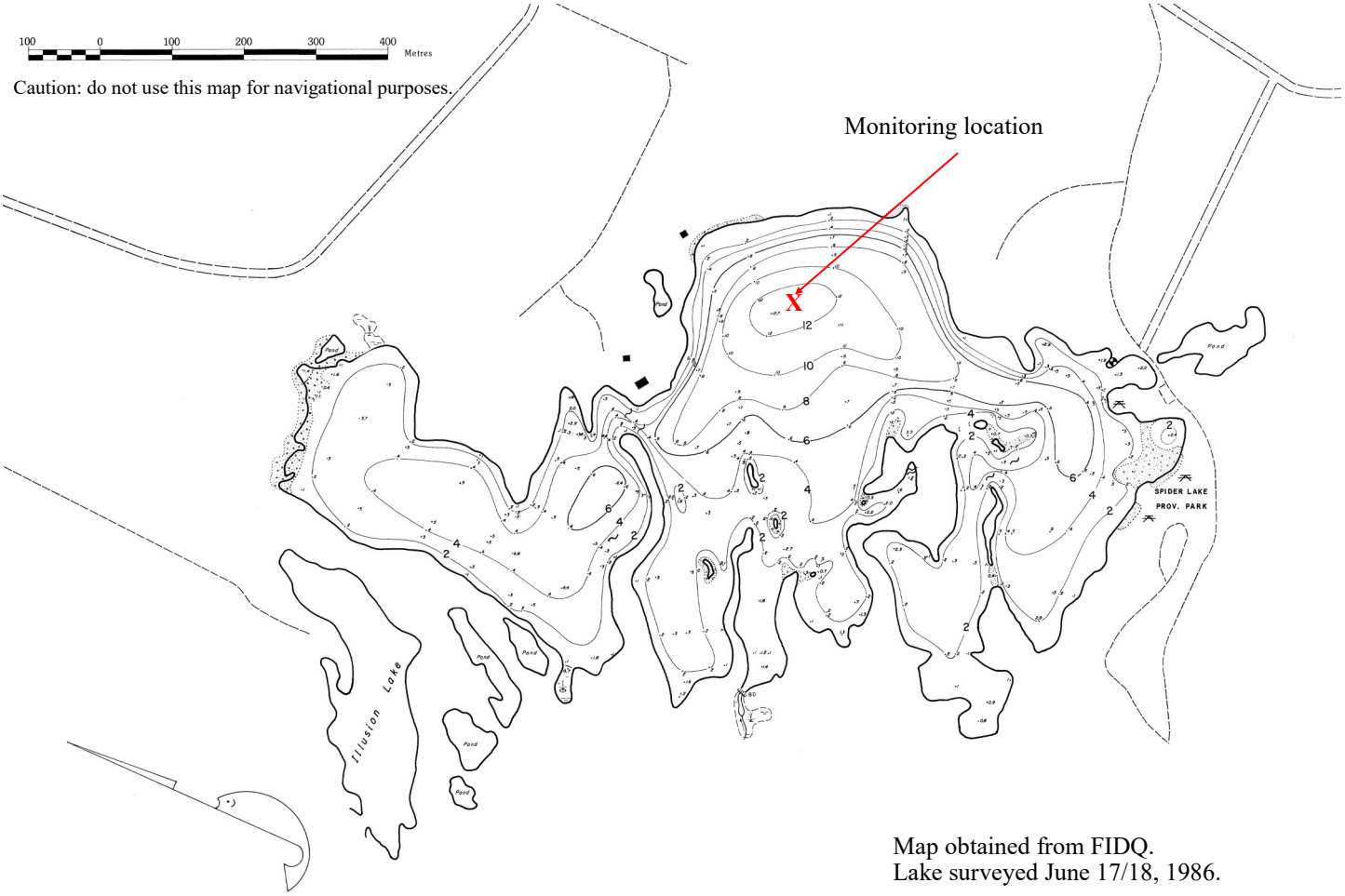
The flushing rate, another factor that affects water quality, is the rate of water replacement in a lake and depends on the amount of inflow and outflow. The higher the flushing rate, the more quickly excess nutrients can be removed from the system. The flushing rate for Spider Lake is unknown.

Land Use and Pollution Sources

Local mining (gravel quarry), logging, agriculture, and septic fields have the potential to impact Spider Lake. There is currently very little development in the area, however there is a private RV Park nearby with large land usage. There is also potential for increased development in the area, which could double the local population (Regional District of Nanaimo, 2011). Growth and development within the watershed, in addition to an increased level of recreational use, could present challenges to maintaining water quality.

All recreational users and land developers within the watershed are advised to practice good land management so that nutrient migration to the lake and its tributaries are minimized. Local residents should follow good environmental practices. Further information on keeping Spider Lake healthy can be found on the following page.

Spider Lake Bathymetric Map



Map obtained from FIDQ.
Lake surveyed June 17/18, 1986.

Should Further Monitoring be Done on Spider Lake?

Generally, trophic status is based on a combination of parameters such as Secchi depth, nutrients, and chlorophyll *a*. Based on the Secchi data collected by volunteers on Spider Lake from 2016-18, the water quality has remained stable throughout the sampling years. Average annual Secchi readings place the lake in the mesotrophic classification.

Mount Arrowsmith Biosphere Region Research Institute (MABRRI) volunteers also collected dissolved oxygen, turbidity, conductivity, and pH values, however analysis of those parameters is out of the scope of a Level 1 report. This additional information is important as it can be compared with future data and be summarized in a higher level report. Volunteer monitors are encouraged to continue collecting Secchi depth and surface temperature readings, with a minimum of twelve readings taken at evenly spaced intervals during the spring and summer. This will provide valuable long term records and help identify early warning signs should there be a deterioration in water quality from its current state.

Tips to Keep Spider Lake Healthy

Recreation and Camping

- Ensure black and grey water are contained and disposed of at a sanitation station.
- When washing yourself or your dishes, dip water out of the lake using a clean container and move 30 m away.
- Dispose of used water by throwing it over a large area away from your site, the sites of others, and flowing or standing water.
- Use phosphate-free, biodegradable soaps.
- If you pack it in - pack it out. Remove all garbage including biodegradable soaps.
- Ensure all vehicles are well maintained and tuned to prevent fuel leaks.
- Pick up after your pets as their waste can lead to bacterial contamination of lake water.

Land Maintenance

- Minimize the disturbance of shoreline areas by maintaining natural vegetation cover.
- Minimize high-maintenance grassed areas.
- Stop or limit the use of fertilizers and pesticides.
- Do not use fertilizers in areas where the potential for water contamination is high, such as sandy soils, steep slopes, or compacted soils.
- Do not apply fertilizers or pesticides before or during rain due to the likelihood of runoff.
- Hand pull weeds rather than using herbicides.
- Use natural insecticides such as diatomaceous earth.
- Prune infested vegetation and use natural predators to keep pests in check. Pesticides can kill beneficial and desirable insects, such as ladybugs, as well as pests.
- Compost yard and kitchen waste and use it to boost your garden's health as an alternative to chemical fertilizers.

Boating

- Powerboats are prohibited on Spider Lake.
- Do not throw trash overboard or use lakes or other water bodies as toilets.
- Use biodegradable, phosphate-free cleaners instead of harmful chemicals.
- Conduct major maintenance chores on land.
- Clean off all aquatic plants, animals, and mud from boats and equipment before entering or leaving a lake.
- Leading by example is often the best method of improving practices - help educate fellow boaters.

Who to Contact for More Information

The BC Lake Stewardship Society
1257 Erskine Street, Coquitlam, BC, V3B 6R3
Phone: 604-474-2441
Email: info@bclss.org
Website: www.bclss.org

Ministry of Environment and Climate Change Strategy
2080-A Labieux Rd, Nanaimo BC, V9T 6J9
Phone: 250-751-3100

Mount Arrowsmith Biosphere Region Research Institute
Vancouver Island University
900 Fifth Street, Nanaimo BC, V9R 5S5
Phone: 250-753-3245 local 2802
Website: http://mabrri.viu.ca/

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Data Compilation and Brochure Produced by:
Dawn Roumieu (BCLSS)

Technical Review by:
Chris Swan (Ministry of Forests, Lands, Natural Resource Operations and Rural Development)

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Bathymetric Map: FIDQ (Fisheries Inventory Data Query)

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