BC Lake Stewardship and Monitoring Program

Somenos Lake 2007 - 2010

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

BRITISH COLUMBIA
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The Importance of Somenos 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 (MoE), 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 results of four years of monitoring (from 2007 - 2010) by local volunteer Dan Ryan, for a modified Level I program for Somenos Lake. All data collected met the minimum data requirements.

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 but widespread and numerous *non-point* sources throughout the watershed to large *point* sources of concentrated pollution (e.g. waste discharge outfalls, spills, etc). Undisturbed watersheds have the ability to purify water and repair small amounts of damage from pollution and alterations. However, modifications to the landscape and increased levels of pollution impair this ability.

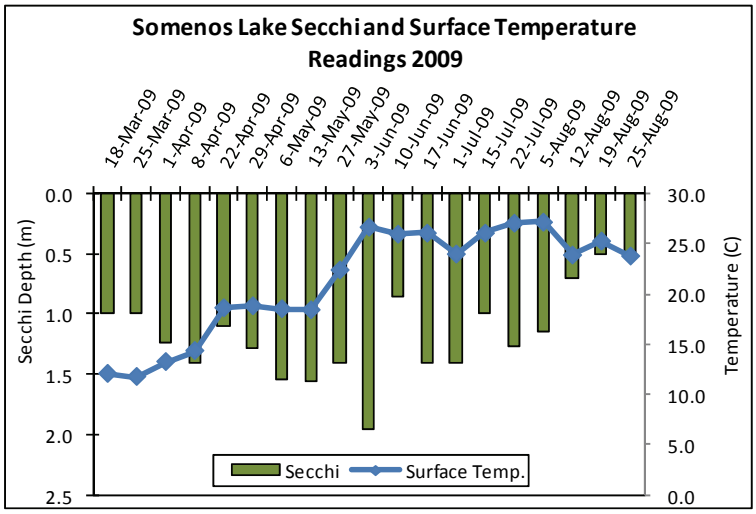
Somenos Lake is located in the Municipality of North Cowichan, approximately 2 km of the city of Duncan, on Vancouver Island. The lake has a surface area of 97.2 ha, a perimeter of 4.4 km and lies at an elevation of 5 m. The maximum depth of the lake is 7 m, and the average depth is 4.2 m (FISS, 2010). The lake has 27 properties along its shores, and the lake and surrounding fields are a critical flood storage area that prevents the city of Duncan from flooding (Fletcher 2010, Pers. Comm.). The Somenos Marsh Conservation Area includes Somenos Lake, four creeks (Averill Creek, Bings Creek, Richards Creek, and Somenos Creek), and the Somenos Garry Oak Protected Area. The marsh is home to the second largest population of overwintering Trumpeter Swans on Vancouver Island (SMWS, 2010).

Somenos Lake contains brook trout, brown catfish, brown trout, chum salmon, coho salmon, cutthroat trout, pumpkinseed, rainbow trout, sculpin, steelhead, stickleback (general) and threespine stickleback (FISS, 2010). Local residents report that the lake contains few fish apart from those that are stocked (Fletcher 2010, Pers. Comm.). In the past 5 years, Somenos Lake has been stocked annually with cutthroat trout and rainbow trout (FISS, 2010). Local residents have been told by representatives from the Department of Fisheries and Oceans that Somenos Lake is the "breadbasket" of the Cowichan River in terms of coho production (Fletcher 2010, Pers. Comm.).

What's Going on Inside Somenos 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 more dense, 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. Somenos Lake is classified as a warm 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. Local residents report that although Somenos Lake has frozen over in the past, it rarely freezes (Fletcher 2010, Pers. Comm.).

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.

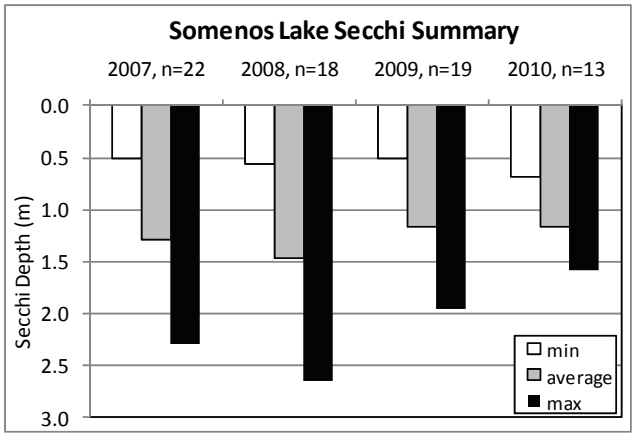
Temperature and Secchi depth (water clarity) were measured at one location on Somenos Lake (see map on p. 3 for sampling site location) from 2007 - 2010. The above graph illustrates the 2009 Secchi and temperature data. The maximum surface temperature was 27.2° C (Aug 5th) and the minimum surface temperature was 11.7°C (Mar 25th). The maximum surface temperatures measured in 2007, 2008 and 2010 were 24°C (Aug 29th), 25.2°C (Jul 16th) and 28.6°C (Jul 20th) respectively. Minimum surface temperatures were 3.8°C (Dec 19th), 9.5°C (Nov 26th), and 11.8°C (Jan 27th), in 2007, 2008 and 2010, 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.

Lakes of low productivity are referred to as ***oligotrophic***, meaning they are typically clear water lakes with low nutrient levels, sparse plant life and low fish production. Lakes of high productivity are ***eutrophic***. They have abundant plant life because of higher nutrient levels. Lakes with an intermediate productivity are called ***mesotrophic*** and generally combine the qualities of oligotrophic and eutrophic lakes.

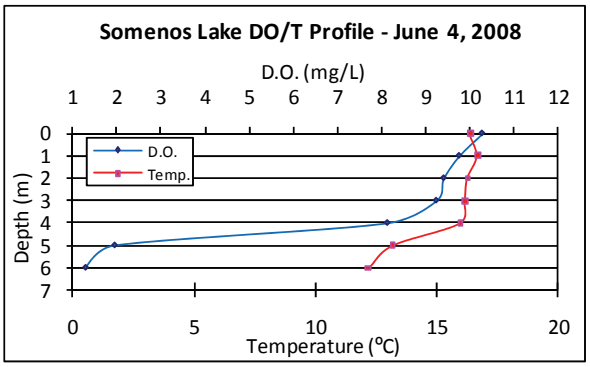
One measure of productivity is water clarity. The more productive a lake, the higher the algal growth and, therefore, the less clear the water becomes. The clarity of the water can be evaluated by using a Secchi disc, an 8 inch diameter black and white disc that measures the depth of light penetration.



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. This general trend is apparent in the 2009 data.

The adjacent graph illustrates the minimum, mean and maximum Secchi readings from 2007 to 2010, as well as the number of readings for year (n). The maximum reading for all sampling years, 2.7 m, occurred on Nov 5th 2008. The lowest Secchi depth measured was 0.5 m in both 2007 (Aug 11th and Aug 15th) and 2009 (Aug 19th and Aug 25th). The average Secchi readings for Somenos Lake ranged from 1.2 m (2009 and 2010) to 1.5 m (2008). Based on these Secchi values, Somenos Lake was exhibiting eutrophic conditions (Nordin, 1985). All years of data met the minimum sampling requirements (12 readings spread between spring and fall), however fewer readings (13) were collected in 2010 compared to other years (18 - 22 readings). Data collection in 2010 began earlier (in January) which may explain why data from 2010 show less variability (i.e. deeper minimum reading and shallower maximum reading) than in previous years.

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 of a lake. The higher the flushing rate, the more quickly excess nutrients can be removed from the system. There is no information for the flushing rate for Somenos Lake at this time.



Dissolved Oxygen and Water Chemistry

Oxygen is essential to life in lakes. It enters lake water from the air by wind action and also through plant photosynthesis. Oxygen is consumed by respiration animals and plants, including the decomposition of dead organisms by bacteria. A great deal can be learned about the health of a lake by studying oxygen patterns and levels.

Dissolved oxygen (DO) and temperature (T) readings were collected on Somenos Lake from 2007 - 2010. The graph on the right shows DO (blue line, refer to top axis for values) was 10.3 mg/L at the surface and 1.3 mg/L at 6 m on June 4, 2008. T (pink line, refer to bottom axis for values) was 16.4 °C at the surface and 12.2 °C at 6 m. Data from 2007 - 2010 indicate the lake has very low DO levels in the bottom waters throughout the summer. If deep-water oxygen becomes depleted, a chemical shift can occur in bottom sediments. This shift causes sediment to release phosphorus to overlying waters. This *internal loading* of phosphorus can be natural but is often the result of phosphorus pollution. Lakes displaying internal loading have elevated algal levels and generally lack recreational appeal. Somenos Lake is suffering from internal loading (Epps 2011, Pers. Comm.).

Water chemistry samples were collected in the spring of 2001, 2002 & 2011. Surface TP values (64 µg/L, 70 µg/L, and 57 µg/L respectively) were high (spring overturn samples with values >30 µg/L are considered eutrophic). Reference is made to the lake being eutrophic for at least the last 15 years in the Somenos Management Plan (Williams & Radcliffe, 2001). True colour samples (an indicator of the amount of organic matter in the water, primarily humic acid) were also collected in the spring of 2001, 2002 & 2011. True colour values at the surface were 45, 50 and 30 TCU, respectively. The Water Quality Guideline for recreation in BC is ≤15 TCU, primarily based on aesthetics. The elevated colour values are likely a phenomenon associated with the lakes marsh-like habitat, however anthropogenic activities can further exacerbate these levels.

Land Use and Pollution Sources

Point source pollution originates from municipal or industrial effluent outfalls. Other pollution sources exist over broader areas and may be hard to isolate as distinct effluents. These are referred to as non-point sources of pollution (NPS). Shoreline modification, urban stormwater runoff, onsite septic systems, agriculture, and forestry are common contributors to NPS pollution. One of the most detrimental effects of NPS pollution is phosphorus loading to water bodies. The amount of total phosphorus (TP) in a lake can be greatly influenced by human activities. If local soils and vegetation do not retain this phosphorus, it will enter watercourses where it will become available for algal production.

Somenos Lake is located in the Municipality of North Cowichan. Land use activities in the Somenos Lake watershed include: urban, agricultural, commercial, rural residential, and lakeshore residential development. The Somenos Marsh Conservation Area includes the lake, all of the southeast properties along the lakeshore, and the Somenos Garry Oak Protected Area which is located on the east side of Somenos Creek (Fletcher 2010, Pers. Comm.).

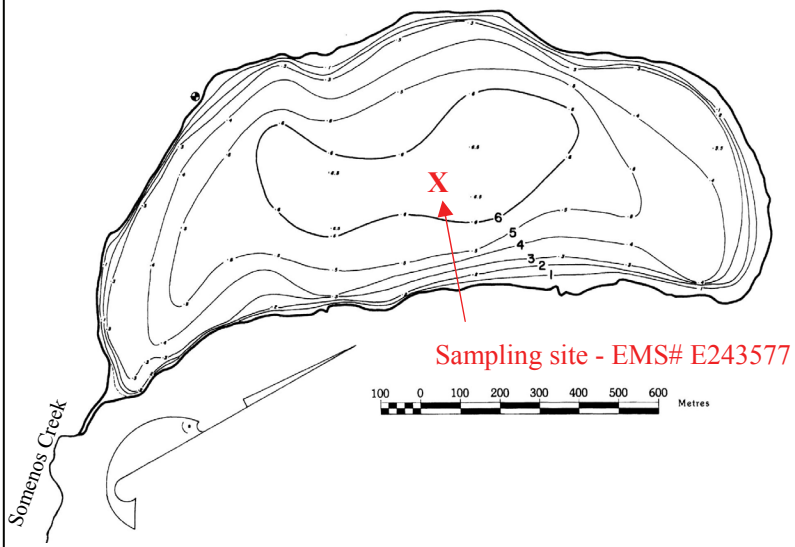
Local residents are encouraged to ensure their septic systems are up to standard and that their land use activities are following good environmental practices. Further information on keeping Somenos Lake healthy can be found on the following page.

Should Further Monitoring Be Done on Somenos Lake?

The data collected on Somenos Lake from 2007 to 2010 indicate that the water quality has remained relatively stable over the sampling years. Secchi readings place the lake in the eutrophic classification, which is consistent with the eutrophic classification of the lake in the Somenos Management Plan (Williams & Radcliffe, 2001). It would be valuable to collect additional years of spring overturn nutrients in order to determine trends. Local volunteer monitors are encouraged to continue collecting Secchi depth and surface temperature readings which will provide valuable long term records and help identify early warning signs should there be a deterioration in water quality from its current state.

All residents and land developers within the watershed are advised to continue to practice good land management so that nutrient migration to the lake and its tributaries are minimized. It would be beneficial to Somenos Lake if local governments move towards having the area hooked up to sewer. It would also be valuable to initiate a liquid waste planning process for the area in order to develop stormwater management plans.

Somenos Lake Bathymetric Map



Map obtained from FISS (lake surveyed 1980)

Tips to Keep Somenos Lake Healthy

Onsite Sewage Systems

- Inspect your system yearly, and have the septic tank pumped every 2 to 5 years by a septic service company. Regular pumping is cheaper than having to rebuild a drain-field.
- Use phosphate-free soaps and detergents.
- Do not put toxic chemicals (paints, varnishes, thinners, waste oils, photographic solutions, or pesticides) down the drain because they can kill the bacteria at work in your on-site sewage system and can contaminate waterbodies.
- Conserve water: run the washing machine and dishwasher only when full and use only low-flow showerheads and toilets.

Yard Maintenance, Landscaping and Gardening

- Minimize the disturbance of shoreline areas by maintaining natural vegetation cover.
- Minimize high-maintenance grassed areas.
- Replant lakeside grassed areas with native vegetation. Do not import fine fill.
- Use paving stones instead of pavement.
- 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

- 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.
- Keep motors well maintained and tuned to prevent fuel and lubricant leaks.
- Use absorbent bilge pads for minor leaks or spills.
- Recycle used lubricating oil and left over paints.
- Check for and remove all aquatic plant fragments from boats and trailers before entering or leaving a lake.
- Do not use metal drums in dock construction. They rust, sink and become unwanted debris. Use blue or pink closed -cell extruded polystyrene billets or washed plastic barrel floats. All floats should be labelled with the owner's name, phone number and confirmation that barrels have been properly maintained.

Who to Contact for More Information

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References

Epps, D. 2011. Email communication - lake history. Environmental Impact Assessment Biologist. Ministry of Environment, Nanaimo, B.C. June 16, 2011.

FISS. 2010. Fisheries Inventory Summary System [online database]. Accessed November 3, 2010. http://srmapps.gov.bc.ca/apps/fidq/

Fletcher, P. 2010. Email communication. Somenos Marsh Wildlife Society. December 3, 2010.

Nordin, R.N. 1985. Water Quality Criteria for Nutrients and Algae. Water Quality Unit, Resource Quality Section. Ministry of Environment, Lands and Parks. Victoria, B.C.

Somenos Marsh Wildlife Society (SMWS). http://somenosmarsh.com. Accessed December 22, 2010.

Williams, P. and G. Radcliffe. 2001. Somenos Management Plan. Madrone Consultants Ltd.. Duncan, B.C.

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Photo Credit:

fletcherfoto.ca

Bathymetric Map:

FISS (Fisheries Inventory Summary System)