Plants and Algae in Charlie Lake: Answers To Some Frequently Asked Questions

CLCS Mandate: To promote conservation efforts for Charlie Lake and its watershed by providing a forum for gathering, sharing and coordinating information for the purpose of developing a comprehensive management plan that will protect, preserve, enhance and support conservation

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Charlie Lake Conservation Society

British Columbia

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1. Why are there so many aquatic plants and algae in Charlie Lake?

Simple answer is: Charlie Lake is a highly productive or eutrophic lake.

2. What do "highly productive" and "eutrophic" mean?

It means that Charlie Lake has large amounts of nutrients, such as nitrogen, phosphorous, carbon and many others which combine to provide food sources for algae, plants and all other forms of biological organisms.

3. Where do nutrients come from?

There are two main sources of nutrients: natural and anthropogenic (caused by human activities).

Natural sources make up the bulk of nutrient inputs into the lake. These nutrients are found in the sediments (lake bottom) and soils around the lake. Some of these nutrients have been present within the lake for hundreds of year, as inferred from sediment samples analyzed by researchers at Queen's University. Their analysis indicated that before the1800's, Charlie Lake was a naturally eutrophic lake.

Anthropogenic nutrient inputs have been associated with increased land clearing and farming due to human settlement in the early 1900's. In more recent years, additional nutrient inputs into Charlie Lake came from various other sources such as, leaky or total lack of sewer systems, lawn and farm fertilizers, and industrial activities.

4. How does Charlie Lake compare to other lakes in BC in terms of productivity?

When productivity of Charlie Lake, measured by the amount of spring Total Phosphorous, was compared to a number of other northern BC lakes, it ranked Charlie Lake very close to the maximum observed.

5. How do high amount of nutrients translate into high animal and plant production (biomass)?

The pathways and processes that allow nutrients to impact biomass are many and complex. The most fundamental properties of lakes relate to the interaction of light, temperature and mixing of the water by wind. Photosynthesis is responsible for producing food that supports most of the food web in a lake. It also provides much of the dissolved oxygen in the water, which is important for the support of life. All aquatic life depend on dissolved oxygen in the water for life. A lot of people don't realize that fish and other organisms can't utilize the oxygen from the H_2O water molecule because it's bound to hydrogen. Instead, organisms utilize dissolved oxygen that comes into the water from the atmosphere and plants. Using carbon dioxide, water and light energy, plants generate new

cells and repair damaged ones, through photosynthesis, and dissolved oxygen gas is released as a by-product.

Algae (phytoplankton) are very efficient at extracting nutrients from the water and as water temperature increases (summer) the rate of nutrient uptake by algae increases eventually resulting in the large algal blooms we see in Charlie Lake in late summer. Small animal organisms (zooplankton), such as Daphnia and other species, feed exclusively on algae. This results in high production of zooplankton and this production works its way up the food chain and ultimately is responsible for the high fish production we see in most species within Charlie Lake.

Aquatic plants also benefit from the high level of nutrients. Through photosynthesis aquatic plants convert inorganic material (nutrients) to organic matter (plant biomass) and in the process oxygenate the water. Unfortunately, like algae, they can overpopulate and interfere with recreational use of the lake, which is the most common complain by some of the Charlie Lake users. However it also important to note that, aquatic plants are effective in reducing shoreline erosion caused by waves. Plants also trap sediments, silt, and organic matter flowing from the watershed around the lake. Nutrients are captured and utilized by aquatic plants, thus preventing them from reaching algae in the open portion of a lake. If aquatic plants were totally absent in Charlie Lake, it is highly probable that more nutrients would flow directly into the deeper portion of the lake, resulting in more intense algal blooms. This filtering of nutrients by plants is analogous to the role that wetlands have in capturing nutrients from runoff.

6. Charlie Lake is a relatively large lake, wouldn't we expect the nutrients entering the lake to be diluted quickly and eventually be flushed out during high spring runoff?

Although Charlie Lake is indeed a relatively medium-large lake, with a length of 15 km, perimeter of 38 km. and a surface area of 19 sq. km., it has small mean depth (15 m.) and volume relative to its size. Water inflow into Charlie Lake is mostly through Stoddard and Coffee Creeks at the north end of the lake, however these flows are relatively low and peak during spring runoff, and typically subside starting around the latter part of May. The flushing rate for Charlie Lake has been estimated at about 0.21 of its total volume per year, which translates into an average retention rate of about 5 years, which is how long it takes for Charlie Lake to flush its total volume once. This is considered fairly typical of inland lakes in BC, but it adds some perspective on nutrient retention in the lake.

7. Given that sunlight penetration through the water column is important for photosynthesis and plant production, why do we get so many aquatic plants despite the high water turbidity which would prevent deep light penetration?

Charlie Lake is indeed a relatively turbid lake. Water transparency measured with a Secchi Disc shows that water clarity averages about 2.5 meters over the period of the open water season. The rule of thumb for light penetration is that it is about twice the Secchi depth, so if the Secchi is 2.5 m. then light penetrates about 5 m.The depth at which light penetrates for effective photosynthesis is referred to as the photic depth, and if we draw a contour line around the lake at the 5 m. depth, this would be considered the photic zone. We would expect photosynthesis to occur within this zone.

We have available water volume calculation at various depths for Charlie Lake, and the photic zone makes up about 70 percent of the total lake volume. This means that light penetration and photosynthesis can potentially occur within 70 percent of the lake volume. If the depth of Charlie Lake increased very quickly from shore, the relative size of the photic zone would be reduced dramatically, along with significant reductions in aquatic plant growth. Of course this would also have all sorts of other consequences such as, greatly reduced fish production and increased shoreline erosion from waves, just to mention a few examples.

8. I've lived on the lake all my life and I've never seen levels of algae and aquatic plants this high. It must be due to < insert cause here>.

This is probably one of the most common observation we hear from folks who think that aquatic plant densities and algae blooms have increased significantly in more recent years. It's very difficult to support or dispute statements such as these, primarily because of the lack of available evidence. It's also important to note that there have been many other people who think that high levels of plants and algae have occurred historically in Charlie Lake and these levels have fluctuated over the course of decades. Many other variations of these comments have also been made.

While not disputing what people may or may not remember about historical conditions of Charlie Lake, it is impossible to use any of these statements as benchmarks that we can use for suggesting management actions by Government managers and biologists. We have some very valuable data that has been collected from Charlie Lake in recent decades and we should use it to educate the public on the factors that impact Charlie Lake, and foster responsible stewardship of the use of its water and watershed.

9. What can we do to reduce algae and aquatic plants in the lake so that they don't interfere with recreational activities?

The answer to this question is much more complicated than most people would expect. Charlie Lake is part of a very complex ecosystem whose boundaries not only include the lake and its shoreline, but also the watershed, which is about 281 square kilometers. Within this ecosystem there are aquatic and terrestrial organisms, which include everything from bacteria to humans, along with a variety of habitats and human activities. If it was possible to draw lines that represent interactions and impacts between all of these organisms, the diagram would be so complicated and incomprehensible that it would be totally meaningless and un-useful.

Given this scenario it would be simplistic and unrealistic to expect humans to manipulate any one of these organisms, such as algae and plants, and not expect to trigger a number of unexpected consequences, beyond what we may have planned for. For example, a number of approaches have been suggested to reduce aquatic plant densities. These range from mechanical removal of plants to application of selected chemical compounds, both organic and inorganic.

A plant harvester has been suggested a number of times to remove plants from Charlie Lake. Harvesters basically use a moving wheel or grate to grab floating plants and pile them on the barge so that they can be transported somewhere. There are a number of

problems with this approach. Most plants in Charlie Lake are rooted and they spread through rhizomes (root systems). It is entirely probable that using such a harvester would create huge amounts of plant material which would the float all over the lake and develop new roots and colonize more shoreline. Even if the methodology could be perfected, the cost associated with purchasing a harvester, operating it enough to make a difference, and transporting the plant material out of the watershed, would be cost prohibitive.

Application of various chemicals have also been suggested. These range from organic compounds, such as bacteria, to inorganic ones, such as copper-based compounds. Again, given the complexity of the ecosystem there are very high risks associated with the use of these applications because we cannot predict all of the impacts, both immediate and cumulative, that could result from these. Even if there was a desirable compound that could be used, the immediate dilution rates that we would expect because Charlie Lake is orders of magnitude larger than the small ponds where these applications usually are used, would make this a very costly and ineffective method.

It is also important to note that any large scale project, either mechanical or chemical based application, would need to be approved by appropriate Ministries who are responsible for various legislations associated with the protection and management of Charlie Lake.

10. Sounds like there's nothing we can do in Charlie Lake, and we have to get used to algae and aquatic plants negatively impacting our recreational activities.

As it was discussed earlier in this article, Charlie Lake is one of the most nutrient-rich (eutrophic) and productive lake in BC. All of the evidence we have shows that Charlie Lake has been eutrophic as far back as we can measure. There is a wide range of opinions among long-term residents in describing relative abundances of algae and aquatic plants. Unfortunately, it's impossible to use these personal opinions to establish reference points that can be used to set management goals for the water quality of the lake. We do know that human settlement around the Charlie Lake watershed has added to the already high levels of nutrients naturally present in the lake.

What we do know for sure is that there are plenty of positive actions that all lake users can do in order to protect the lake and its watershed and not add negative impacts. The Charlie Lake Conservation Society has been very proactive in promoting responsible stewardship and projects on the lake and its watershed. An example of a relevant and timely project is the completion of two aquatic plant surveys in 2014 and 2016. This was the first time that the abundance and distribution of aquatic plants were documented and mapped in a quantifiable way. The reports from these surveys are available on the CLCS website.

Some things you can do:

A. You can manage aquatic plant growth at a small scale in front of your property. A permit from the Ministry allows for mechanical removal of aquatic plants up to a width of 5 meters. If done early in the season, you could have a clear path to launch the boat into the lake as well as swimming areas.
B. Avoid clearing the shoreline of all existing vegetation to replace it with grassed areas or physical structures. This will more than likely result in significant erosion from fluctuating

water levels, waves and ice scouring. Willows have a very good roots system that can stabilize soils, and if the plants are pruned annually without pulling the roots, it will provide stabilization of your shoreline property, as well as reducing sediment loading into the lake from soil erosion.

C. Avoid heavy and indiscriminate use of lawn fertilizers. Aquatic plants will like that fertilizer just as much as your grass does.
D. Report any suspicious dumping of any kind in and close to the lake. The Charlie Lake watershed is fairly large and all runoff within the watershed eventually ends up in the lake.
E. Join the Charlie Lake Conservation Society which provides an organized forum to discuss issues, promote good lake stewardship, collaborate with the Ministry to support valuable projects within the lake, participate in surveys and other valuable activities such as annual shore cleanup and workshops, as well as lobby all levels of government as needed.
F. Enjoy the countless recreational activities in Charlie Lake, such as: boating, canoeing, kayaking, swimming, fishing and wildlife watching. The walleye population in Charlie Lake is one of the most healthy and productive anywhere. Charlie Lake also has an incredible number of waterfowl and many other species of birds, that nest on the lake and are there through all the open water season.

RELEVANT REPORTS AVAILABLE ON THE CLCS WEBSITE

Baccante, D.A. and B. Kosugi. 2014. Spatial survey of aquatic plants in Charlie Lake on July 11, 2014. 13 pages.

Baccante, D.A. 2017. Spatial survey of aquatic plants in Charlie Lake August 17, 2016. 20 pages.

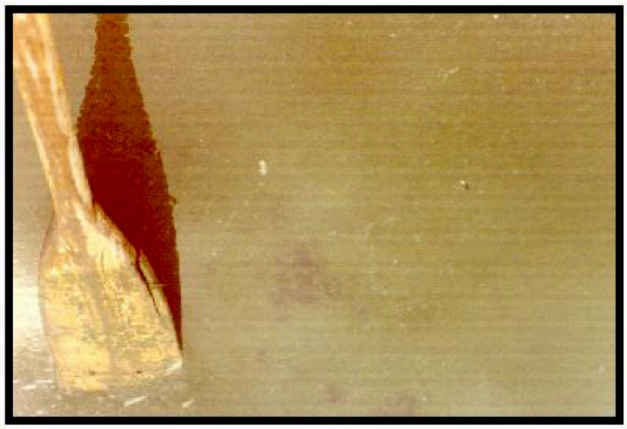
French, T.D. and N.B. Carmichael. 1999. Limnological aspects of Charlie Lake (Peace River drainage, British Columbia): A summary of data collected between 1974 and 1995. 115 pages.

SOURCES FOR SOME RESOURCE MATERIAL USED IN THIS DOCUMENT

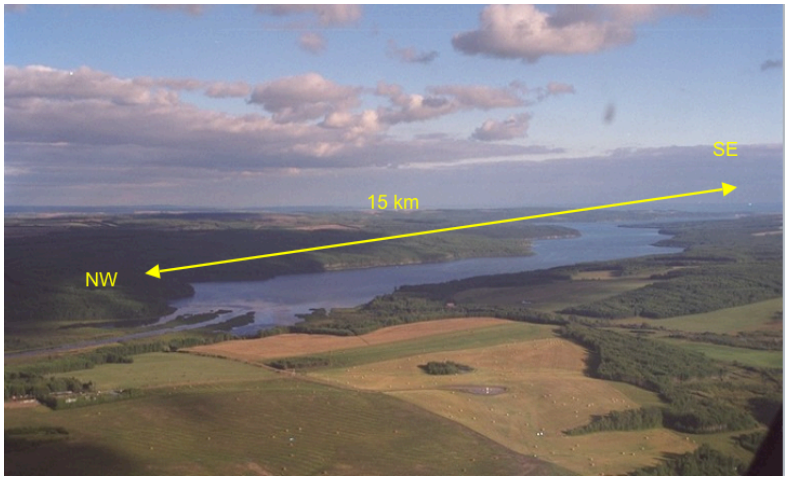
LAKE ECOLOGY OVERVIEW (Chapter 1, Horne, A.J. and C.R. Goldman. 1994. Limnology. 2nd edition. McGraw-Hill Co., New York, New York, USA.) https://www3.nd.edu/~aseriann/Limnology_Horne_Goldman.pdf

Plant Management in Florida Waters - an Integrated Approach. Center for Aquatic and Invasive Plants. University of Florida. http://plants.ifas.ufl.edu/manage/overview-of-florida-waters/water-quality/dissolved-oxygen/

Some relevant graphics.

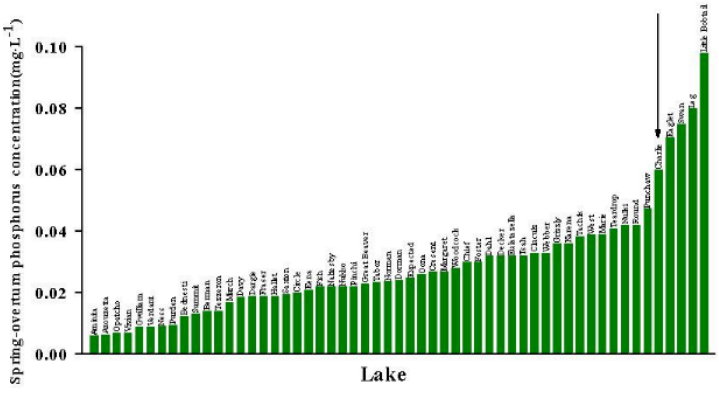


Paddle immersed in a thick cover of blue green alga in Charlie Lake in 1974. Photo credit: Dennis Ableson, Ministry of Environment, Ft. St. John.



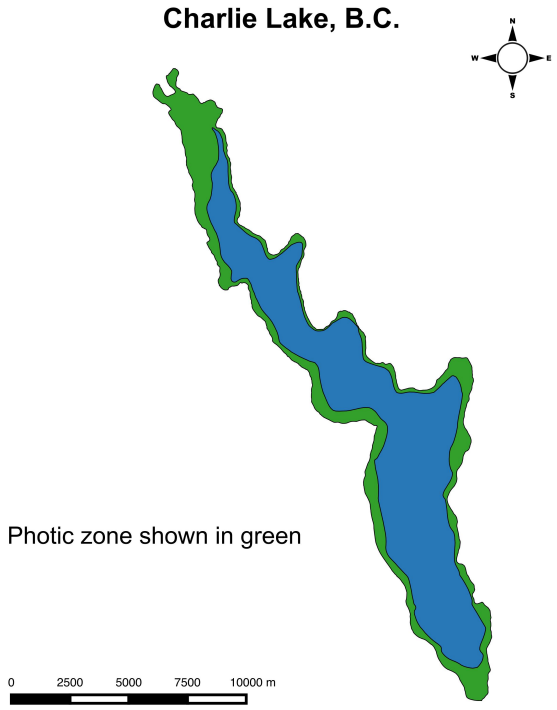
Directional alignment and length of Charlie Lake

from: French and Carmichael 1999

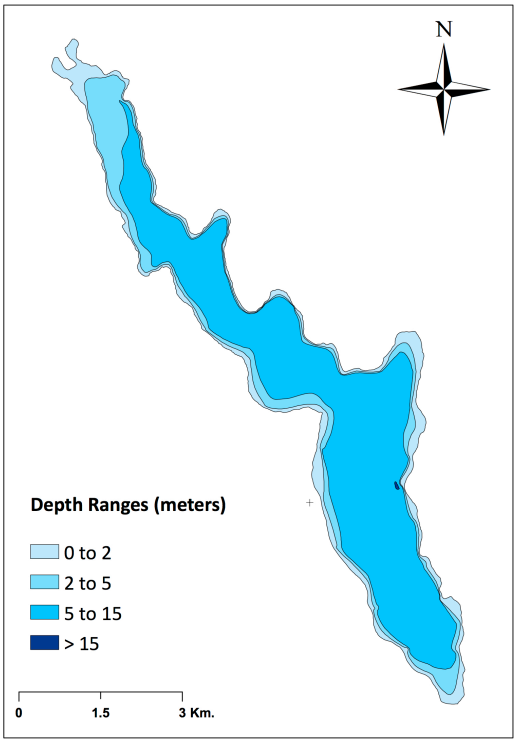


A comparison of 55 British Columbia lakes

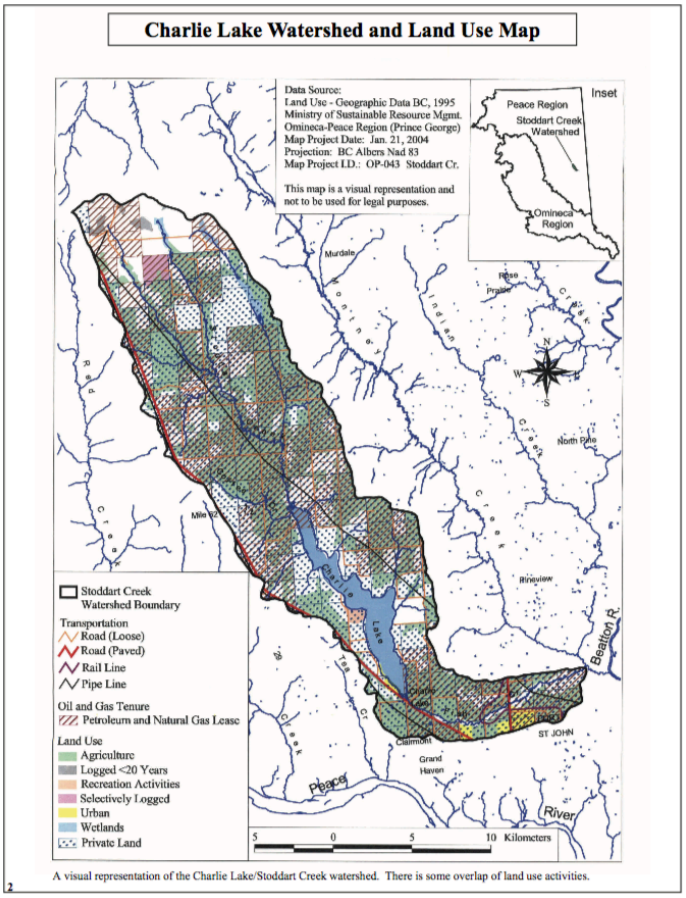
Productivity of Charlie Lake compared to other lakes in B.C.



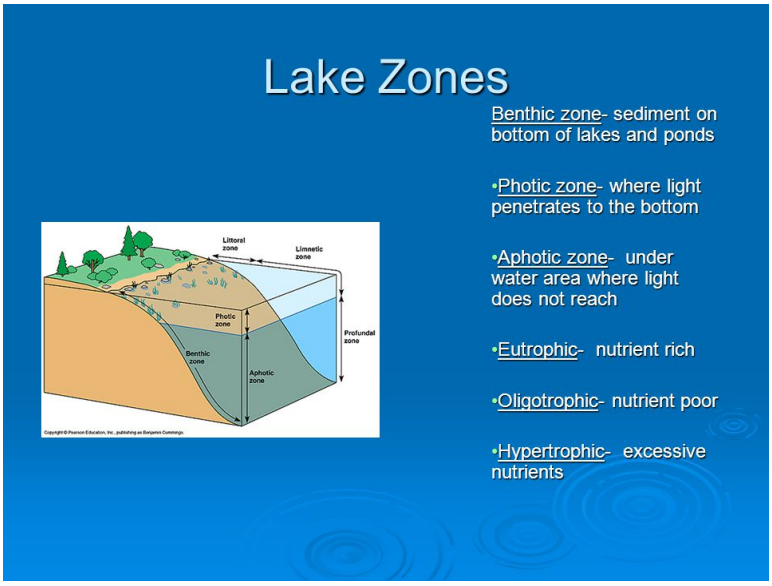
Photic zone in Charlie Lake.



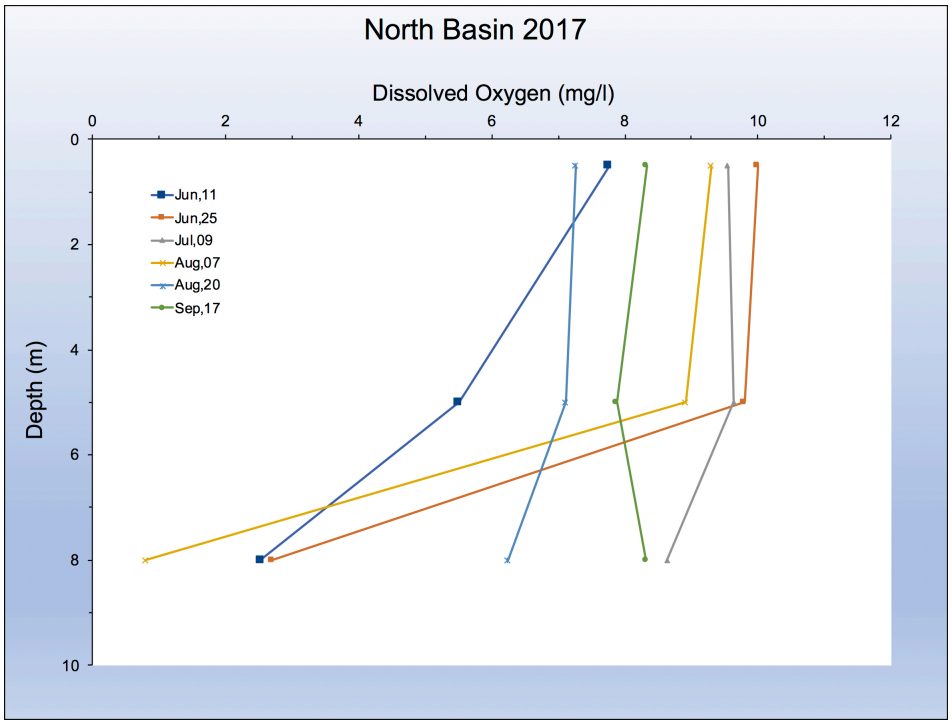
Depth map of Charlie Lake.

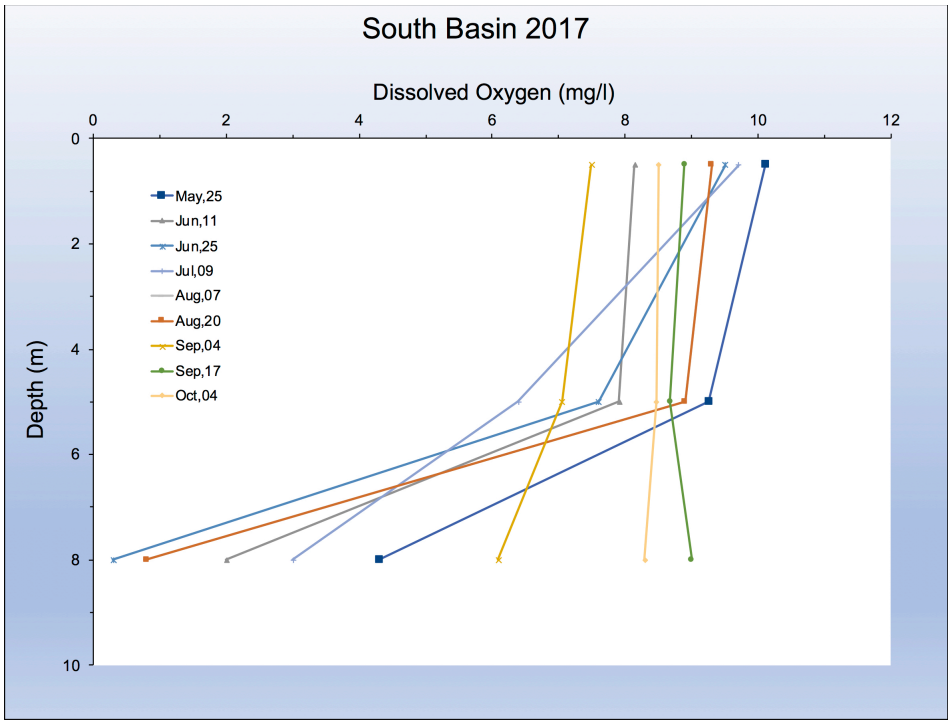


Charlie Lake watershed and Land Use Map



Representation of lake zones. From: http://slideplayer.com/slide/3442359/





Dissolved oxygen profiles in the North and South basins of Charlie Lake showing seasonal variations in 2017 as well as higher dissolved oxygen levels in the photic zone (depth of 0 to 5 meters).

Some photos from our 2016 aquatic plant survey. (Photo credits: Bruce Kosugi).