Oregon Lake Watch Water Quality Monitoring

Overview

Does it seem like there’s more algae floating in your lake, or the water just seems cloudier? Or maybe it seems like the water’s been getting clearer over the years. Or maybe your lake seems warmer to you this year. Without high quality water quality data that has been collected over a long period of time, it’s difficult to say for sure whether your impressions are correct.

One of the main goals of the Oregon Lake Watch (OLW) program is to train volunteers to collect simple, but very important water quality data that can begin to answer these types of questions. One type of water quality measurement we will train you to collect is water transparency using a Secchi disk. Water transparency is a surrogate for the amount of algae or other suspended material in a lake. Declines in water transparency over the long term (many years) may be indication that there is something wrong in your lake or its watershed. On the other hand, changes in water transparency over the short term (days to several years) may just be due to natural variation in your lake’s ecological and weather conditions. The long term data that you collect will help answer these questions.

Another type of water quality measurement we will train you to collect is water temperature at the lake surface, and down as deep as 15 meters (49 ft). These temperature profiles are very useful for putting your transparency measurements into context (for instance, if your water transparency was poor one year, did it correspond to a year with especially warm water temperatures?), or to look at long term trends in your lake’s temperature changes with depth.

We will provide a number of tools and materials to help plan and carry out your monitoring, a streamlined way to report your data, and information about how to make sense of your data. And if you have questions, we’ll be here to help you out.

Temperature Profile Monitoring Using an AquaCal™ Clinefinder®

Water temperature is an important characteristic to measure in lakes since it influences biological, chemical, and physical characteristics. Most notably:

- Water temperature influences the types of plants and animals that can live in a lake as well their growth and survival rates. For example, bass survive and grow better in warmer temperatures than trout. As another example, some toxin-producing blue-green algae species tend to be more abundant in warmer water.

- Water temperature influences the amount of oxygen dissolved in water that is available for fish and other aquatic organisms to breathe. Colder water generally contains more dissolved oxygen than warmer water.
Warm water is less dense than cool water. This physical property of water can create thermal stratification of a lake, the condition when a layer of warm, less dense water “floats” on top of a layer of cool, denser water (see box for details). Stratification restricts the movement of gases and other dissolved substances between layers which can result in oxygen depletion, nutrient buildup, and other related changes in the bottom layer. Lakes deeper than about 20 feet can stratify during the summer.

Water temperatures are also a reflection of seasonal weather and climate conditions. The start, duration, and depth of thermal stratification, as well as ice-on and ice-off dates can be used to assess long term trends in weather and climate if the data is regularly collected over many years. In the shorter term, this information can provide context for other water quality observations. For instance, you may find that blue-green algal blooms on your lake tend to occur during years when thermal stratification starts earlier in the year than normal.

As an Oregon Lake Watch volunteer you will be measuring water temperature profiles using an AquaCal™ ClineFinder® handheld digital thermometer. The ClineFinder® has a 15 meter (49 ft) long cable attached to the temperature sensor so you can measure temperatures at many depths in your lake.
Thermal Stratification and Mixing of a Water Column

Thermal stratification of a water column occurs in deep and moderately deep lakes during the warmest part of the year. A thermally stratified lake is characterized by an evenly warm surface layer (the epilimnion), an evenly cool bottom layer (the hypolimnion), and a layer between the two that bridges the warm and the cool water (the metalimnion). Another term that you may hear is the thermocline which is the depth in the metalimnion at which temperature declines the most. An important characteristic of a stratified lake is that the movement of dissolved gases and nutrients between layers is restricted. This can result in hypolimnetic oxygen depletion, which reduces the habitat available for many types of fish and other aquatic life and can lead to water chemistry changes that fuel excessive algal growth.

To understand why thermal stratification occurs, it is instructive to follow the typical season pattern of stratification and mixing in an Oregon lake. During the early spring, winds are able to mix the entire lake volume resulting in an iso-thermal (even temperature) water column. As the spring progresses, more intense sun shines on the lake and warms the surface waters. This warmer water is less dense and floats on top of cool water. At relatively cool temperatures, however, this difference in density is not enough to resist mixing by wind energy and the entire lake will warm up. At warmer temperatures, density differences become great enough that wind energy cannot completely mix the water column and we end up with a thermally stratified lake. The depth to which winds mix the epilimnion (the upper warm surface layer) ranges around 20 ft or deeper in large, wind-exposed lakes; and shallower in small, wind-protected lakes. As the epilimnion cools in the fall, density differences become smaller until wind energy is able overcome the resistance to mixing. Fall turnover occurs when the lake completely mixes. Throughout the fall, cool winds will continue to mix and cool the entire water column.
Equipment Required

- Anchor and anchor rope
- Lifejackets
- Lake map with sampling site marked
- GPS coordinates of sampling location or description of landmarks used to locate sampling site
- AquaCal™ Clinefinder®
- Water Quality Field Datasheets (Secchi Transparency and Temperature Profile)
- Pencil or waterproof pen

Monitoring Procedures

**STEP 1:** Tie or clip the Clinefinder® surface unit to your boat or dock to prevent it from falling overboard.

**STEP 2:** Unwind the temperature sensor (located at the end of the cable) and lower it to 0.1 meters (just below the surface). Leave the sensor at 0.1 meters for at least one minute to give the sensor time to equilibrate with the water temperature at that depth. Record the depth, temperature, and time of measurement on the Temperature Profile Datasheet.

**STEP 3:** Lower the sensor to one meter and one meter intervals thereafter to 15 meters or to the bottom of the lake, whichever is shallower. At each depth repeat Step 2, including leaving the sensor at each depth for at least one minute. Make sure the cable hangs straight down vertically so measurements are made at the correct depth in the water column. Take measurements at 0.5 meter intervals throughout the metalimnion where temperatures change quickly with depth.

**STEP 4:** Wind the cable until into the Clinefinder® until the temperature sensor is at one meter and repeat the one meter measurement and record the results.

**STEP 5:** Wind the cable into the Clinefinder®. Allow the Clinefinder® to air dry and store it out of direct sunlight.

**STEP 6:** Enter your data online at [http://lakewatch.research.pdx.edu/](http://lakewatch.research.pdx.edu/)

Tips:

- If you have a downrigger on your boat, you can clip the temperature sensor to your downrigger weight and use the downrigger to lower the sensor to each depth.
- If your anchored boat is moving too much for the temperature sensor to hang down vertically, you can throw another anchor off the stern of the boat, or add more weight to the clip that attaches to the lead weight. Do not clip more than a total of two pounds onto the cable and only clip the weight to the clip that comes with the Clinefinder®. The Clinefinder® clip is specially designed to release the weight if it gets caught on the bottom without damaging the temperature sensor.
Water Clarity Monitoring using a Secchi Disk

The clarity of lake water is a simple but reliable measure of the amount of suspended matter (algae and sediment) and color (dissolved compounds from decaying wetland plants) in the water. The Secchi disk is a standardized method of measuring the clarity of water. It is the most common and perhaps the easiest measurement made on lakes, yet it provides very valuable information about a lake’s condition.

Water clarity can be used to compare between lakes (their trophic status), or to track seasonal or long term trends in a particular lake. Water clarity can be used to indirectly track changes in suspended algae and sediment and water color over time due to natural seasonal and annual trends, as well as human-caused trends such as eutrophication. Eutrophication results from excessive nutrient loading from watershed development, farming, forestry, or leaking septic systems.

Water clarity determines the depth to which algae and aquatic plants have sufficient light for growth. Fish, birds and other wildlife depend on water clarity to find food or avoid being eaten.

Equipment Required
- Anchor and anchor rope
- Lifejackets
- Secchi instruction manual
- Water Quality Field Datasheets (Secchi Transparency and Temperature Profile)
- Pencil or waterproof pen
- Lake map with sampling site marked
- GPS coordinates of sampling location or description of landmarks used to locate sampling site
- Secchi disk with depth calibrated line
- View tube

Lake Trophic State

Nutrient input into many lakes determines the amount of algae in the water column. Since algae are the base of the food web, the amount of algae determines the overall biological productivity of the lake. Lakes with a lot of biological activity (high algae, plant, and fish abundance and growth rates) are termed eutrophic (well-fed). Lakes with very little nutrient input and therefore low biological activity are termed oligotrophic (poorly-fed). Lakes with intermediate amounts or nutrient input are termed mesotrophic. Describing a lake’s trophic state is therefore, a shorthand way of communicating important information about a lake.
Secchi Transparency Measurement Procedures

**STEP 1:** Before heading out to your sampling site, make sure the time and conditions are right for sampling. Measurements should be taken between 10 am and 4 pm. Ideal conditions are calm waters and sunny skies, but measurements can be taken whenever conditions are safe (no whitecaps on the lake or ice on the boat).

**STEP 2:** Navigate to the designated sampling site on your lake and anchor the boat to prevent drifting. Your OLW trainer will provide you with a map showing the designated sampling site, the sampling site identification number, and the GPS coordinates of the site. In shallow lakes, be mindful of suspending sediments that could interfere with Secchi disk readings.

**STEP 3:** Remove your sunglasses and slowly lower the Secchi disk over the sunny side of the boat. Observe the disk through the viewtube until the disk disappears from view. Take your time and move the disk up and down by several feet to narrow down this point of disappearance and reappearance. Place a clothespin at the water surface once you determine this point.

**STEP 4:** Bring the Secchi disk back onto the boat and measure the distance from the disk to the clothespin. The rope is marked as single black lines in one meter increments and red lines at 0.5 meter increments.

**STEP 5:** Record the measurement on your Secchi field data sheet along with your name, the time and date of measurement, wave conditions, sky conditions, and any notes that may be useful (for example, “algal clumps that looked like small blades or grass were visible throughout the water column”).

**STEP 6:** Repeat steps three through four as a measure of the repeatability (also known as precision) of your measurement. Record the new measurement and note that it is a precision check sample.

**STEP 7:** Enter your data online at [http://lakewatch.research.pdx.edu](http://lakewatch.research.pdx.edu)