Ohop Lake Volunteer Lake Monitoring Program

Introduction

In Spring 2021, the Ohop Lake Improvement Club assembled a committee to begin monitoring the lake with the goal of collecting basic water quality data to help homeowners track and better understand lake conditions. OLIC lake volunteer monitors attended a lake monitor training in April, and eight OLIC members participated in data collection during the 2021 monitoring season. This report contains a summary of the data collected in 2021 on Ohop Lake between May and October.

Ohop Lake is a 230-acre lake with a maximum depth of 25 feet located in the Nisqually watershed. Ohop Creek flows into the north end of the lake and exits out of the south end.

Monitoring Program

Water chemistry and physical characteristics of lakes vary both seasonally and with depth. Lake volunteers recorded observations of lake conditions, weather, recreational use, measured transparency, measured temperature and dissolved oxygen profiles, and collected a water sample for pH monthly at two sites in Ohop Lake.

Measurements of temperature and dissolved oxygen profiles were made throughout the water column at the deepest point at two sites on the lake. Site 1 is located near the center of Ohop Lake and Site 2 is located at the south end of the lake near the boat launch. Field data collected in 2021 can be found in Table 1. Field data collected between 2004 -2006 can be found in Table 2, and 2004-06 graphs are in Appendix 1.

Dissolved Oxygen and Water Temperature Profiles

Dissolved oxygen and temperature are important attributes of a lake ecosystem, and both are critically important to determining the types of aquatic life found in lakes. The amount of oxygen dissolved in water is affected by the water temperature – all other factors being equal, cold water holds more oxygen than warm water. The amount of dissolved oxygen present in water will determine where in the lake plants and animals can live.

With the onset of warmer weather in spring and early summer, deep lakes will begin to separate into a warmer, low-density layer at the surface, known as the epilimnion, and a cooler, high-density layer at the bottom, known as the hypolimnion. Between the epilimnion and the hypolimnion is a layer of rapidly changing temperature called the thermocline. This process is called thermal stratification. Once this condition is fully developed in deeper lakes, usually in summer, there is no vertical mixing of the upper and lower layers because of their density differences. Shallower lakes may also separate into these layers although the layers may not remain separate throughout the entire summer. These shallower lakes will mix on windy or stormy days.

With the arrival of cooler weather in the fall, thermal stratification begins to break down and the shallow and deep layers of water begin to mix vertically once again. This phenomenon is usually called turnover. Nutrients (from decomposed aquatic plants and animals) that have been released from the bottom sediments over the course of the summer due to low oxygen levels (in the bottom waters) will mix up into the water column during turnover becoming available to the free-floating algae and can led to an algae bloom. Figure 1 below demonstrates a typical temperature profile in summer and after turnover occurs in a lake.

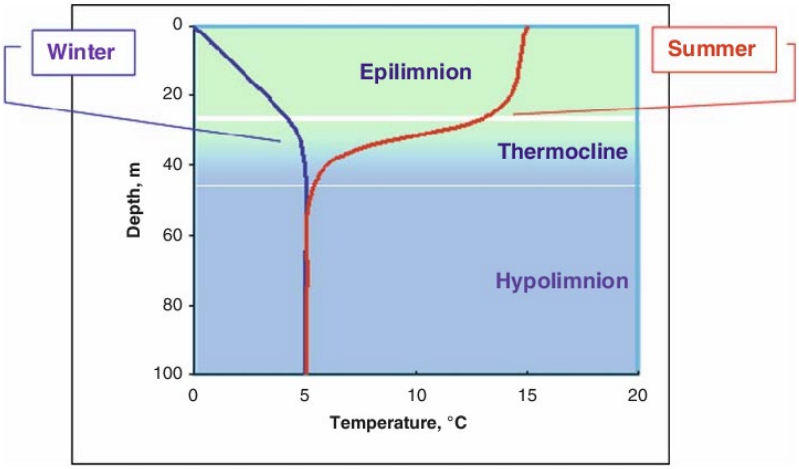
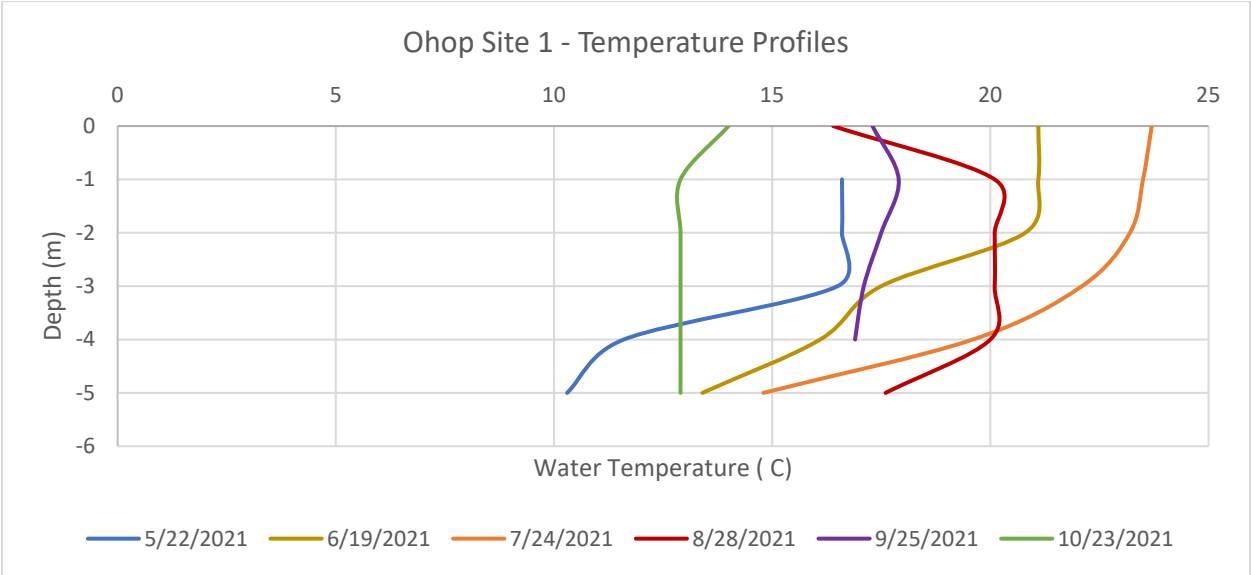
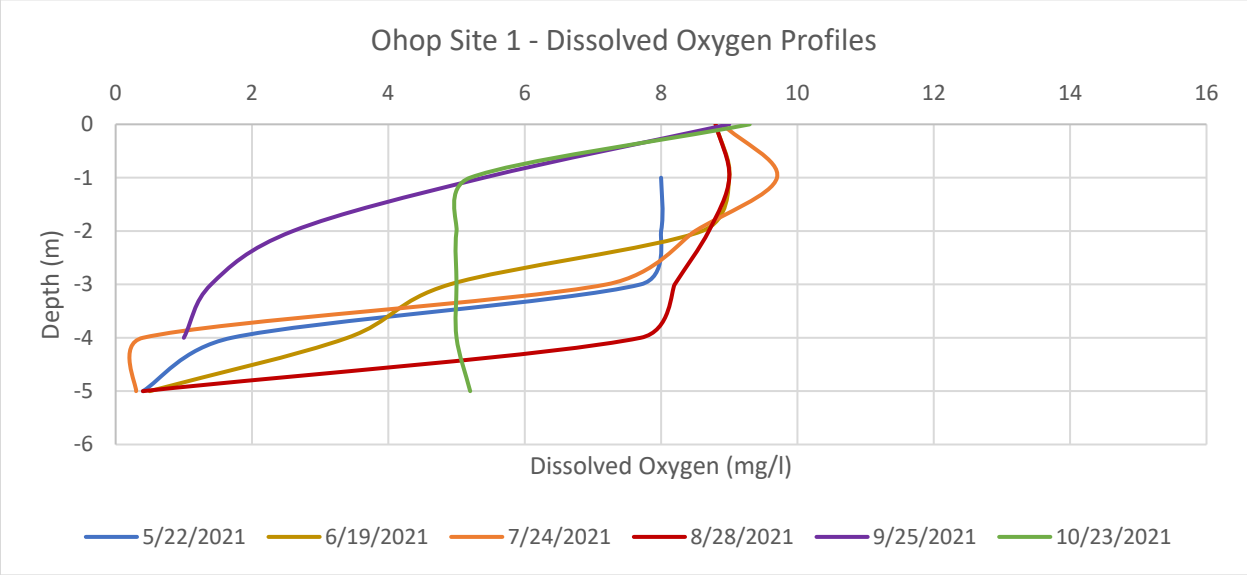
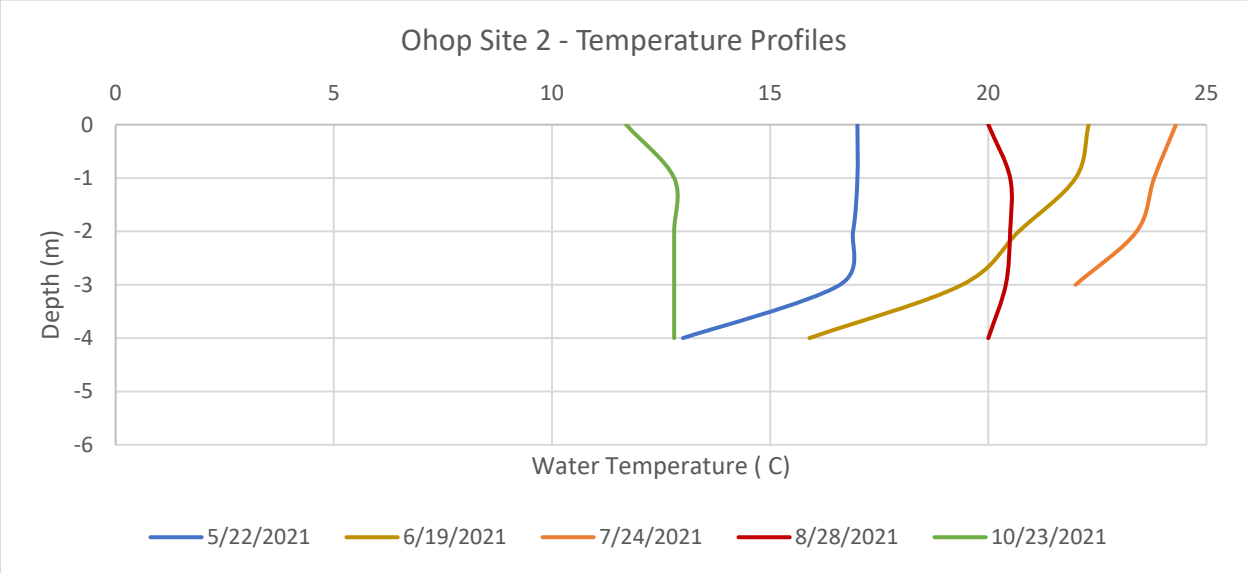


Figure 1. Thermal Stratification

The temperature profiles for both sites on Ohop show that stratification was well underway in late May (blue line). Turnover was underway in late September and nearly complete by late October (green line). The dissolved oxygen profiles are similar to the temperature profiles (Figure 2). Dissolved oxygen levels in the hypolimnion remained low (<2 mg/l) and had a lowering effect on oxygen levels in the epilimnion at the time of turnover. Ohop Lake is relatively shallow and may not remain stratified throughout the summer, it could mix on windy and stormy days. This year's temperature and dissolved oxygen profiles are similar to those measured in 2004-2006 (Appendix 1).







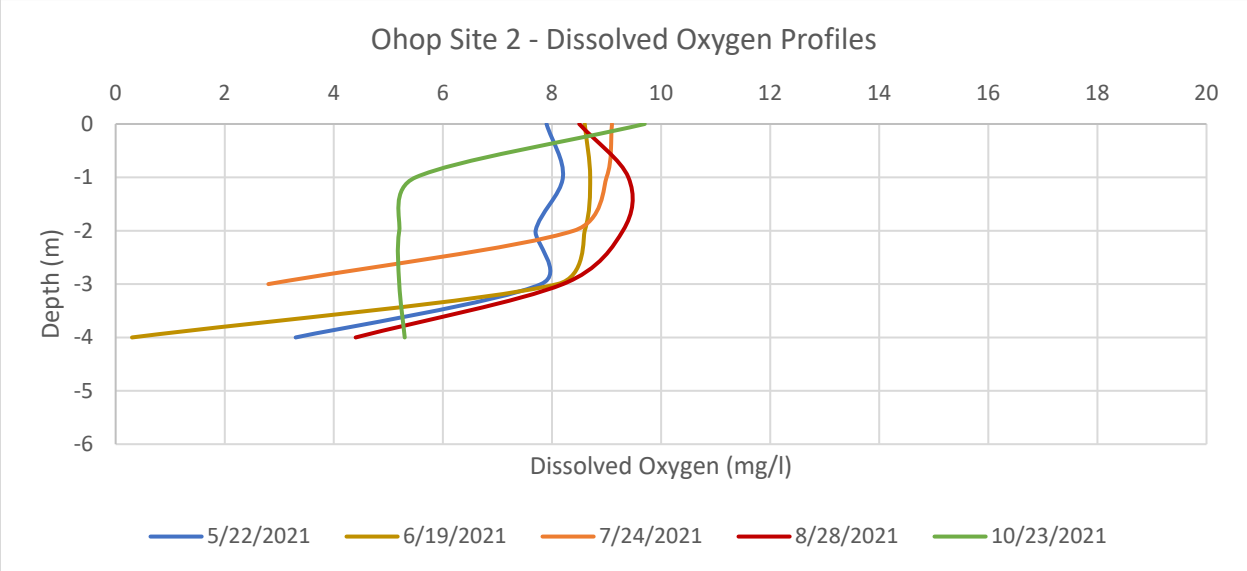


Figure 2. Temperature & Dissolved Oxygen Profiles

Transparency

Water transparency is measured with an eight-inch diameter, black and white secchi disk and is traditionally reported as secchi depth, in meters (1 meter = 3.3 feet). Transparency is influenced by several factors such as dissolved substances, algae, and sediment particles. Transparency readings can also be affected by waves, wind, and glare at the water surface. Deeper secchi depth readings indicate clearer water (more transparent) while shallower secchi depth readings indicate more turbid water. Clear water allows sunlight to penetrate deeper into the lake, allowing photosynthesis in aquatic plants and algae to occur; this leads to higher levels of dissolved oxygen. A decrease in transparency is often seen with an increase in algal density, or an influx of sediment and detritus due to a major storm event in the watershed. Secchi depth is an indirect indicator of algal abundance.

Secchi depth measurements observed in 2021 (Figure 3) for Site 1 ranged from 0.7 to 2.5 meters with greater transparency (deeper secchi depth) occurring in late spring/early summer. Secchi depths for Site 2 ranged from 0.5 to 2.2 meters, and like Site 1 greater transparency occurred in late spring/early summer. Both sites had the lowest secchi depths in September. Volunteer monitors noted that there was a substantial bloom occurring at their September monitoring session. The Tacoma-Pierce County Health Department issued a toxic algae caution advisory in early September. The 2021 secchi depths are similar secchi depths measured in 2005.

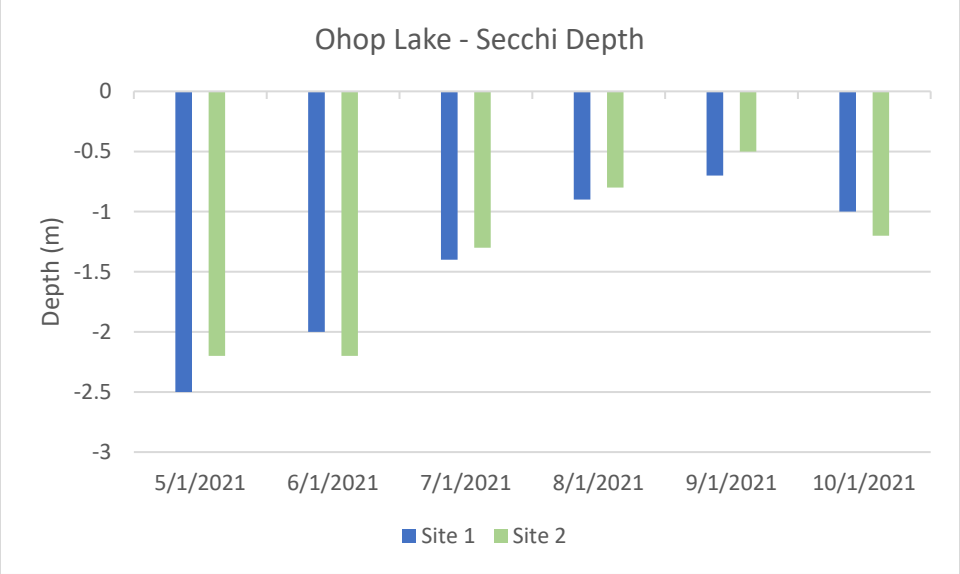


Figure 3. Secchi Depth

pH

pH is a measure of the hydrogen ion concentrations in water and indicates whether water is acidic, basic, or neutral. The pH scale goes from 0 to 14 with 7 being neutral. pH above 7 is considered basic and pH below 7 is considered acidic. The pH scale is logarithmic, meaning that a change of one whole number on the scale is a tenfold change in acidity. pH affects nearly every water function where chemistry is involved.

Water samples were collected from the lake surface at both sites for measurement of pH. pH results were near neutral at both sites. The July & August pH tended to be more basic while the end of season pH was slightly acidic. Photosynthesis in the upper portion of the lake tend to push the pH levels higher (more basic), and decomposition of organic material at the lake bottom tend to push the pH levels a little lower (acidic). Lower pH at the end of the season reflects lake turnover and mixing of lower pH waters near the lake bottom with more neutral surface waters.

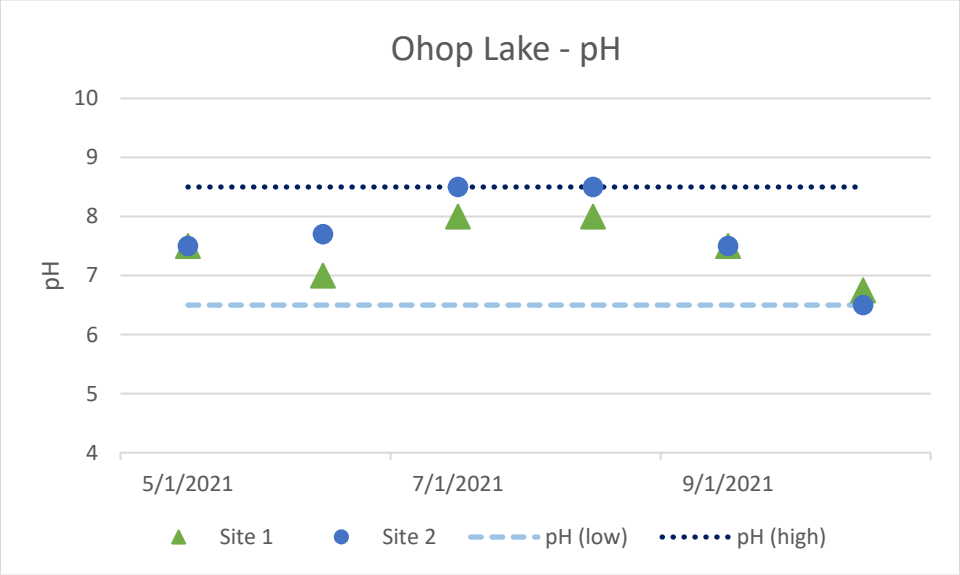


Figure 4. pH

Summary

Lake volunteer monitors collected data monthly beginning in May and ending in October. The data are summarized as follows:

- Temperature & dissolved oxygen profiles show the lake is stratified through the summer
- Secchi depths declined over the summer and were at their lowest in September; at this time an algae bloom was occurring
- pH values fall within the 7.0 – 8.5 range that supports aquatic life.

While conditions may vary from year to year, long-term data collection is the key to tracking trends in water quality over time.

Recommendations

Many lakes suffer from too much phosphorus, which comes from homes in the watershed that drain into the lake. When it rains the phosphorus and bacteria wash into ditches and down storm drains eventually ending up in the lake. This can lead to problems such as excessive aquatic vegetation, algae and toxic algae blooms, lower water clarity, stressed fish and wildlife, and lower property values.

Phosphorus comes from many common household sources like fertilizers, pet and animal wastes, septic systems, and dirt from driveways, roofs, and erosion. Soils in our area are naturally rich in phosphorus.

Lake management is a complicated job and takes the combined efforts of local government, community groups, individuals, and landowners. To be effective lake management is a long-term commitment and investment. Here are some voluntary actions lake watershed residents can take to protect the health of the lake:

- Avoid fertilizer. If you do fertilize choose phosphorus-free products.

- Scoop pet waste, bag it and toss it in the trash.
- Divert runoff from roofs and driveways into stable vegetated areas.
- If you have a septic system, schedule routine inspections. More information about septic tank maintenance can be found on Tacoma-Pierce County Health Department's website - https://www.tpchd.org/healthy-homes/septic-systems
- Cover bare soil area with mulch or plants.
- Fix eroding areas in the yard, driveway, and parking areas.
- Maintain existing natural shorelines – these areas provide additional wildlife benefits for birds, turtles, frogs, and other aquatic life.
- If you are a boater or angler prevent the spread of aquatic invasive species in your lake using the Clean/Drain/Dry method recommended by Washington State Department of Fish & Wildlife. Check here for more information: https://wdfw.wa.gov/ais/youcanhelp.html.

Table 1. Ohop Lake - 2021 Data

Lake	Date	Time	Site Depth (m)	Secchi Depth (m)	Air Temp (C)	Water Temp (°C) Top	Dissolved Oxygen (mg/l) Top	Water Temp (°C) Bottom	Dissolved Oxygen (mg/l) Bottom	Lake Level (ft.)	Suspended Algae	pH (surface)	pH	Comments/Observations
Ohop Lake - Site 1 46.898, -122.280	5/22/2021	10:45am	6.2	-2.5	11.1	16.6	8	10.3	0.4		None	7.5		Wind cond: light; SW; weather: overcast; water surface cond: ripples; light cond: overcast. No water odor. 22 geese (6 adults, 16 young). 10 boats, 20 people fishing; 0 waders/swimmers.
	6/19/2021	10:17AM	5.8	-2	16.11	21.1	8.8	13.4	0.5	NA	None	7		Wind cond: Calm; weather: clear; water surface cond: calm; Light cond: strong sunlight. No odor. 15 Canada geese; 4 boats; 10 people fishing.
	7/24/2021	10:20 AM	6.2	-1.4	21.1	23.7	8.9	14.8	0.3		Light, small particulate	8		Wind cond: light; weather: clear; water surface cond: ripples; light cond: strong sunlight. No water odor. 30 Canada geese. 14 boats; 10 people fishing; 2 swimmer/waders
	8/28/2021	10:20am	6.3	-0.9	16.4	16.4	8.8	17.6	0.38		Moderate, small particulate	8		Wind cond: calm; weather: clear; water surface cond: ripples; light cond: strong sunlight. No water odor. 1 heron. 0 boats, 0 fishing, 0 swimmers/waders.
	9/25/2021	10:15am	5.2	-0.7	16.1	17.3	9	16.9	1		Substantial bloom, green with white soapy suds on surface	7.5		Wind cond: calm, weather: clear; water surface cond: calm; light cond: strong sunlight. Fishy water odor. 3 boats; 2 people fishing; 0 swimmers/waders
	10/23/2021	10:15am	6	-1	8.8	14	9.3	12.9	5.2		None	6.75		Wind cond: light; weather: overcast; water surface cond: ripples; light cond: overcast. No odor. 10 ducks; 0 boats; 1 person fishing; 0 swimmer/waders

Lake	Date	Time	Site Depth (m)	Secchi Depth (m)	Air Temp (C)	Water Temp (°C) Top	Dissolved Oxygen (mg/l) Top	Water Temp (°C) Bottom	Dissolved Oxygen (mg/l) Bottom	Lake Level (ft.)	Suspended Algae	pH (surface)	pH	Comments/Observations
Ohop - Site 2 46.888, -122.277	5/22/2021	11:15AM	5.4	-2.2	11.1	17	7.9	13	3.3	NA	none	7.5		Wind cond: light; weather: overcast; water surface cond: ripples; light cond: overcast. No water odor. 22 geese. 10 boats, 20 people fishing, 0 swimmers/waders.
	6/19/2021	10:53AM	5.2	-2.2	17.7	22.3	8.6	15.9	0.34	NA	none, grainy appearance	7.7		Wind cond: calm; weather: clear; water surface cond: ripples; light cond: strong sunlight. No water odor. 15 Canada geese; 10 boats.
	7/24/2021	10:55 AM	4.3	-1.3	22.8	24.3	9.1	22	2.8		light, small particulate	8.5		wind cond: light; weather: clear; water surface cond: ripples; light cond: strong sunlight. No water odor. 30 Canada geese. 14 boats, 10 people fishing, 2 swimmers/waders.
	8/28/2021	10:40 AM	5.1	-0.8	18.4	20	8.5	20	4.4		moderate, small particles substantial bloom, green, surface algae lighter green. No bubbles.	8.5		wind cond: light; weather: clear; water surface cond: calm; light cond: strong sunlight. No water odor. 0 waterfowl; 0 boats, 0 fishing, 0 swimmers/waders.
	9/25/2021	10:40am	5.3	-0.5	17.2	18.6	7.95					7.5		Wind cond: clam; weather: clear; water surface cond: clam; light cond: strong sunlight. Fishy odor. 6 ducks; 3 boats; 0 fishing, 0 swimmer/waders
	10/23/2021	10:40am	5.3	-1.2	11.1	11.7	9.7	12.8	5.3		None	6.5		Wind cond: breezy; weaterh: overcast, rain; water surface cond: ripples; light cond: overcast. 10 ducks; 0 boats, 1 person fishing; 0 swimmers/waders.

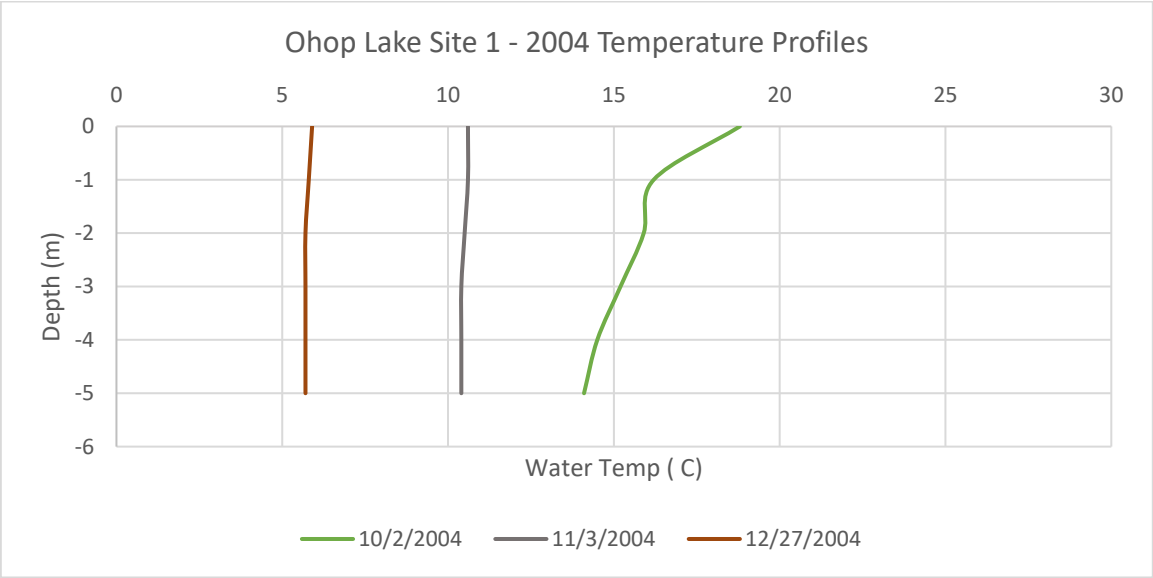
Table 2. Ohop Lake - 2004-2006 Data

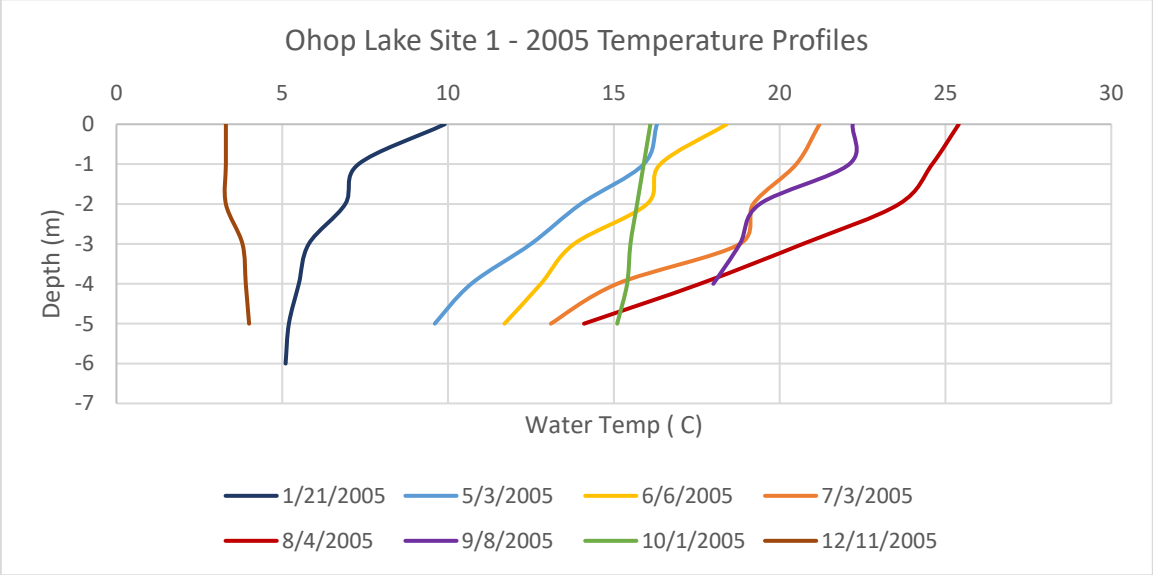
Lake/Site #	Date	Site Depth (m)	Secchi Depth (m)	Water Temp (°C) Top	Dissolved Oxygen (mg/l) Top	Water Temp (°C) Bottom	Dissolved Oxygen (mg/l) Bottom	Chlorophyll a (mg/m^3) shallow	Total Phosphorus (µg/l) shallow	Total Phosphorus (µg/l) deep	Lake Level (ft.)	Suspended Algae	Comments/ Observations
Ohop/Site 1	10/2/2004	5.8	-1.3	18.8	10.1	14.1	0.1				0.2	Moderate	
	11/3/2004	6	-0.7	10.6	8	10.4	7				0.78	Light	6 geese
	12/27/2004	6	-1.1	5.9	9.2	5.7	9				0.43	None	50 geese
	1/21/2005	6.3	-0.4	9.9	10	5.1	10.7				1.36	None	
	5/3/2005	5.9	-2.8	16.3	9.1	9.6	5.2				0.6	None	2 geese
	6/6/2005	6	-1.56	18.4	10.5	11.7	2	9	40	70	0.52	None	30 geese
	7/3/2005	5.9	-1.5	21.2	8	13.1	0.4				0.26	None	25 geese
	8/4/2005	5.6	-1	25.4	9.5	14.1	0.2	27	20	150	0.16	Moderate	30 geese
	9/8/2005	5.3	-0.7	22.2	12.4	18	4.1				0.06	Moderate	30 geese
	10/1/2005	5.75	-1.5	16.1	6.8	15.1	3.6				0.6	Light	40 geese
	12/11/2005	5.7	-1.2	3.3	10.6	4	9.1				0.36	Moderate	50 geese
	3/19/2006	5.7	-1.3	9.5	11.5	6.5	11.2				0.64	None	40 geese
	7/10/2006	5.6	-1.5	23.2	8.7	14.2	0.4				0.09	None	60 geese
	8/14/2006	5.3	-1.5	22.1	8.5	17.9	0.5				0.03	Light	20 geese
	9/30/2006	5.2	-1.5	19.2	8.7	15.8	3.2				0.02	Moderate	40 geese

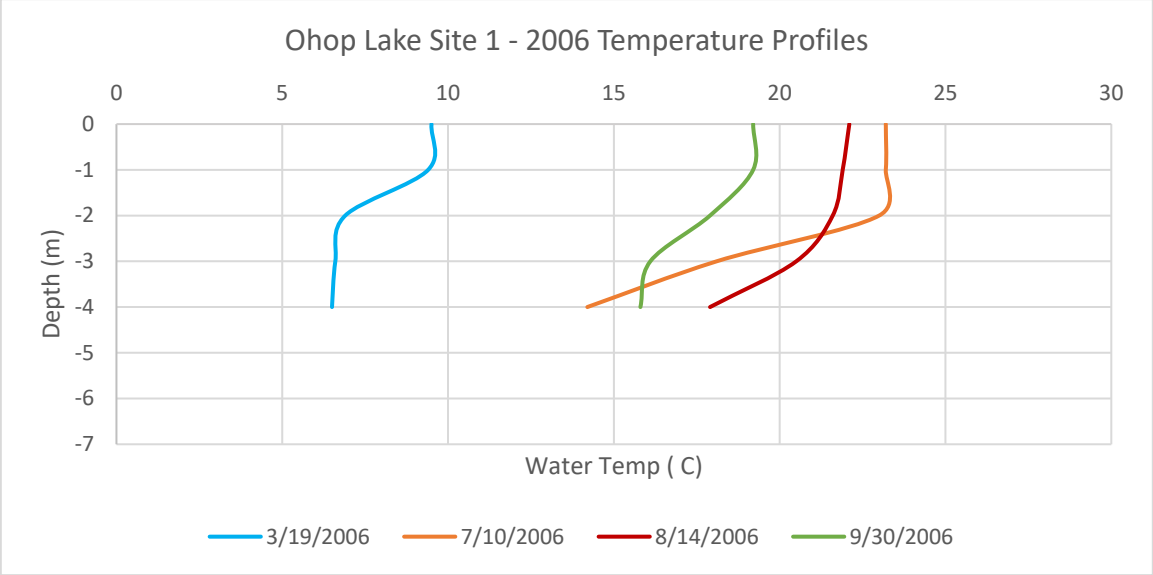
Lake/Site #	Date	Site Depth (m)	Secchi Depth (m)	Water Temp (°C) Top	Dissolved Oxygen (mg/l) Top	Water Temp (°C) Bottom	Dissolved Oxygen (mg/l) Bottom				Lake Level (ft.)	Suspended Algae	Comments/Observations
Ohop /Site 2	10/2/2004	5.5											
	11/3/2004	5.5	-0.7	10.6	7	10.4	7						
	12/27/2004	5.3	-1.1	5.9	9.2	5.7	9						
	1/21/2005	5.5	-0.4	8.5	10.5	5.6	10.9				1.36	None	
	5/3/2005	5.5	-1.4	17.1	9.5	9.9	7.5				0.6	None	
	6/6/2005	5.3	-1.5	17.8	10.9	13.6	5.3				0.52	None	
	7/3/2005	5.1	-1.5	22.3	8	13.6	0.6				0.26	None	
	8/4/2005	5.2	-1	26.1	9.5	16.9	0.4				0.16	Moderate	
	9/8/2005	5.2	-0.7	23	11.6	18.8	3				0.06	Moderate	
	10/1/2005	5.3	-1.5	16.1	7.4	15.1	0.9				0.6	Light	
	12/11/2005	5.1	-1.2	4.3	9.1	4	9						
	3/19/2006	5.1	-1.3	9.4	11.23	6.3	10.9						
	7/10/2006	5.1	-1.5	23.8	8.5	16.1	0.4						
	8/14/2006	5.1	-1.5	23.2	8.9	19.4	0.7						
	9/30/2006	5	-1.5	19.7	8.8	16.1	2.4						

Appendix 1. 2004-2006 Data Graphs

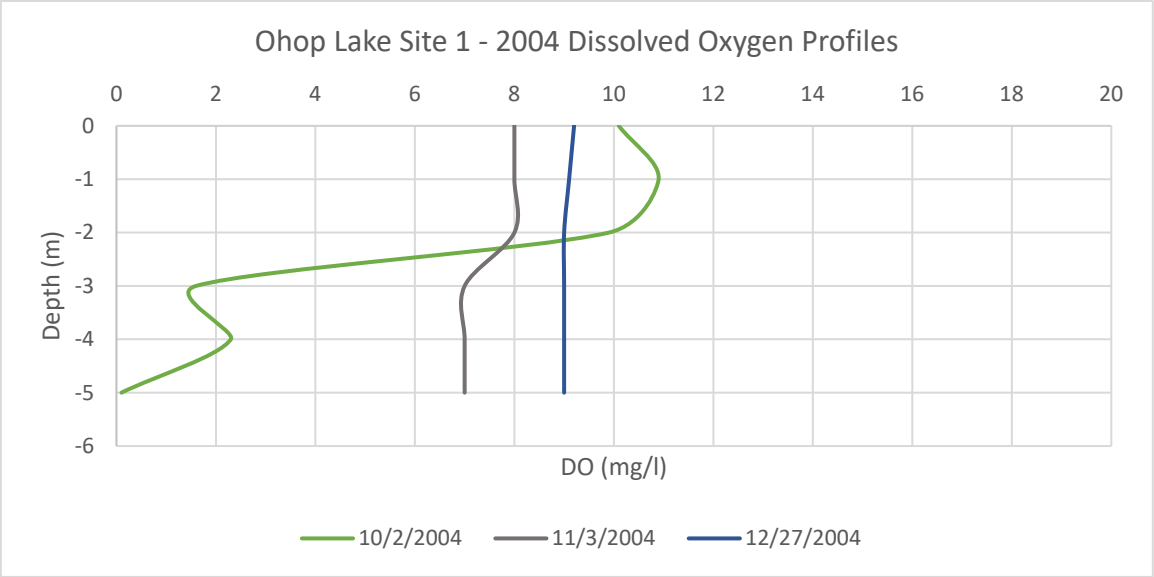
Ohop Lake Site 1 Temperature Profiles

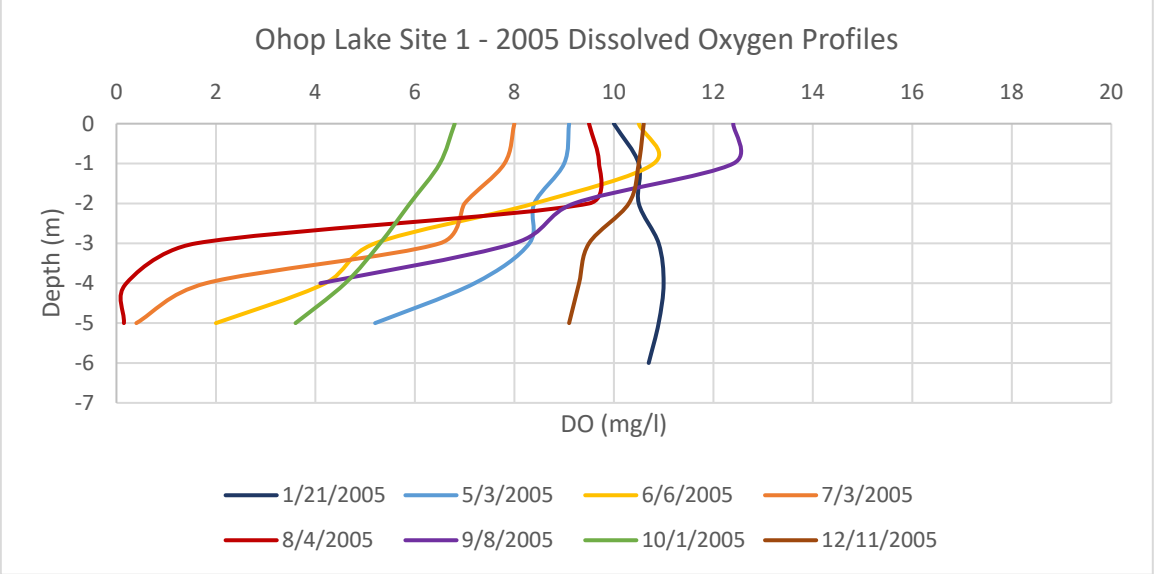


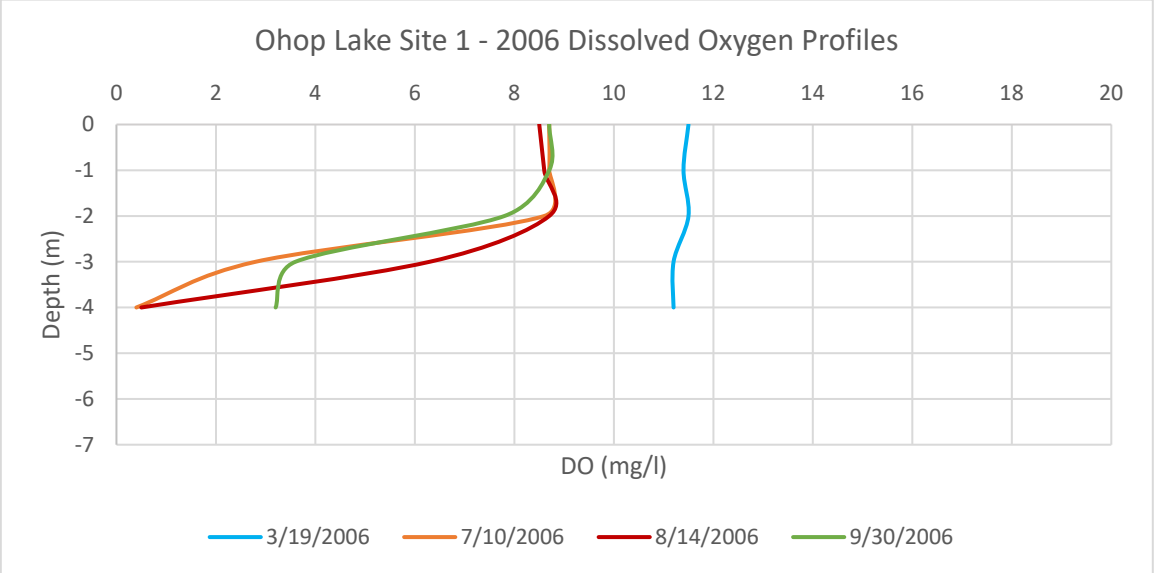




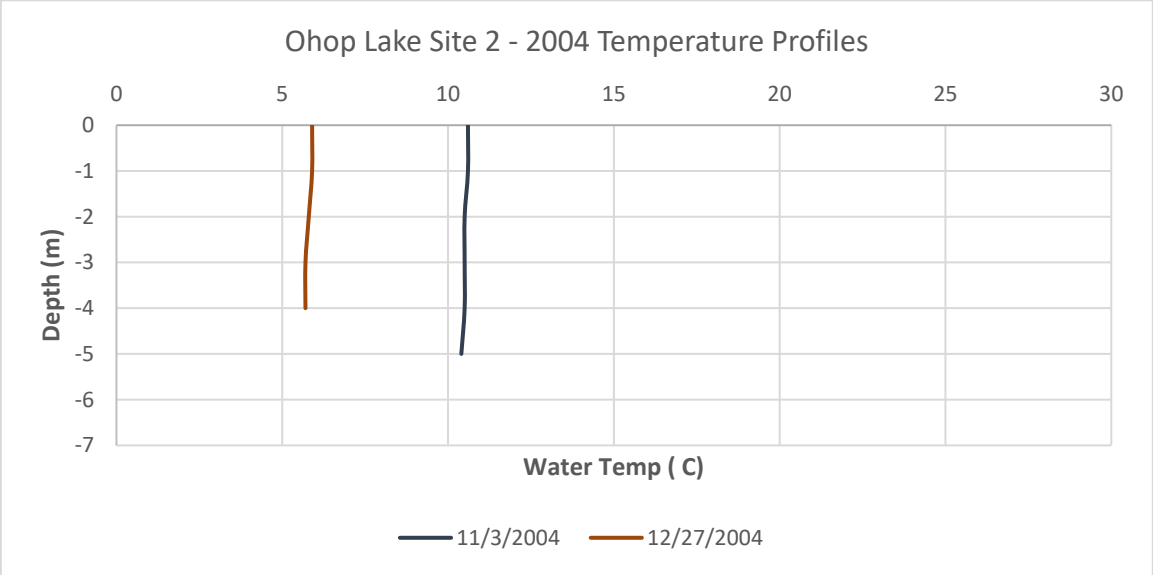
Ohop Lake Site 1 Dissolved Oxygen Profiles

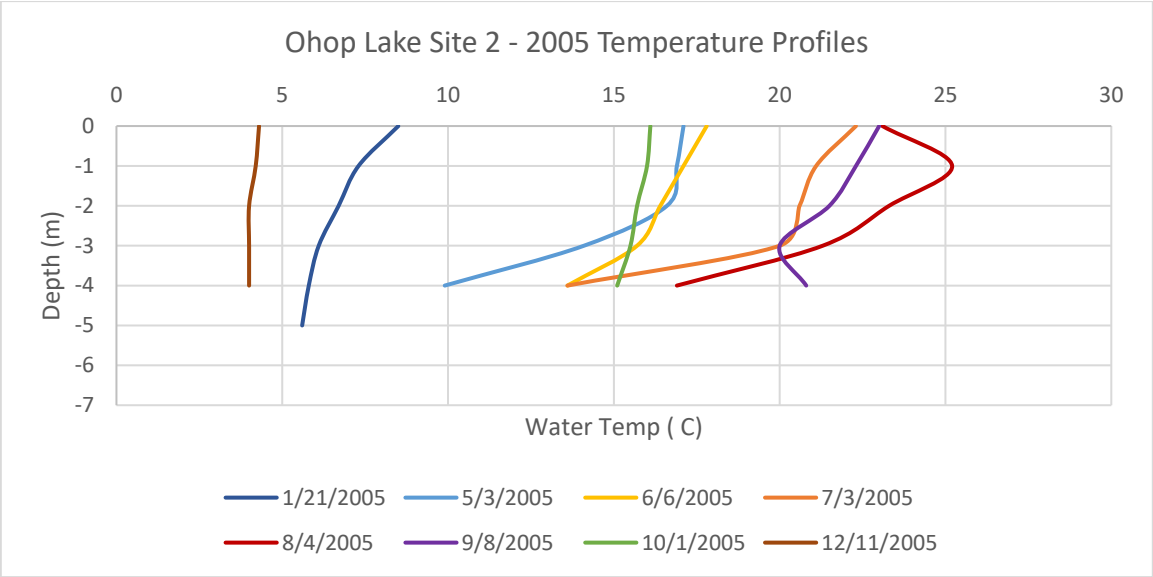


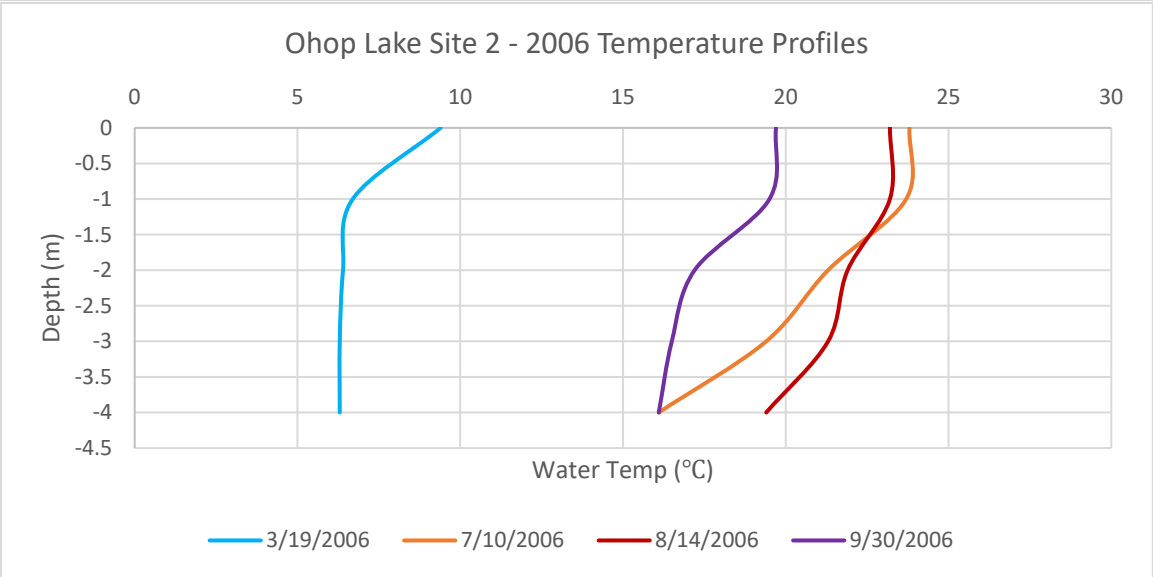




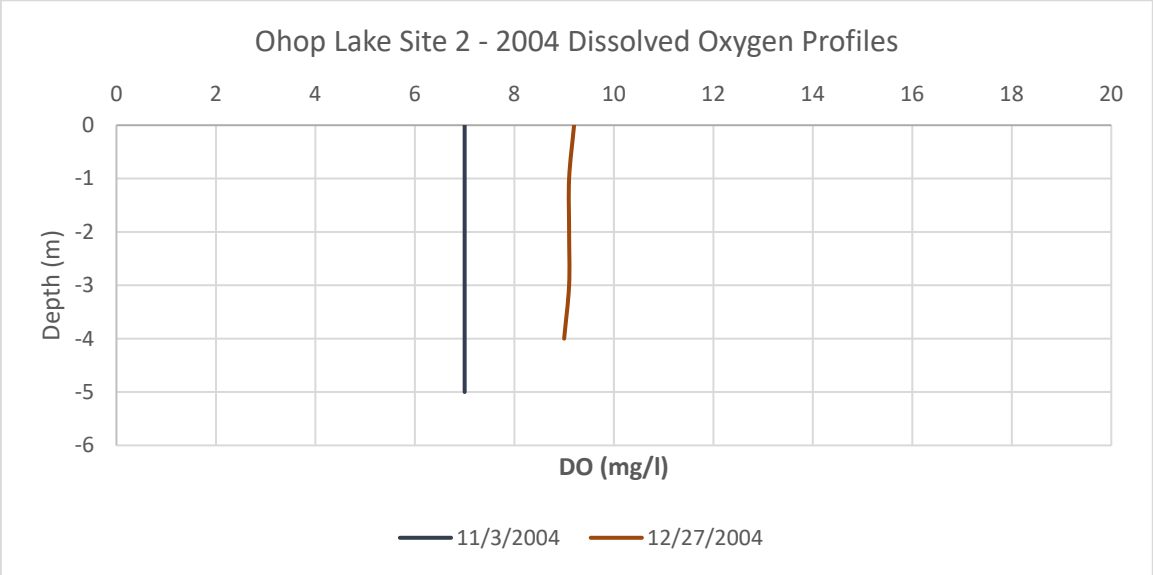
Ohop Lake Site 2 Temperature Profiles

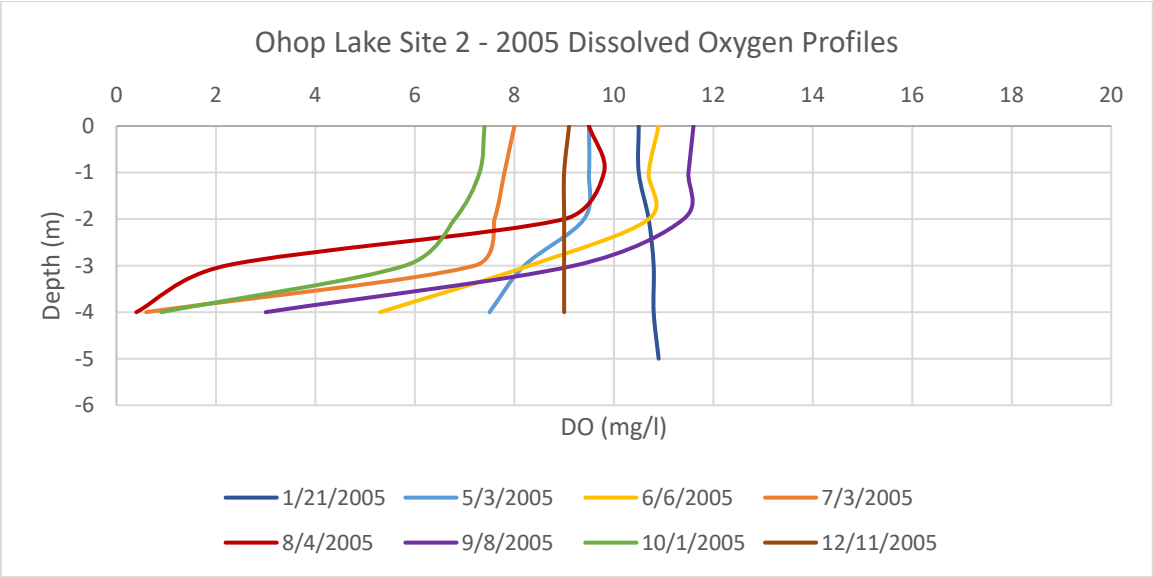


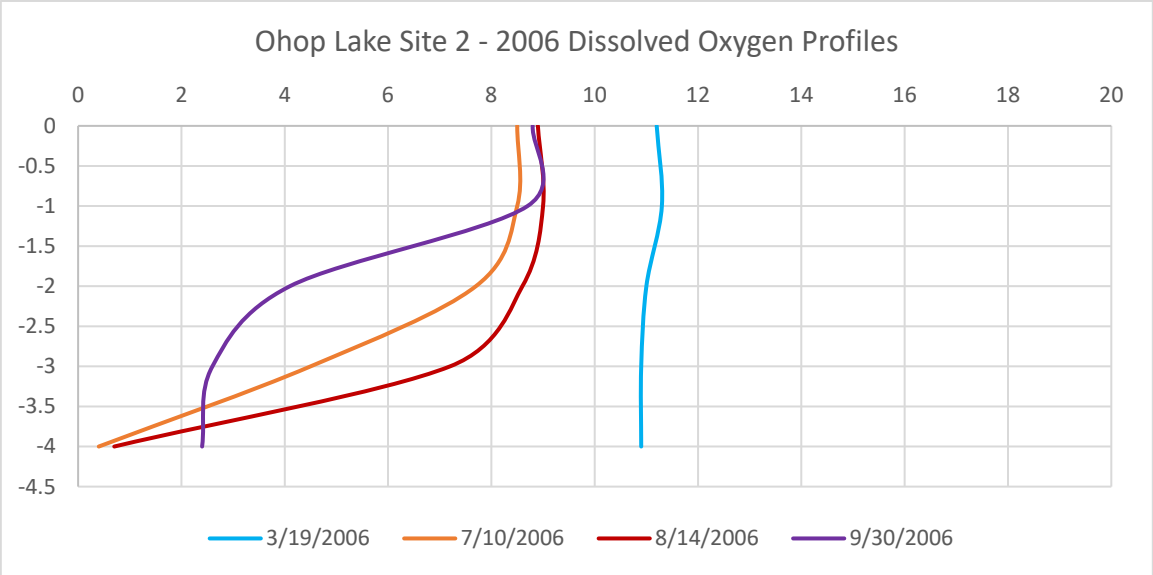




Ohop Lake Site 2 Dissolved Oxygen Profiles







Ohop Lake Secchi Depths