

Thermocline and Dissolved Oxygen

This is an attempt to explain two concepts – thermocline and dissolved oxygen and how they relate to fish populations.

The **thermocline** is a thin but distinct layer in a large body of fluid (e.g. water, such as an ocean or lake, or air, such as an atmosphere), in which temperature changes more rapidly with depth than it does in the layers above or below. The temperature gradient is relatively steep at the thermocline depth relative to the equivalent gradient above and below that depth.

Thermoclines are normally a large factor in oceans but they can also be observed in lakes. In colder climates, this leads to a phenomenon called stratification. During the summer, warm water, which is less dense, will sit on top of colder, denser deeper water, with a thermocline separating them. Because the warm water is exposed to the sun during the day, a stable system exists, and very little mixing of warm water and cold water occurs, particularly in calm weather. One result of this stability is that as the summer wears on, there is less and less oxygen below the thermocline, as the water below the thermocline never circulates to the surface, and organisms in the water deplete the available oxygen.

The thermocline is of primary interest to fisherman as this is the best starting place for locating walleyes and other warm water species. The intersection of the thermocline with hydrographic features such as points, bluff walls with trees and other types of structures are important starting locations when first graphing for fish or bait fish locations.

As winter approaches, the temperature of the surface water will drop as nighttime cooling dominates heat transfer. A point is reached where the density of the cooling surface water becomes greater than the density of the deep water, and overturning begins as the dense surface water moves down under the influence of gravity. This process is aided by wind or any other process (currents for example) that agitates the water.

This turnover process usually begins when the surface water temperature reaches the low 60's and is completed when the surface water temperature reaches approximately 55 degrees(F.). Evidence that turnover has begun will be the appearance of ribbons of bubbles in long strings across the surface of the lake or reservoir. Once turnover is completed fish can now utilize the entire water column since oxygen and temperature barriers no longer exist.

There are lots of subtleties and nuances on this topic but the basics, as they apply to Twin Lakes area lakes are...

- During the winter and early spring months there is no thermocline in the lakes. The temperature gradient per foot of depth is fairly even. Additionally, the dissolved oxygen is fairly consistent regardless of depth.
- As summer approaches and the water warms a thermocline develops and as summer advances the thermocline drops lower and lower.
- At some point the amount of dissolved oxygen below the thermocline is too low for most fish to be comfortable and thrive.

- Fish, like you and me, like comfortable temperatures. As the surface temperature rises they head for the lower depths. At some point there is a cross over – too little oxygen at lower depths and too warm at shallow depth.

Each month, sometimes twice per month, the water temperature and dissolved oxygen are measured in both Bull shoals and Norfolk lakes. The results are made available to the TLWC members via email.

Preferred Temperature/Oxygen Range

Species	Temperature Preferences (°F)			Oxygen Preferences (PPM)	
	Spawning	General Activity	Peak Activity	General Activity	Peak Activity
Panfish	60-75	72-78	86	7.9 - 8.4	8.1
Yellow Perch	45-50	55-70	69	8.6 - 10.2	8.7
Catfish	70-75	70-75	73	8.1 - 8.6	8.3
L.M. Bass	62-65	68-78	73	7.9 - 8.8	8.3
S.M. Bass	59-65	65-75	68	8.1 - 9.0	8.8
Striped Bass	55-70	55-75	65	8.1 - 10.1	9
Walleye	40-55	55-70	65	8.6 - 10.1	9
Northern Pike	45-55	60-70	65	8.6 - 9.7	9
Pickeral	45-55	55-70	60	8.6 - 10.2	9.7
Muskie	50-60	60-70	65	8.6 - 9.7	9
Lake Trout	45-50	40-55	45	9.6 - 11.7	10.9
Brook Trout	45-50	53-65	60	8.5 - 9.8	9.1
Brown Trout	45-50	55-70	60	8.1 - 9.6	9.1
Rainbow Trout	45-50	50-65	57	8.5 - 10.2	9.4
Coo Salmon	45-50	50-57	54	10.0 - 10.8	10.2
Chinook Salmon	45-50	50-57	54	10.0 - 10.8	10.3

Pick your specie – in this case walleye. Note that they like temperatures of 55 to 70 degrees with a dissolved oxygen content of 8.6 or more. If you look at the Dissolved Oxygen reports that are mailed out you will quickly see where the desired fish are **NOT** to be found. Further analysis will indicate the optimal area for both temperature and oxygen. There will be periods during the year when there is no optimal cross between temperature and oxygen – in short the fish are uncomfortable and in some cases in distress.

As a gross approximation, most of the game fish in our lakes (panfish, perch, catfish, bass and walleye) seem to like the same general temperature profile. Some like it a skosh cooler, others a little warmer.

Note that the desirable dissolved oxygen is also close for all species – 7.9 to 10.

And that is what the Dissolved Oxygen report is telling us – where the fish probably are and certainly where they are not.